

Sustainable Value Creation in



Working Environments

network4value

Sustainable Value Creation in Networked Working Environments

Final Report

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The opinions expressed in this study are those of the authors and do not necessarily reflect the views of the European Commission

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Final Report of network4value

Forewords and Executive Summary

The economic relations of EU countries have expanded to cover the globe. The net revenues of multinational corporations have reached levels higher than many nation-states. Successful operations within the borders of one nation differ from the way successful businesses are conducted globally.

Rapid and ongoing innovation in information and communication technologies has changed the way organisations operate. ICT can be expected to significantly contribute to sustained productivity growth and gains in efficiency as well as related economic and social returns across the diversity of value networks and collaborating individuals. The global competition between companies will take place between extended global enterprises which are constantly evolving into new partnerships. These extended enterprise networks are orchestrated by most dynamic and innovative companies. The ability to extract value from these global collaborative networks will determine the prosperity of such emergent Networked Working environments (NWEs). Europe and European organisations should maximize their role as orchestrators of such value networks embodied in global innovative product creation processes. Such product creation processes are being completed by networks of collaborating organisations and individuals belonging to these extended enterprises. The product creation process is no longer limited by organisational or national borders. The product creation processes span across time zones, a variety of technological platforms and across versatile organisational and national cultures. New concepts such as the agile extended enterprise, the borderless company, real time enterprising, battle of partnerships and silent commerce are denoting this type of development of the so-called "now economy". How the European economic area participates, competes and captures value in the new global economy, has emerged as a critical question.

The main objective of the network4value project was to outline development paths leading to the goals of creativity, innovativeness and productivity in future networked work environments (NWEs). To achieve this goal, the study applied an interdisciplinary research approach, which combined strategic future analysis based on assessment and projection of current developments with qualitative and quantitative in-depths analysis of NWEs. It started by selecting a diverse set of interesting case studies to understand the phenomena. Then it identified evidence for indicator construction in order to understand and monitor development and change. Then the study selected a set of visionary roadmaps to understand the challenges of the future by creating horizontal enabling roadmaps and vertical validating industry roadmaps for the vision of achieving some of the Lisbon goals. Then research areas of the collaborative networked working areas were identified for the purpose of the 7th framework program of the European Commission. Finally in the recommendation for action and in the conclusions, relevance to i2010 and policy development was created. Conceptual policy and technology initiative as Open European Collaborative Space (OECS) was created.

The objective of the case studies was to identify key value drivers in NWEs. Four areas were chosen for in-depth case study research: Global Product Development in ICT-Industry, Health Care Service Delivery, NWEs in Media and Supply Chain Management. The NWE taxonomy

developed in the University of St. Gallen distinguishes NWEs according to their level of human interaction and their collaboration context. The taxonomy describes distinct clusters of NWEs with different knowledge focus and the major optimisation focus of NWEs. The value driver analyses were distilled into key research questions for NWE-performance increase which were considered in the proceeding project activities. An integral set of conclusions was drawn for the development of indicators for impact measurement in NWEs, and the development of an explicit "NWE-view" was recommended.

The lessons learned from the case studies conducted in successful new working environments indicate that the management of change is critical. Successful change management includes: placing clear targets, assigning adequate resources for equipment acquisitions, ensuring that the change process enjoys top-management support and implementing the change in a transparent way. Early user involvement has also been identified as a key factor. Also, adopting new technologies into work processes does not ensure increased productivity: the business processes need to be developed to utilise the new opportunities of the technology and the changing operation environment.

The objective of the evidence base and indicator construction was to search for available evidence on the impact of new working environments and to evaluate to what extent existing statistics and data can be used for tracking these developments. In connection to this the goal was to explore the need for new indicators and to develop a set of (existing and new) indicators to be used for continuous monitoring of the phenomenon.

The lessons learned from the evidence base work were that there is very little available evidence about the diffusion and impacts of NWEs. There are, however, research findings on the likely effects of particular *features* of NWEs. Most evidence seems to suggest that NWEs, when combined with new forms of work organisation (emphasizing flatter decision-making structures, worker empowerment, an open information policy and continuous learning), have a huge potential for boosting sustainability.

The lessons learned from the indicator work point towards the fact that there is a case to be made for developing the European Survey on Working Conditions into a fully-fledged element of the European Statistical System. This could provide economical feasibility since the ESWC is partly a duplication of national surveys which are being carried out at great cost by many of Europe's National Statistical Institutes. Comparable, timely data on working conditions and NWE related issues must be a top priority in order to tailor the European Employment Strategy to the individual situation in each Member State.

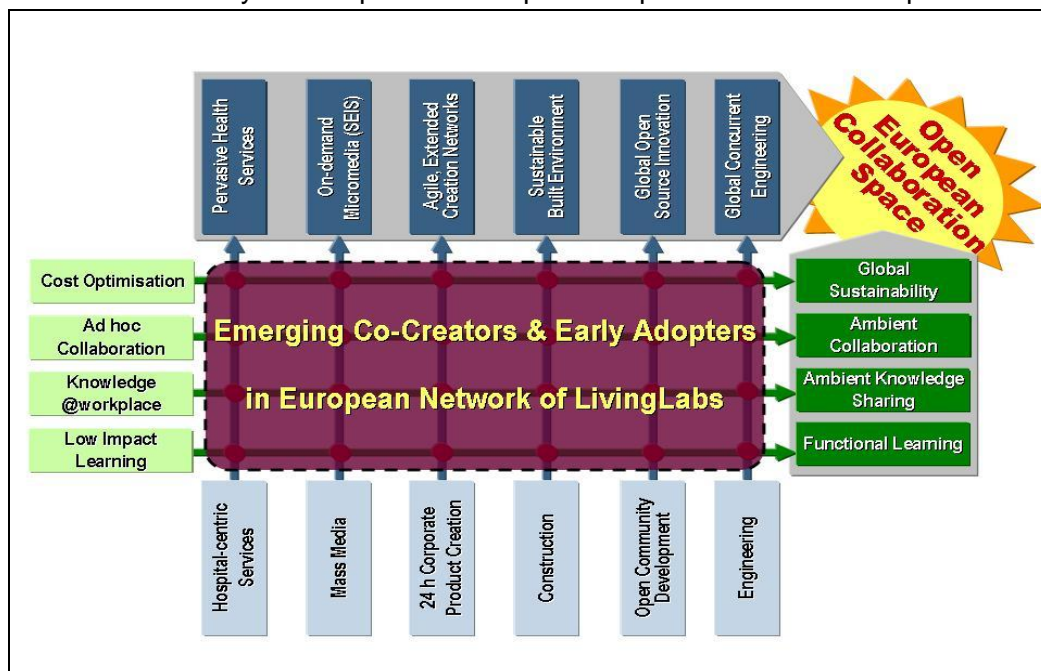
The Visionary roadmaps together with industry/theme specific research ideas (RTDs) for the 7th Framework program have been summarized in Annex I.

In conclusion, the study report calls for unified European collaborative actions in order to achieve the Lisbon goals. These collaborative actions, which are further elaborated in Chapter 5, need to be taken in order to reach the overall objective of people and planet friendly prosperity. These NEW goals are to:

- a. Speed up innovation by improved utilisation of the European and Global network resources of user and citizen centric service and application creation.
- b. Participate in the orchestration of global collaborative innovation value networks for maintaining and taking leadership in selected areas of highest sustainable value for the European implementation and highest value out of global value capture.
- c. Exploit the strength of diverse European Public-Private-Civic-Partnerships for systemic innovation which creates sustainable value through collaborative good practice regional networks.
- d. Focus research activities on multidisciplinary phenomena-based research of emerging collaborative technologies, applications, products and services.
- e. Call member states to formulate and align national innovation strategies towards tackling global competition in the innovation economy. This would enable European level policy making and drive global regulatory needs for new global collaborative technology platforms and standards.

The outcome of all these actions is illustrated in the picture below aggregating the visionary roadmaps. The Open European Collaborative Space (OECS) can be achieved through multilevel actions and policies, but the most important contributing factor is the support for the collaboration of existing regional innovation initiatives (OECS defined in Chapter 6 as a joint policy and technology initiative). These initiatives should be networked to form a network of Living Labs (see the work of Corelabs from IST 5th call) and strengthened with the support to achieve common methodology. **These Living Labs enable true user-centric validation (vertical roadmaps) and co-creation. New forms of Public-Private-Citizen partnerships (PPCPs) can take place in the creation of sustainable systemic innovation and larger markets for faster uptake and evolutionary growth.**

The visionary roadmaps and the Open European Collaboration Space.



The report will now further elaborate the actions that need to be taken and the development work that needs to be conducted in order to reach the overall objective of people and planet friendly prosperity, by the implementation of the OECS collaborative policies and actions(A to I)

- A. Rapid product creation by networking – Europe’s competitive advantage
- B. Better utilisation of ICT through collaborative technologies to foster economic growth
- C. More ICT entrepreneurship – Collaborative micro-businesses
- D. Redefining the relationships of employer organisations and employees-Creative Commons thinking
- E. Extracting value in the global economy-Orchestration capability
- F. Maintaining and growing the proportion of active labour force-Wise regulation and immigration
- G. Deployment and utilisation of open collaboration and the digital convergence process
- H. Utilisation of economies of scale in public service provision-European legacy in diversity and public sector role turned to competitive advantage
- I. Advocating people- and planet-friendly growth and development focus on sustainable growth and development- Social transparency and eco-efficiency hold highest value ranks to emerge, providing potentials for global business development.

The target groups of the study are anticipated to be research communities in general and the IST FP7 research community in particular, European regulators and the industry.

- Research communities in general and IST FP7 research community in particular: Researchers looking into knowledge work, collaboration and new working environments can review current research in Chapter 2. Chapter 3 looks into the possibility of utilising a new working environment taxonomy . In addition to these, Chapter 4 may be interesting as a tool for the more detailed elaboration of research needs and industry/theme specific RTDs in the annex 1.
- European regulators: The European regulators needing to become more familiar with the complexity of value creation in global innovation networks may find the Chapter 4 and Chapter 3 with its case study summaries most interesting. The report is perceived to be applicable to be utilised in active processes and policy work following in the footsteps of the revised Lisbon agenda, in the European Employment Strategy work, the ERA (European Research Area) policy work, within the eLearning Programme and various entrepreneurial activity related policy work.
- Industry: Industry readers may be able to make best use of the case study summaries of Chapter 3 as these identify new forms of collaborative and networked work. Also the visionary roadmaps in general (Chapter 4), or some domain or theme in particular are of interest.

Chapter 1: Introduction

1.1 Introduction to the Study

The impacts of new and networked working environments (NWEs) and related developments at workplace, team and organisation levels require further research. This study has been built on the suggestion that more multi-disciplinary, integrated research on NWE impacts is needed. The study has addressed the opportunities and preconditions for sustainable development in knowledge societies, and provides input to ongoing strategy work at a European level.

Sustainable development is understood here as it is common practice in the European policy debate, i.e. we follow the definition set down by 1987 Brundtland Commission: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Sustainable development is enshrined in the EU treaty as an overarching objective of the European Union. In 2001, EU governments launched the Sustainable Development Strategy, which focuses on a number of key unsustainable trends. The priorities are to:

- combat climate change,
- ensure sustainable transport,
- address threats to public health,
- manage natural resources more responsibly and stop biodiversity decline,
- combat poverty and social exclusion, and
- meet the challenge of an ageing population.

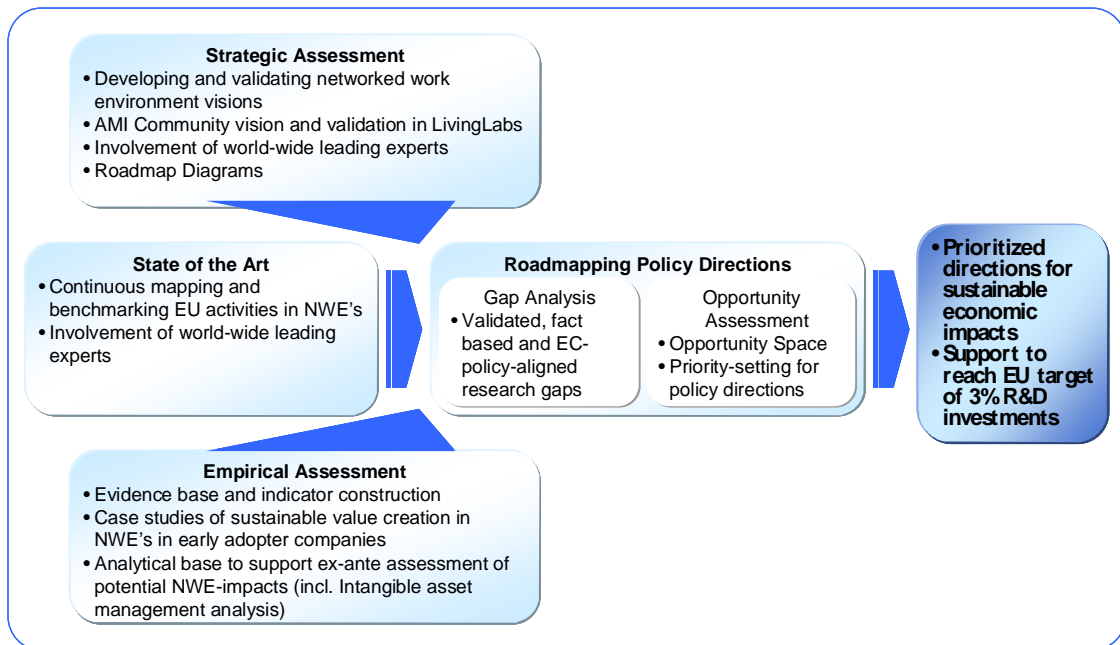
Another distinction which is often being made, including in this report, is between ecological, economic and social sustainability. The relevance of all of the above in relation to new work environments has been explored in the network4value project.

Objectives and approach

The main objective of the network4value project has been to identify areas that require more research, and to produce empirically validated roadmaps to serve development activities:

- To explore potential technical and user centric foresight scenarios as well as potential future new working environments
- To explore, define and classify the new phenomenon and compare it to existing known old working paradigms such as teleworking, etc.
- To draw together, synthesize and structure available evidence about the drivers and impacts of networked working environments.
- To evaluate to what extent existing statistics and data can be used to track these developments, to explore the need for new indicators and to develop a set of (existing and new) indicators to be used for continuous monitoring of the phenomenon.
- To identify the most effective EC-research policy tools to steer towards the adoption of new networked working environments with the objective of sustainable development.

Figure 1: Research Approach and Methodologies



To achieve the goals outlined above, the study has applied an interdisciplinary research approach, which combines strategic future analysis based on assessment and projection of current developments with qualitative and quantitative in-depths analysis of NWEs.

The relationship and interdependencies of the different research methodologies are depicted in Figure 1.

First step: The research work began with an in-depth analysis of the state-of-the art of existing and emerging NWEs and a first initial rapid development of hypotheses and methodologies for further quantitative and qualitative research of NWEs. The state-of-the-art analysis included systematic collection, classification and evaluation of existing scientific results, ongoing programs and activities. These activities continued throughout the study and fed into an integrated repository of knowledge on NWEs.

Second step: In the second phase the study team conducted parallel research in two directions:

- strategic analysis and development of visions for future development of NWEs, and
- in depth empirical assessment of NWEs and their impact.

The aim of strategic analysis was the development of future visions for NWEs. This was based on two research approaches:

- Development of future visions for NWEs in cooperation with leading international experts within expert interviews and workshops.

- Scenario development leading to the production of roadmap diagrams to present a structured forecast for long term NWE-developments.

The aim of the empirical assessment was the in depth quantitative and qualitative analysis of existing and emerging NWEs. It combined an interdisciplinary, qualitative research methodology based on case study analysis and a quantitative analysis of empirical data.

Besides case studies, a broad empirical analysis of quantitative evidence about drivers and outcomes of NWEs was performed. This included the following activities:

- In-depth secondary analysis of available data sources in order to extract new insights into readiness, intensity and impact aspects of NWE. The evidence was collected at three levels of analysis: a) workplace/work team, b) organisation/enterprise, and c) national/EU. The aim of the secondary analysis was to make best use of available data sources.
- In depth statistical analysis of data sources in order to single-out how wide spread aspects of flexible, NWEs are today.
- Development of indicators for measurement of drivers and impacts of emerging NWEs.

Third step: In the last phase the findings of both approaches, i.e. the future visions and the results of the empirical analysis, were consolidated and compared. Research and development gaps were identified and linked to each thematic roadmap. The research directions and necessary political and regulatory recommendations were then linked to a wider EU-policy framework – mainly the i2010.

1.2 Introduction to NWEs

1.2.1 Conceptualising New Working Environments

Progress in new work environments (NWEs), which enable effective virtual collaboration and easy access to the resources required for carrying out knowledge-intensive work tasks, has been swift in recent years. With the widespread availability of multi-channel, mobile, broadband access to the Internet, this process is bound to continue at the same pace – or even accelerate – in the near future.

As with socio-technological innovations of the past, the impacts implementation of next-generation NWEs will have on the economic agents that utilise them, as well as on the wider society, are unknown. There can also be no certainty about the value drivers and success factors which will determine to what extent NWEs will be taken up, and to what degree they will fulfil their potential.

Against this background, it has been common practice to explore impacts of innovations ex post only – which usually implies that there is a sizeable gap between the time that effects play out themselves in reality and the time they are measured and analysed by research. This diminishes the possibilities of policy-making to influence the shape and intensity of the diffusion process – which becomes more problematic the more everyday life is becoming dominated by technology, and the faster new technology-based innovations are becoming available.

There is a strong need for better knowledge to support policy-makers in making the right decisions about NWEs. Some of the main policy-related questions are:

- What types of NWEs are most beneficial for society?
- How can they help maintain and further develop the European Social Model in the context of an increasingly volatile global environment?
- Is there a case for policy intervention, and how can the limited resources of government best be deployed to guide developments in a direction which is socially, economically and ecologically sustainable?

For providing answers to these questions, we need better instruments to measure ex ante already likely effects of the implementation of socio-technical systems.

This will only be possible if we make best use of the evidence which is already available about likely characteristics of upcoming work paradigms. For example, if one of the propositions of NWE developments is that people will be enabled to establish network connections to economic agents across the world much easier than ever before, research findings about the success factors of cross-cultural co-operation and Internet-mediated collaboration will be of much relevance – even if the actual NWE technologies required for this purpose are still at an early stage of development.

Such an attempt is very ambitious. The more so since some of the upcoming technologies are likely to have characteristics of what are called “disruptive technologies”, i.e. they will undermine some of the very principles on which the ways work is being carried out in Europe today are based. Nevertheless, the wealth of research which is available about factors which are discussed as key characteristics of upcoming NWEs offers much opportunity for learning from past experience.

Two bodies of research appear to be of most value for the discussion of drivers, success factors and impacts of NWEs (cp. Picot at al.: 11).

- The first surrounds the conditions for, and the impacts of new forms of work organisation. These have been discussed intensively for the last 20 years or so under a number of headings.
- The second is concerned with computer-supported co-operative work (CSCW) and virtual collaboration via ICTs.

At the interplay of these two fields of research, phenomena including telework, multi-location eWork and mobile work have attracted much interest as well.

The main findings of these strands of research will be presented in this document. We argue that the attempts to integrate both research areas have been insufficient until now, and that bigger efforts are required to exploit past experience in order to project future impacts of NWEs.

The document is structured as follows: Section 2 sets out to define the phenomenon of NWEs. For this purpose, related concepts of work modernisation are briefly discussed. The chapter finishes with a working definition of NWEs along seven dimensions: collaboration, spanning of boundaries, telemediation, virtual teamwork, coordination, people focus and technology:

Section 3 briefly outlines the main drivers for change which are expected to foster take-up of NWEs, and also refers to existing obstacles and facilitators which work against change. It distinguishes between technological, business-related and societal factors - keeping in mind that all of these are closely related and should, wherever possible, be analysed in a holistic way. Examples for such drivers are the shift towards more knowledge-intensive work, towards more variation with regard to lifestyle and accepted career paths, and the changing role of gender as reflected in predominant roles and conventions.

Section 4 contains the findings from the literature analysis into empirical evidence for outcomes of, firstly, new forms of work organisation, and secondly, virtual collaboration. Since next generation NWEs are hardly diffused across Europe yet, these research findings allow us an approximation to the most likely impacts of NWEs where no real evidence exists. The evidence reported suggests that the extent to which NWEs will impact positively or negatively on people, society and economy is in no way predetermined, but rather it is contingent among a large number of factors that can (and must) be influenced by the actors involved. This indicates that there is indeed much room for policy intervention to make a real difference.

Section 5 comprises some preliminary conclusions of the research.

Approaching the Subject

The term new (networked) working environments (NWEs) is often understood to indicate the same as "collaborative working environments". For example, the European Commission's "New Working Environments" Unit describes the phenomenon as follows: "Next Generation Collaborative Mobile Virtualised Working Environments focus on workers interacting with their environments and collaborating with each other, having access to all the (also virtualised) resources (including also assisting robotics) required to carry out their tasks and enhancing their capabilities. Among these resources, the key is the knowledge of the co-workers to complement in dynamic groups the needed competences and skills to carry out the task in an efficient way leading to increase on productivity, and generating innovative and creative solutions."¹ The Unit's Work Programme 2005-2006 further describes NWEs as "enabling seamless and natural collaboration amongst a diversity of agents (humans, machines, etc) within distributed, knowledge-rich and virtualized working environments."²

The focus of such discussion is mainly on the development of the technological tools which will enable virtual collaboration with remote co-workers and knowledge systems. For the purpose of this paper it is useful, however, to look into the broader context in which NWEs are being implemented. For example, research on working environments should also include the physical environment in which the worker is located when carrying out their tasks. This refers back to the concept of work environment which was established in the 1960s as an extension of the previous emphasis on the protection of the worker against the immediate hazards of (mainly manual) labour (Allvin & Aronsen 2001). The newer work environment literature gives insights into the factors to be considered when analysing NWEs. Shah and Pritchett (2004) distinguish between three groups of aspects:

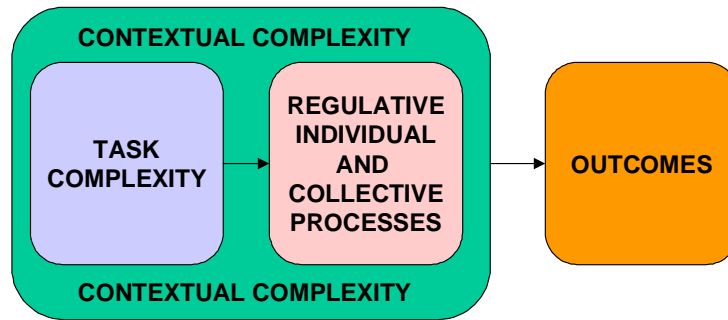
- "physical aspects (including spatial, topological, parts-whole and other physical relations amongst environmental elements which the agents need to know to be able to accomplish the physical task);
- functional aspects (including task structures, means-end structures), and
- social aspects (including the distribution of desires, goals and capabilities amongst the agents)."

This relates to the model by Vartiainen (2006) who, based on the elements of Activity Theory (Engeström 1987), distinguishes between three basic features of collaborative work systems which need to be analysed in order to obtain proper understanding of all issues involved, and which together account for the outcomes of the work system in question, such as social and economic impacts (see Figure 2):

- the complexity of collective joint tasks (task or job complexity);
- the complexity of context or space (physical, virtual, regulatory) where a team of collaborators is operating;
- internal processes of individual or collective subjects (e.g. inter-connectedness, trust, desires, common goals, etc.).

The focus here is, as the term New Working Environments implies, on exploring the complexity of context or space, and how it relates to impacts and outcomes.

Figure 2: Networked work as an activity system



Source: Vartiainen (2006)

In order to develop an adequate understanding of the concept of NWEs and how they look like in real-world applications of ICT-based, collaborative working environments, it is useful to take a look at related, but more established concepts of change in the area of work organisation and ICT-enabled collaboration.

Comparing similarities and differences between our understanding of NWEs on the one hand, and these other existing concepts of change on the other hand, will allow us to explore to what extent results from other research can help us better understand the drivers, success factors and possible outcomes of applications of NWEs.

1.2.2 Relations to Other Recent Concepts of Work Modernisation

Work environments are considered in various research disciplines. The following brief literature review probes into work environment research from three major research streams.

Flexible Firms, the “Pro-active” Workplace, and Quality of Work

New, modern ways of work organisation play an important role in recent policy-making. In this regard, ICTs and other technologies are of big importance firstly because they are driving the need for companies and labour forces to change (through their role in overarching developments such as globalisation), and secondly for enabling new production systems and new ways to work – thereby opening up new possibilities for change.

While the topic of “work modernisation” has its roots in efforts to make work less hazardous and more “humane” and improve quality of working life (Huzzard 2003), in recent years other objectives have driven the political debate. Against the background of a perceived growing need for flexibility in labour deployment, in the second half of the 1990s policy-makers began to show increasing interest in what has interchangeably been termed “new forms of work organisation”, “new organisation of work” or “modernisation of work organisation”.

The European Commission’s “Green Paper on a Partnership for a New Organization of Work” (1997) has been essential for initiating the debate at the European level. Its basic aim was to achieve consensus about the ways of reaching “better organization of work at the workplace, based on high skill, high trust and high quality” (CEC 1997: 5). On the basis of the outcomes from

the public consultation the Commission issued a communication (CEC 1998) listing as the main issues in the area:

- ensuring proper training;
- developing working time packages in a comprehensive framework;
- facilitating the diversification of working relations as well as new forms of work;
- ensuring the optimum conditions for the introduction and uptake of new technologies;
- promoting workers' motivation and adaptability through increased involvement; and
- promoting equal opportunities.

It pointed out the need to speed up the modernisation process, for which partnership between firms, social partners and all other stakeholders is considered as essential.

The European Employment Strategy (EES) which was launched at the European Council in Luxembourg in 1997 has included the objective of modernising work organisation from the very start – initially through the third pillar of the Employment Guidelines on “adaptability”.

In recent years, discussion on these issues has taken place in the context of the debate about how to increase “job quality”. The European Commission's focus on job quality was emphasized through the 2001 Communication on “Employment and social policies” (CEC 2001), which outlined the key issues related to quality of work against the background of the Lisbon and Social Policy Agendas. A key objective of this attempt is to make employment more attractive for persons which as yet tend to stay outside of the labour force. The document aimed at the definition of “a clear approach to the policy goal of improving quality of work (and to policy implementation)”, including the establishment of a “coherent, broad set of indicators on quality of work to reinforce the effectiveness and efficiency of policy [in the area]”. It sees the core challenge as “to combine flexibility with security in ways that benefit workers and companies alike. Appropriate training, lifelong learning and investment in human resources are central here. New forms of work can, where chosen voluntarily by workers, also offer positive and welcome flexibility in meeting individual and family needs and interests” (CEC 2001: 9). The suggested framework distinguishes between two main dimensions:

- Job characteristics: objective and intrinsic characteristics, including: job satisfaction, remuneration, non-pay rewards, working time, skills and training and prospects for career advancement, job content, match between jobs characteristics and worker characteristics;
- The work and wider labour market context: gender equality, health and safety, flexibility and security, access to jobs, work-life balance, social dialogue and worker involvement, diversity and non-discrimination.

A Communication on concrete policy approaches towards “Improving quality in work” was published in 2003, focussing on efforts to improve quality at work in line with the 2003 Brussels Spring European Council request. The new, completely revised European Employment Strategy (European Council 2005) also deals with quality issues in manifold ways, especially by promoting a lifecycle approach to employment and by more generally stressing the need for improvements in job quality. The latest Employment Guidelines (2005-8) contain as one of three overarching priorities to “improve adaptability of workers and enterprises”.

In recent years, the issue has also attracted increasing interest from industry policy. After the bust of the “Internet bubble” shortly after the turn of the century, a number of experts and policy-making documents stressed the need to view technological progress at workplaces in the overall context of increasing the efficiency and effectiveness of work organisation (CEC 2003b, OECD 2003, 2004) and business processes (Smith & Fingar 2003). The earlier OECD paper on “Knowledge, Work Organisation and Economic Growth” (2001) was decisive in moving the agenda forward. While new forms of work organisation are not per se associated with ICTs, anecdotal research as well as survey data suggest that these new work practices are indeed often introduced hand-in-hand with new ICTs (OECD 2001: 32-34).

This is hardly a surprise since “looking at individual practices, it appears that most of them are associated with a high incidence of ICT-use” (ibid.: 32), for example employee involvement schemes, team and group working, telework, and new production systems. Another example is knowledge management systems. Following its line of argument, the European Commission (2003b), the European Foundation for the Improvement of Living and Working Conditions (2005) as well as the OECD (2004) stress that investments in ICT need to be more often supported by investments in company reorganisation and in staff retraining – something which happens too seldom, as empirical evidence for example from the EWCS and Eurobarometer indicate.

How can modern ways of organising work be distinguished from more traditional patterns? A widely used definition of New Work Organisation was adopted by the European Work Organisation Network (EWON) (see Savage 2001):

New Work Organisation is the application of principles and practices within enterprises which aim to capitalise on, and develop the creativity and commitment of employees at all levels in achieving competitive advantage and in meeting the business and service challenges posed by the social, economic and technological environment in which the enterprise exists.

In a similar vein, Business Decisions Limited (1999: 15) – in a study for the European Commission – states that “new forms of (‘high performance’) work organisation are based on a ‘high trust’ and ‘high skill’ organisational model that encompasses extensive employee involvement in operational decision-making”, while also putting stress on the fact that “there is, however, no single model of desirable organisational change. Each company must adopt organisational structures and forms of work organisation that fit with its strategy and its source of competitive advantage”. The antidote to new ways of work organisation is seen in the “scientific management” principles usually associated with the names of Frederick Winslow Taylor and Henry Ford (Amin 1997).

These definitions implicitly refer to the earlier classification of Atkinson (1984) who distinguished between functional flexibility, numerical flexibility and wage flexibility. New work organisation is primarily concerned with functional flexibility, which is “the ability of enterprises to reorganise jobs so that the jobholder can deploy his or her skills across a broader range of tasks and be well prepared for new tasks” and which is “based on decentralised responsibility and a multi-skilled workforce” (Nordflex 1999: 54; see also OECD 2001). Opposed to this is numerical flexibility, i.e. the ability of a company to adapt (quantitatively) the work input to variations in workload, for example through over-time, short-time, part-time or temporary work contracts. Wage flexibility is

“the ability of a work place to adjust wage costs to market fluctuations and to differentiate wages depending on performance of employees” (Nordflex 1999: 72).

Other terms which have been much in use to describe basically the same phenomenon (albeit putting the emphasis on different features) are “High Performance Work Organisation” (Sung & Ashton 2005) and “High-Involvement management” (Bessant 2003). Antila and Ylöstalo (2002, 2005), in their research on Finland, talk about “proactive workplaces”, key characteristics of which are “that personnel have increased possibilities to exert influence, and at the same time increased responsibility. [...] In the proactive way of working (in an ideal case), the management controls the goals and how they are reached. The worker controls the working methods and the results of his/her work, by which the goals of the organisation are reached” (Antila & Ylöstalo 2005: 9-10).

Based on the available empirical research it is possible to identify a number of features which are at the core of these concepts (cp. BDL 2002: 18):

- The way work is organised within operational activities
 - Work being organised in semi-autonomous work teams;
 - Multi-skilling as opposed to workers being assigned to single tasks;
 - Job rotation.
- The way work is coordinated across the organisation
 - Non-hierarchical decision making structures;
 - Open information policy ensuring that performance information is made available to individual employees;
 - Frequent team/management interaction (employee participation in decision-making at business manager level);
 - Performance measurement using a range of financial and non-financial measures.
- Supporting human resource management policies
 - Regular off-the job training of all employees, covering both job specific and generic skills;
 - Reward systems, i.e. an important element of the pay depends on individual or team performance.

Nordflex (1999) and BDL (1999, 2002) stress the importance of new forms of work organisations being implemented as a system rather than in piecemeal fashion. One reason for this is that the success of each of the above elements of a modern work organisation depends to a certain extent on complementary measures being put in place as well. For example, a higher degree of decentralisation in an organisation is bound to imply stronger demand for self-management skills:

[...] Decentralisation of responsibility requires a wide range of knowledge on the part of employees, and therefore a professional attitude towards skills development and the training of staff. If the staff acquires greater skills and knowledge, there are greater possibilities for everyone to participate in the decision-making process and to perform several different tasks. Decentralised responsibility for decision-making and working tasks often implies a more frequent use of teams and job rotation [...] (Nordflex 1999: 78)

For this reason, many studies including the above mentioned defined the most advanced users of new forms of work organisation as those that use a combination of several of the above mentioned elements. Based on this premises, BDL (2002: 21) drafted a categorisation of users according to their propensity to use new forms of work organisation, see Figure 3. The same approach was also used by Antila & Ylöstalo (2005) in their study on “proactive workplaces” in Finland.

Figure 3: Categorisation of New Forms of Work Organisation

New Forms of Work Organisation A Categorisation of Organisations		
Category A Non-Users	Category B “Transition” Users	Category C “System” Users
<p>Ø Unaware of NFWO</p> <p>Ø Aware but rejected it</p> <p>Ø Planning to introduce it in the future</p>	<p>Ø Did not set out to introduce a „system“</p> <p>Ø Tried but failed to introduce a „system“</p> <p>Ø On the way to a “system” but not got there yet (step-by-step approach)</p>	<p>Ø Implemented a “system” but experienced difficulties on the way (which led to delays, or amendments to the original plan)</p> <p>Ø Implemented a system and experienced no problems</p>

Source: Business Decisions Limited (2002)

More detailed definitions for components of the concept exist. For example, focussing on forms of direct participation only, the European EPOC study (see Sisson 2000: 3) distinguishes between:

- Individual consultation
 - ‘Face-to-face’: arrangements involving discussions between individual employee and immediate manager, such as regular performance reviews, regular training and development reviews and ‘360 degree’ appraisal.
 - ‘Arms-length’: arrangements which allow individual employees to express their views through a ‘third party’, such as a ‘speak-up’ scheme with a ‘counsellor’ or ‘ombudsman’, or through attitude surveys and suggestion schemes.
- Group consultation
 - ‘Temporary’ groups: groups of employees, who come together for a specific purpose and for a limited period of time, e.g. ‘project groups’ or ‘task forces’.
 - ‘Permanent’ groups: groups of employees who discuss various work-related topics on an ongoing basis, such as quality circles.
- Individual delegation
 - Individual employees are granted extended rights and responsibilities to carry out their work without constant reference back to managers – sometimes known as ‘job enrichment’.
- Group delegation

- Rights and responsibilities are granted to groups of employees to carry out their common tasks without constant reference back to managers – most commonly known as 'group work'.

Because of the central role of team work for collaboration (and thereby for NWEs), it is useful to note that "team-oriented ways of working can mean some very different things (Antila & Ylöstalo 2005: 5). The authors define the concept of a well-functioning team as follows (ibid.):

- "the team members have good possibilities for influence and, at the same time, a lot of responsibility both for their own work tasks and for achieving the team's goals quantitatively and qualitatively;
- the team members have versatile know-how and they are able if necessary to cope with the work of other team members;
- the teams interact directly both with other team members of the workplace and with outside instances; and
- the team members are rewarded for good results."

We can summarise the main features of modern, flexible, pro-active work organisations as follows (cp. BDL 1999: 16; OECD 2001: 8-9; Ylöstalo & Antila 2002, 2005):

- Decentralised organisational structures
 - flat hierarchies and decentralised decision-making (reduction of the number of management layers and number of different functions, i.e. job enlargement; improved flow of information between shop floor and management);
 - semi-autonomous work teams;
 - market and process focus.
- Flexible ways of working
 - flexibility in working times and locations;
 - flexible working methods (multi-skilling, job enrichment)
- Flexible business practices
 - focussing on quality management and continuous improvement;
 - high responsiveness to market changes.
- Corporate cultures which focus on people
 - worker focus: strong people orientation, human capital development, greater personal autonomy and accountability;
 - customer focus: continuous assessment of business processes according to value created for customers
- Continuous investment in lifelong learning
 - more systematic approach to skill acquisition (lifelong learning) with a focus on widening skills rather than simply adapting skills to changing functional requirements;
 - greater focus on soft skills such as communication skills, team-working, conflict management etc.;
 - wider participation in training, also involving less qualified members of staff

- Innovative performance measurement & reward schemes
 - management by objectives (for teams and individuals);
 - financial and non-financial performance measures;
 - performance-related pay: use of profit sharing, bonus and share schemes etc.

Only three studies have been identified which have been designed for the purpose of cross-country comparison, namely the EPOC study (which focussed on direct employee participation across 10 EU Member States, see Sisson 2000), the Nordflex study in the four Nordic countries (Nordflex 1999) and a study carried out by BDL on behalf of the European Commission in 2002 (BDL 2002), which was later extended to Finland (Ylöstalo 2005). All of this research comes to the conclusion that, whereas individual elements of new work organisation have diffused widely among EU organisations, more advanced applications using an integrated or even systematic approach have been adopted by only a very few organisations.

For example, the EPOC study found that “there is a very considerable gap between rhetoric and reality as far as the new forms of work organisation are concerned. The rhetoric suggests that new forms of work organisation are widespread and inevitable. The reality is that some of even the most basic practices associated with these forms are absent in the majority of EU workplaces. Something resembling an integrated approach affects only a handful of organisations” (Sisson 2000: 29-30). Only 4% of establishments covered by the sample used more advanced forms of team work. A similar number (3%) was found in an extensive survey conducted in Germany (Wengel et al. 2002).

The Nordflex (1999) study carried out in the second half of the 1990s in Finland, Sweden, and Denmark used a common definition of “flexible organisations” that focuses on employee development and task delegation. It found that between 15% and 25% of Nordic workplaces can be defined as “flexible”.

A review of available statistics by BDL (1999: 25) concludes that while “many companies use at least one high-performance work practice somewhere in their company [...] few use them extensively throughout the company.”

A similar review carried out by the OECD (2001: 9-13) comes to the conclusion that the rate of adoption is large only for “practices which can be accommodated with relatively little change in the overall work organisation structure, e.g. suggestion schemes and weakly autonomous teamwork.” Still, the OECD reports that “there is some evidence that the proportion of firms adopting new work practices is on the rise. In the four countries where comparisons through time can be made (Australia, France, the United Kingdom and the United States), the rate of adoption of each practice (except quality circles) is on the rise”.

Based on the results of its own company survey conducted in 2002, BDL (2002) estimates that 60% of organisations with more than 50 employees are users of some new forms of work organisation, but only 10% are what the study calls “system users” (cp. Figure). The survey was later also conducted in Finland (Ylöstalo 2005, Antila & Ylöstalo 2005), where 83% of organisations with 50 or more employees were found to be “transition users”, but only 4% were found to be system users.

Lorenz & Valeyre (2003), in their analysis of data from the 2000 European Survey on Working Conditions, emphasise the existence of national differences in the diffusion of models of work organisation. Through cluster analysis the authors identified four different models of work organisation: learning organisation (comprising 39% of the EU workforce), lean production (28%), Taylorism (14%) and traditional organisation (19%). The type which appears to resemble the new form of work organisation as defined in this paper is the “learning organisation”, which is most wide-spread in the Netherlands the Nordic countries.

CSCW and Virtual Collaboration

Once computer technology and related markets had sufficiently developed to make desktop computing at the workplace a viable option for companies, researchers started to take increasing interest in how collaboration via networked computers could support work processes. Research into computer supported cooperative work (CSCW) started in earnest in the early 1980s, and generally looks into how collaborative work processes can be supported by means of computer systems, and what impacts the use of such technologies has on the persons and structures involved. As such, insights from CSCW research are of high relevance to the topic of NWEs as described in this document. Related research has often focused primarily on technology insofar as it analysed the suitability of specific CSCW tools for collaborative activities, and the effects of these on the efficiency and effectiveness of joint work processes. Before the advent of the Internet and the WWW, the main tools for CSCW were groupware software (e.g. Lotus Notes), videoconferencing, and messaging (e-mail, instant messaging). Today, IP-based tools for collaboration play a key role.

The rapidity of these developments in the computer technology domain – in combination with the ongoing trend of economic restructuring in the advanced capitalist countries – led some observers at the beginning of the 1990s to believe that the age of the large, vertically and horizontally integrated corporation had ended. A number of management approaches were discussed as ways that can help companies deal with the challenges of increasingly volatile markets, harsh global competition, more differentiated consumer preferences, and high labour costs at traditional locations of production. At their core, all these management concepts aim to make organisations more flexible, i.e. enable them to react quicker and more accurately to changes in their environment, by reducing slack (e.g. **just-in-time** production) and by involving workers in finding ways to improve the way things are done (e.g. **continuous improvement**, **total quality management** and **kaizen** approaches). In addition, these approaches try to make organisations more competitive by letting them focus on the things they do best (the **core competencies**), while handing everything else to external providers who can do it better – because of being specialised in this particular area (what is termed **outsourcing**).

In this context, the concept of the **virtual organisation** was proclaimed from the early 1990s onwards, most prominently by Davidow and Malone (1992). It received considerable attention among management theorists, policy-makers and the wider public. The first wave of scientific research (e.g. Arnold et al. 1995) defined virtual organisations based on a whole set of characteristics, the most important of which were:

- emphasis on core competence, marginal activities are outsourced;

- temporary networks of individuals, small companies or parts of larger corporations that are set up for a specific purpose, mostly laid down in clearly defined goals;
- co-operation on ICTs (such as groupware and workflow systems);
- autonomy: no central management/coordination of communication interfaces; instead: self-management and equality between members (sometimes, the role of a broker is allowed);
- no contractual regulation of relationships between partners; no common legal structure;
- single 'shop window' for customers, products are marketed in integrated form and under one brand to make market communication with customers easier.

Virtual organisations are understood to be non-static formations without predefined structures (such as job descriptions) but rather evolving in parallel with product development stages – a type of in-flux-organisation that is sometimes called “process organisation” (e.g. Scholz 1995). For Mowshowitz (1997: 33), virtual organisations are marked out by their ability to:

- logically separate requirements from the means for their satisfaction (satisfiers) and
- switch the assignment of satisfiers (e.g. production techniques) to requirements so as to optimise results.

The author (ibid: 36) also claims that the “virtual organization paradigm is consistent with all forms of organisation [with centralised or decentralised control structures] because the paradigm applies at the task level”. This conceptual trick made it much easier to apply the virtual organisation term to real-life objects, as the emphasis is on meeting market demands as adequate as possible: “The ability to switch allows for a high degree of flexibility in providing cost-effective services. [...]. It is an essential feature of virtual organization. Conventional corporate management may occasionally switch between options, but it normally does so on an ad hoc basis, whereas in virtual organization, switching is standard operational procedure; that is, it is a basic management principle of this innovative form of organization” (ibid: 33).

Such switching is not without costs, namely transaction costs. Transaction cost theory (Coase 1937, Williamson 1975, Sarkar et al. 1997) suggests that there are marked differences in the costs of executing transactions inside of an organisation as opposed to market transactions. This leads to the theoretical finding that profit-maximising companies execute those transactions internally that would cost more to conduct through market contracts. As Coase noted in the case of early communication technology, i.e. the telephone, transaction costs can be altered by technological progress. Researchers often assume that ICTs in general, and the Internet, in particular, will reduce the costs of inter-company co-operation. They conclude that this will enhance the competitiveness of highly specialised companies which rely on outsourcing, in comparison to vertically and horizontally integrated corporations (Holmstrom & Roberts 2003).

Criticism of this assertion has come from various directions. Vetschera (1998), for example, claims that there is no general move towards greater emphasis on switching in the economy. He observes that more and more of the large companies are reducing the number of suppliers instead of increasing them. This supports the analysis of Clemens and Row (1992) who found that the ‘move to the market’ hypothesis (i.e. claims that decreasing transaction costs lead to an increased use of the market as a coordination mechanism) refers only to the ownership

dimension, while overlooking the control/coordination dimension. On the one hand, ICTs present vastly improved possibilities to exert control beyond the boundaries of individual organisations; on the other hand; however, this often seem to require close relationships between these organisations – often based on trust and a common understanding of goals, codes and ways how to do things.³

There is little doubt, however, that individual characteristics of virtual organisations are spreading with great speed. In this context, DeScantis et al. (1999: 84) state that “the virtual organization may not be so much a pure form as a continuum for describing a range of relationships along the dimensions of space, time, culture and organizational boundary. To the extent that the relationships of a firm take on more and more of these characteristics, the firm is relatively more virtual. Being virtual, therefore, is a matter of degree” (cp. also Gareis 2002; Vartiainen 2006). Phenomena which appear to spread quickly inside as well as between organisations are virtual collaboration and virtual teamwork. For example, Edwards & Wilson (2004: 88) found in a survey of the top 500 manufacturing, financial, retail and technology companies in the UK that 25% of them used virtual teams “to a large extent”, and further 58% used them “to some extent”.

Virtual teams

Virtual teams are generally defined as in Townsend et al. (1998: 17) as “groups of geographically and/or organizationally dispersed co-workers that are assembled using a combination of telecommunications and information technology to accomplish an organizational task”. As Bell & Kozlowski (2002: 15) point out, literature about the phenomenon “has been primarily descriptive and has focused mainly on the benefits of such teams” (see for example: Davidow & Malone 1992).

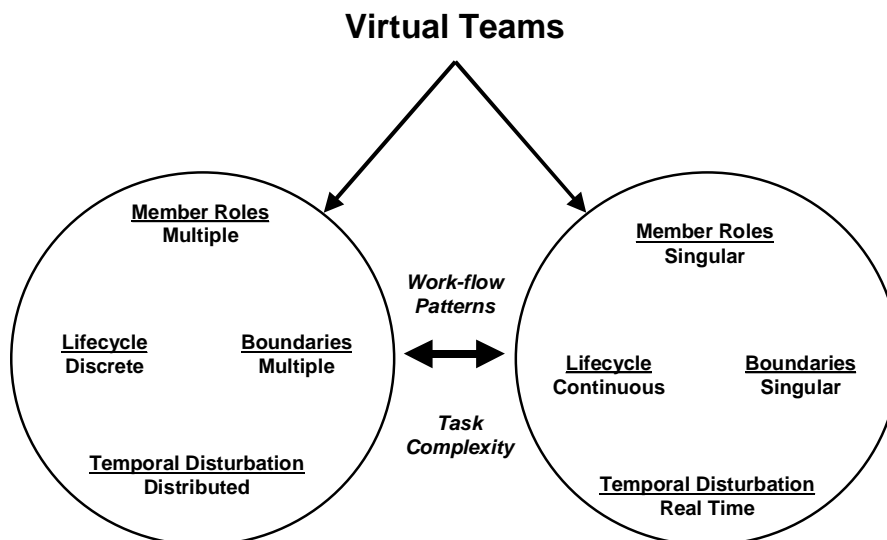
Bell & Kozlowski (2002: 16) stress the need to distinguish between different types of virtual teams in order to be able to make summary statements about drivers, success factors and impacts (see also Cascio & Shurygailo 2003). The reason is that “virtual teams need to adopt different characteristics to successfully operate within the constraints that are imposed by the complexity of their collective task”. According to Bell & Kozlowski (2002: 18-20), the dimension to be used for devising a typology of virtual teams are temporal distribution, the extent of boundary spanning, type of lifecycle, and member roles (see Figure 4):

- With regard to the **temporal distribution**, members of virtual teams can work in each of the four interdependence arrangements described Van de Ven et al. (1976). (a) **pooled/additive** means that work activities are performed separately by team members and afterwards combined into a product; (b) **sequential** means activities are performed sequential, with work inputs and outputs moving from one workers to the next; (c) **reciprocal** means that work inputs and outputs flow back and forth between team members, one by one, over time; and (d) **intensive** means that team members must diagnose, problem solve, and/or collaborate simultaneously to accomplish their task. These four types of interdependence arrangement are related to other characteristics of team task complexity such as the task environment (static ○ dynamic) and the extent of internal and external coupling.
- With regard to the extent of **boundary spanning**, these can be of a functional, organisational, geographical or cultural nature. The more such boundaries are crossed and

the more complex the communication task is, the more difficult it will be to successfully organise collaboration (Bell & Kozlowski 2002). Cultural boundaries pose specific problems for complex tasks, such as joint decision-making and team building.

- With regard to the **lifecycle** of a virtual team, we can distinguish between discrete lifecycles – characterised by teams being set up to carry out a particular, clearly defined task, changing members frequently, and dissolving as soon as the job is done – and continuous lifecycles which are of a more open-ended nature and often established to maintain a constant connection between organisation, for example along the value chain.
- With regard to **member roles**, these can be stable/fixed and singular, or flexible and multiple. Townsend et al. (1998) found that virtual teams are more likely to feature flexible roles than traditional teams, as they are usually set up to allow for flexible responses to external changes.

Figure 4: Characteristics That Distinguish Different Virtual Teams



Source: Bell & Kozlowski (2002: 30)

A special form of virtual collaboration are the virtual communities of interest (see Mansell & Steinmueller 2000; Steinfield 2004).

As much as there is talk of the benefits of virtual collaboration, there is also an extensive debate about the challenges surrounding such technologically mediated forms of collaboration. One key challenge is how to build and sustain – under conditions of less and less face-to-face interaction and co-location of work teams – the human capital base which is of such critical importance for competitiveness in today's business environment. **Knowledge management**, therefore, is a key concern of companies which are to introduce virtual collaboration (Huysman & de Wit 2003).

Telework and eWork

Clearly, the discussion around NWEs is related to earlier debate around telework⁴ and eWork, although there are also fundamental differences with regard to the context in which both phenomena are discussed in the political and also academic domain. It appears necessary to

make these similarities and differences explicit in order to know what can be learned from previous research, and in what areas different or totally new approaches are necessary.

Telework is understood as individual workplaces which have been made geographically flexible by the use of ICT. Often a relocation of the work from a centralised office environment to a decentralised workplace in the home of the worker, or a mobile workplace (anytime, anywhere) is implied. The European Commission (1999), based on Gareis (1999), distinguished three types of telework:

- **home-based teleworkers** who work from a workplace installed in their home, and transmit work inputs/results via ICTs. Permanent home-based teleworkers spend more than 90% of their working time at home, alternating teleworkers spend at least one full working day per week at home and supplementary teleworkers do so for less than one full working day per week. Home-based teleworkers have an employment contract, as opposed to self-employed SOHO-based teleworkers (see below).
- **mobile teleworkers**, i.e. those who spend a certain minimum share of their working time on business trips, travelling or on customer's premises, and make job-related use of online connections while doing so.
- **telework by self-employed** who work from **SOHOs**, i.e. small offices in their home, on the same grounds as their home or with their home as their base, and use online ICTs for interaction with clients, collaborators and suppliers.

It is important to note here that this definition of telework requires that *paid working time* is spent at remote locations. This definition implies that some form of (not necessarily explicit) agreement between employee and supervisor/employer exists about the issue⁵.

The term **eWork** has been promoted mainly by the European Commission (CEC 2003) to indicate a step onwards from previous notions of telework. From the research and practitioner literature, it appears that the ways in which eWork differs from the earlier concept of telework are:

- (a) while telework in the traditional sense is mostly focussing on individualised changes of work location, most prominently at home, eWork also includes remote work in shared office premises, such as call-centres and (other) remote back offices (Huws & O'Regan 2001);
- (b) in addition to traditional telework, eWork is understood to also cover *tele-collaboration*, i.e. telemediated work forms carried out by workers located in traditional office environments, like in the case of virtual teams as discussed above (see Eichmann et al. 2002).

In order to distinguish between such tele-collaboration and traditional types of telework, it is useful to describe the latter as *principal/agent relationships* (see Eisenhardt 1989) to highlight the fact that they consist of a principal (i.e. somebody, such as a superior, who does not act directly but instead by giving incentives – such as money, career prospects – to other persons) and agents who carry out the work on their behalf. In collaboration, there is usually no hierarchical relationship between co-workers, but rather a situation where two or more people work together to create or achieve the same thing (Hanhike & Gareis 2004).

eWork therefore comprises *any type of telemediated remote work* and includes the following types:

- individualised or shared-office based (this refers only to the physical workplace of the worker, not to the fact that they share an office with the principal or collaborators);
- collaborative work (tele-cooperation, virtual teams) or work which is performed in the context of principal-agent type relationships;
- work interaction which is inter-organisational, i.e. coordinated over the market (such as in client/contractor relationships and freelance work) or work interaction which is intra-organisational, i.e. coordinated internally in organisations.⁶

Conceptualised as such, the definition of eWork also includes phenomena such as virtual organisations (Jackson & Van der Wielen 1998) and eOutsourcing. Table 1 presents a typology of eWork, based on previous work by Huws & O'Regan (2001) and Hanhike & Gareis (2004). The grey cells contain the main types of eWork, while the last row lists some types which do not fall in the eWork category.

Table 1: Typology of eWork, and distinction between definitions of eWork and NWEs

		Coordination mechanism			
		Principal/agent		Collaboration	
		intra-organisational	inter-organisational	intra-organisational	inter-organisational
Work environment	Individualised eWork (away from office premises)	Telework in employment relationships	Freelance telework ⁷	Work in virtual teams composed of teleworking employees from a single company	Work in virtual teams made up of teleworkers from different companies (or self-employed)
	eWork on shared office premises	eWork at other site of same company (e.g. back offices)	eOutsourcing	Work in virtual teams composed of employees from a single company	Work in virtual teams composed of employees from different companies
	Non-eWork (examples)	Employed agents co-located with principals	Self-employed co-located with clients	Work in co-located teams composed of employees from a single company	Work in co-located teams composed of employees from different companies

Source: based on Huws & O'Regan (2001), Hanhike & Gareis (2004)

In order to distinguish between traditional notions of telework on the one hand, and work in NWEs on the other hand, it is possible to draw a boundary between principal-agent type coordination relationships (which are typical for telework as understood by most observers) and collaboration

(which is the coordination mechanism typical for NWEs). Accordingly, the bold line in the table marks out the definition of NWEs deployed in this document.

Physical Mobility

The concept of NWEs is also much related to the notion of **mobile work** because of its emphasis that workers are enabled to carry out work processes, including those which require collaboration with other agents, at any place and at any time. Moreover, physical mobility has traditionally been required for remote workers to collaborate. Virtual collaboration can thus act as an enabler of physically mobile work (because it liberates work from being bound to a stationary, co-located workplace) but also a substitute to physical travel. For these reasons, the following will briefly review some concepts of worker mobility.

According to Perry et al. (2001), mobile work activities involve “working at multiple (but stationary) locations, walking around a central location, travelling between locations, working in hotel rooms, on moving vehicles and in remote meeting rooms”. Sometimes, mobile work of the type “walking around a central location” is excluded since it does not comply with any criterion of remoteness (see above). In order to distinguish mobile workers from non-mobile workers, one may also need to add the temporal dimension, i.e. set a lower threshold of time spent in mobile work activities for a worker to be considered as mobile. Other important dimensions include the mode of working (i.e. to what extent the mobile activity is supported by technology and how much the mobile worker is integrated in company information networks) and the purpose of worker mobility (cp. Heinonen 2004). While the former concerns the distinction between mobile work and mobile eWork, the latter is linked to the question whether mobility requirements are work-related or not.

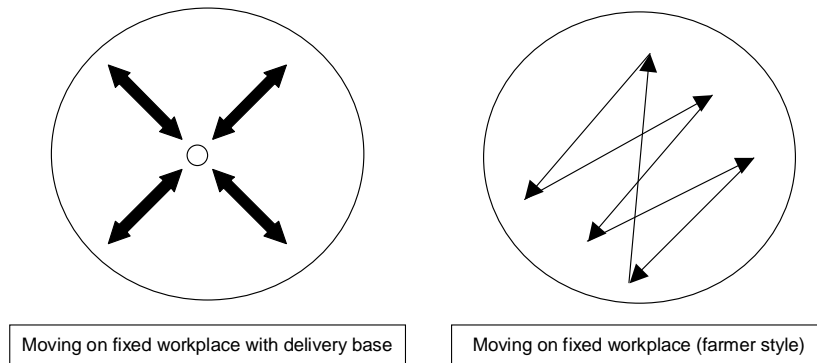
Lilischkis (2003) distinguishes between different types of mobile work, which in general is defined as work implying the move between different locations. The five types are distinguished by an increasing level of detachedness of the workplace from a fixed place:

- “On-site movers”: work requiring movement around a certain site.
- “Yo-yos”: occasionally working away from a fixed location.
- “Pendulums”: alternate working at two different fixed locations.
- “Nomads”: working at changing fixed locations.
- “Carriers”: working on the move transporting goods or people.

Since the definition of mobile work chosen here refers to alternating locations, the term “multi-location work” can also be used to describe this phenomenon. While “mobile” work stresses the ability to move workers and tools, “multi-location” work has a connotation of being able to work at numerous different places. However, the term “multi-location” does not completely suit the carrier type.

“**On-site movers**” are working on a certain site but have to move around or back and forth for certain purposes. Examples are farmers harvesting their land with a tractor, security agents walking around and watching sites, materials drivers in manufacturing companies, and hospital doctors visiting patients.

Figure 5: Examples of the on-site moving type of mobile work

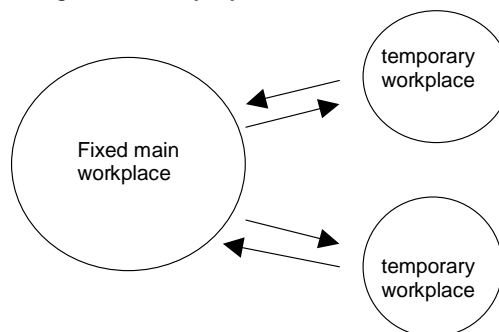


Source: Lilischkis (2003)

This is a very basic level of mobility because almost everyone moves around his or her working site at some time of the day, so everyone can be considered a mobile worker in this sense. However, there are certain kinds of professions that are very immobile even in the on-site moving sense: e.g. call centre agents, receptionists, and supermarket cashiers. For the topic discussed at the workshop, on-site moving work that involves the use of ICTs and/or that may be facilitated by them is of particular interest.

The definition of the “yo-yo” type of mobile work refers to a fixed location as a reference point that is vacated with certain regularity, and for a certain period of time, to work elsewhere. This type is generally considered to be the second most prevalent one.

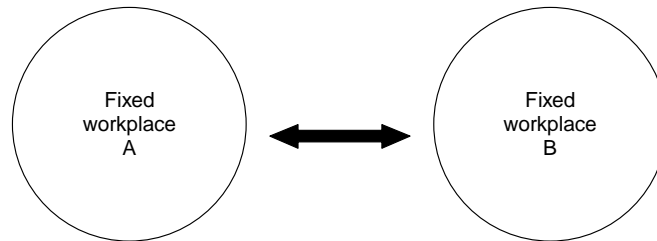
Figure 6: The yo-yo kind of mobile work



Source: Lilischkis (2003)

Examples of the yo-yo kind of mobile work are work by salespeople in the field, work on business trips (e.g. taking part in a meeting in a foreign town), when travelling (e.g. writing reports while sitting in a train), on emergency service (e.g. firemen and emergency physicians) and at customers' premises (e.g. ICT developers visiting potential customers). When temporarily leaving the workplace, ICTs may allow to keep in touch with headquarters and to carry a “mobile bureau” for remote work.

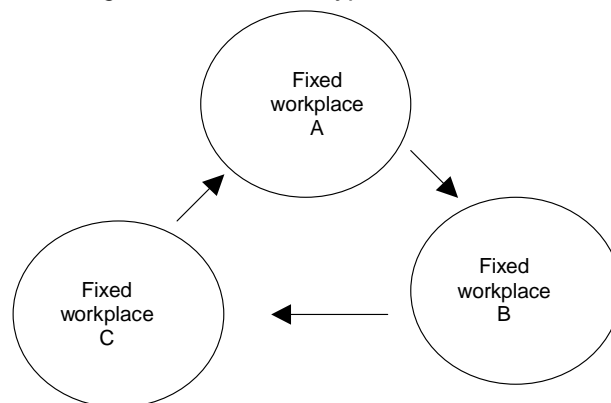
Figure 7: Example of the pendulum type of mobile work



Source: Lilischkis (2003)

The **"pendulum"** type of mobile work includes work with two fixed work locations such as the employer's premises, a home office or a client's premises, between which the workers alternate. The pendulum type includes the much-discussed alternating telework: working several days per week at home (at a distance from where its results are used), implying computer use, and the use of telecommunication for electronically exchanging work results and messages with colleagues, superiors or external agents such as clients⁸. Only those teleworkers who *exclusively* work at home or at another location away from the employer's premises are *not* to be counted as mobile workers. According to most available evidence, there number is all but negligible in Europe⁹.

Figure 8: The nomad type of mobile work

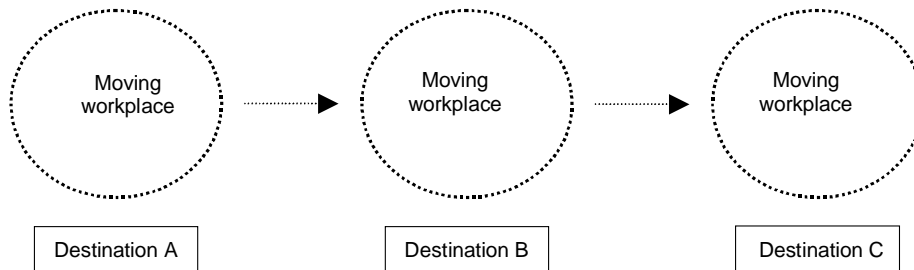


Source: Lilischkis (2003)

The **"nomad"** type of mobile work refers to people who constantly move from one location of work to another. The total number of work locations is much more than two, but often only one at any time. They may or may not have headquarters. Several kinds can be distinguished according to the time the workers spend at a certain location. Business auditors, for example, spend from several days to many weeks at one establishment before moving on to the next. Field sales forces such as in the insurance business typically have many house calls per day and could also be considered to be "nomads" in a wider sense. Others may be highly specialised freelancers who change the enterprise where they work after some days, weeks or months. Apart from this modern kind of "white collar nomads"¹⁰ there are rather traditional kinds: Cattle nomads moving with their herds from one place to another can be included in this group as well as circus performers who travel around in the country to perform.

It makes only sense to speak of nomadic mobile work if the periods spent at each working location are too short to implement a fixed workplace. Diplomats who also usually move from one country to another every few years should therefore not be considered mobile workers.

Figure 9: The carrier type of mobile work



Source: Lilischkis (2003)

Finally, there are “**carriers**” which refers to personal or commodity transportation involving continuously moving from one place to another. Examples are jobs such as train conductors and ticket collectors, airplane stewardesses, sailors as well as taxi and bus drivers. A sub-category of “deliverers” has a base where they collect goods and then deliver them, e.g. postal delivery workers and home delivery drivers. The carrier type usually implies the use of a specific vehicle (although some, e.g. postal workers, may do without).

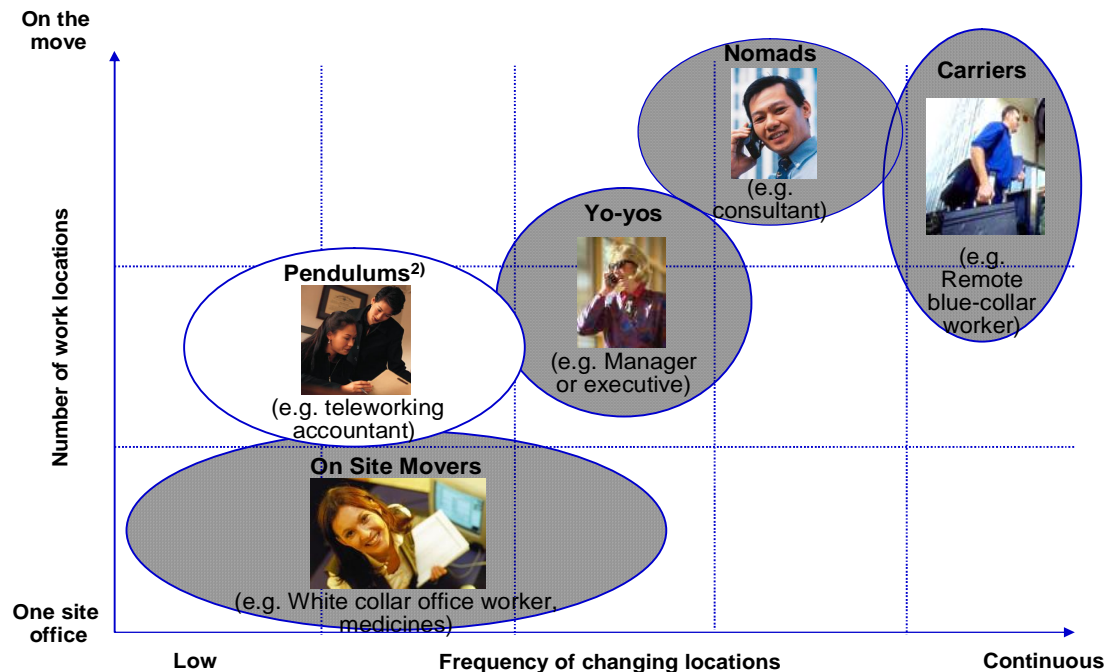
These five types of mobile work do not exclude one another. Some workers may perform many types of mobile work in a certain period of time. For example, alternate teleworkers (pendulums) may visit meetings from time to time (yo-yos) or work in two different offices at their employers’ premises (on-site movers).

A limitation of this typology is that it looks at workers in isolation from co-workers and collaborators, which also means that reasons for mobility are considered to be externally determined (e.g. deriving from the worker's tasks) rather than endogenous.

On the basis of Lilischkis' paper, Schaffers et al. (2006) produced a two-dimensional matrix in order to characterize the type of physical mobility of a worker. It distinguishes between the frequency of changing locations (x-axis) and the number of different work locations (y-axis) (See Figure 10).

Since the definition of mobile work chosen here refers to alternating locations, the term “multi-location work” can also be used to describe this phenomenon. While “mobile” work stresses the ability to move workers and tools, “multi-location” work has a connotation of being able to work at numerous different places. However, the term “multi-location” does not completely suit the carrier type.

Figure 10: Types of physically mobile workers



Source: based on Schaffers et al. (2006), Lilischkis (2003)

Broader Concepts of Mobility, and “Virtual Mobility”

There has been some confusion about the term "mobile work" as recent contributions to the debate have started to widen the meaning of "mobility" towards including non-physical mobility (enabled by electronic mediation) or "virtual mobility" (Vartiainen 2006). Moreover, a distinction (not always readily acknowledged) is being made between mobile work, mobile workers and mobile workplaces (Vartiainen 2006). For example, Schaffers et al. (2006) state that:

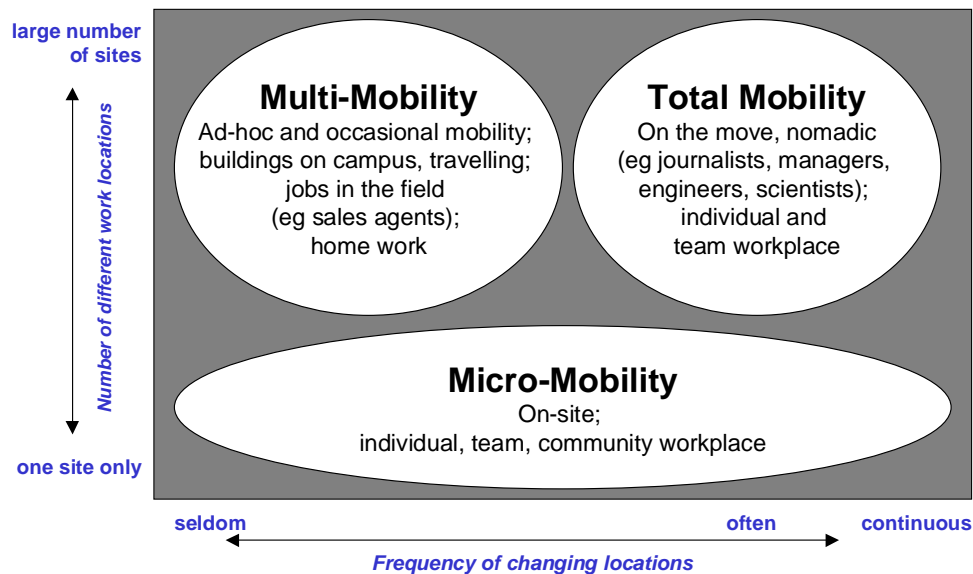
Mobile work in a broader meaning would include the mobility or flexibility of the workplace and the organisation, increasingly adapting to the changing needs and opportunities of the mobile worker and team irrespective time, place and other context-related constraints: the network may become the working place. The mobile workplace thus evolves towards a scenario of work organisation characterised by empowerment of workers and teams being part of ad-hoc temporary projects and organisations, and by awareness of and dynamically responsive to context variables.

It appears worthwhile, therefore, to distinguish between:

- **mobility of the worker** in a physical sense, which Perry et al. (2001) define pragmatically as “working at multiple (but stationary) locations, walking around a central location, travelling between locations, working in hotel rooms, on moving vehicles and in remote meeting rooms”.
- **virtual mobility**, which means that "an actor moves with the help of ICTs in a virtual working space. The subject itself may be physically stationary and working on the object of work in a working space" (Vartiainen 2006).

- **mobility of a workplace**, with a **mobile workplace** being described as such if it "fully supports worker mobility" (Schaffers et al. 2006).

Figure 11: Forms of physical mobility



Source: adapted from Schaffers et al. (2006)

Schaffers et al. (2006) distinguish between three basic forms of **mobile collaborative workplaces**:

- "1) Workplaces supporting full worker mobility. An example is remote work such as maintenance, sales or relations management, and consulting. Whereas this maybe is the most direct meaning of "mobile work" the type of work situations and the types of group collaboration covered are rather limited and ICT support is confined to providing communication support and access to databases.
- 2) Fixed multi-location collaborative workplace. Work is carried out at fixed locations; synchronous or asynchronous; the worker is travelling to such a location or a location is the home base of the worker. An example is distributed design review in aerospace engineering, supporting multi-functional teamwork and bringing in multiple competences in judgment and evaluation.
- 3) Dynamic multi-location collaborative workplace. This seems to be a realistic scenario but not yet fully realised in practice. The workplace tool environment is aware of and adaptive to changing locations of individual workers (in case of distributed group work) or to changing location of the commonly used physical workplace (hotspot) and could be built up from inception (awareness of a problem, or opportunity, or emergency) to full operation and in the end dissolution."

Authors such as Vartiainen (2006) suggest speaking of mobility also in cases where the worker him- or herself is stationary (but work takes place in a virtual working environment with access to resources physically located at other locations, including computer networks). In that case,

virtual mobility would mean that "an actor moves with the help of ICTs in a virtual working space. The subject itself may be physically stationary and working on the object of work in a working space" (Vartiainen 2006).

While arguably leading to the risk of conceptual ambiguity, this debate points at the fact that in the world of work, physical mobility is (in the large majority of cases) not an end in itself. It serves economic interests and underlies considerations of (pecuniary) costs and benefits. In general, worker mobility is being utilised to achieve an optimal allocation of human capital in the production system. The costs involved in working in a mobile rather than fixed setting can be significant, as shown by Perry and Brodie (2004) who call such costs "mobilisation work". In general, human capital is today by far the least mobile of all production factors. Companies are, therefore, constantly seeking out alternatives to physical mobility in order to control costs while still enjoying the benefits from close interconnectedness with value chain partners and customers. One way of doing so, much discussed in the futurist literature, is to supplement ICT for physical mobility. An example would be to conduct a video-conference instead of calling persons for a face-to-face meeting (which imply physical travel). Other examples for virtual mobility include all kinds of computer supported collaborative work (CSCW). Complex documents such as construction drafts that used to be presented and discussed in meetings can be circulated and discussed through the Internet.

While physical and virtual mobility serve similar purposes – namely to make work (products, inputs) available where it produces the highest added value at any given time – there is much evidence which suggests that both do in practice not so much substitute for each other as they are complementary: the more people interact with others through ICTs, the more likely they are to seek face-to-face interaction as well (Niles 1994, OECD 2000). One reason for this is that ICTs not only provide potential substitutes for physical travel, but they are at the same time also making mobile working much more efficient and effective than ever before (see Gareis et al. 2006).

General management driven concepts

Driven by the need to address increasing globalisation, management research investigated new opportunities to organise work by the extensive use of new ICTs. As such, a network view of the firm started to develop (Easton 1992). Under the paradigms of the resource-based view (Hamel & Prahalad 1994, the management research perspective brings NWEs into the broader context of strategic management (Gulati et al 2000) and organisational science (Sydow 1992). From early on, researchers in this field draw their attention to changes in the work environments of employees (e.g. Järvenpää & Ives 1994, Davidow & Malone 1992). Typical functions that have been researched under the network view are knowledge centred functions of research and development (e.g. Arundel & Bordoy 2002, Birkinshaw 2002) and the process-oriented functions of operations (Christopher 1998). As a consequence researchers have defined the "networkability" of organisations as one source of competitive advantage (e.g. Gemünden et al. 1996; Ritter 1999; Klüber et al. 2000; Sivadas & Dwyer 2000). In the view of the authors it appears sensible to utilise the process-oriented and the knowledge-oriented perspectives for the categorisation of NWEs.

1.2.3 Towards a Definition of NWEs

The research carried out in these areas, when related back to our initial discussion of the term “new work organisation”, allows us now to list the dimensions which are needed to define the subject of our analysis (NWEs) by using seven dimensions: collaboration, spanning of boundaries, telemediation, virtual teamwork, coordination, people focus and technology:

Collaboration: Collaboration occurs “when two or more people interact and exchange knowledge in pursuit of a shared, collective, bounded goal. [...]. Bounded goals imply a beginning and an end. Two people interacting in order to get smarter is not collaboration. However, two people interacting in order to prepare for a calculus exam is.”¹¹ For empirical research, this definition needs to be operationalised. We suggest that one should speak of collaboration only when an explicit (e.g. written, but not necessarily legally binding) agreement about common aims has been made.

Boundary spanning: As Bell & Kozlowski (2002) point out, an important aspect in which virtual collaboration differs from traditional forms is the extent to which it crosses boundaries of space, time, function, culture, and organisation. This stems from the initial rationale behind virtual collaboration which is to combine the skills and capabilities of a number of agents for the pursuit of a certain goal regardless of the traditional constraints of distance. Mobility – in any sense of the term – plays a key role in this regard.

Telemediation is defined as the transfer of work inputs and/or outputs via data telecommunications links. Remoteness refers here to the physical distance between co-workers or principal and agent. Remote work most often is being (implicitly) defined as meaning different sites/locations/addresses.

Virtual teams: We define collaboration in virtual teams as a group of individuals who (or: some of whom) are located remotely from each other and who collaborate, and in which interaction takes place exclusively or almost exclusively via telemediation (compare Lipnack & Stamps 1997). They can, but do not have to stretch across organisational boundaries. Virtual collaboration is understood to take place in teams, i.e. in groups of persons who work together for a longer stretch of time. Any threshold regarding the minimum period of time necessary to speak of collaboration must be arbitrary, though. In recent years, cases of (virtual) collaboration between companies and their customers have attracted increasing interest (Voß & Rieder 2005). It can be argued that this is also a case of NWE (see Stanoevska-Slabeva et al. 2005). It is not covered by this document’s scope, though, as the instruments of marketing research appear to be better suited for researching the subject.

Coordination: It is important to distinguish collaborative work contexts from other forms of coordination. Recourse to the well-established typology of Van de Ven et al. (1976) seems useful in this respect. The typology distinguishes between four coordination modes in the context of workflow processes: These are, ranked according to increasing interdependency: pooled/additive, sequential, reciprocal and intensive interdependence arrangements. These types also relate to the extent to which co-workers carry out tasks in parallel, sequentially, or together. Depending to the extent to which tasks are designed as business processes, the two last types (reciprocal and intensive) are most likely to fit our understanding of “collaboration”. However, sequential coordination can also amount to collaboration if co-workers “interact and exchange knowledge in pursuit of a shared, collective, bounded goal” (Kim 2004)¹².

People focus: Depending on the complexity and nature of the tasks involved (see further below), NWEs need to provide optimal working conditions for the worker if they are to support high levels of productivity – as research into high performance work organisation and related concepts has shown. Worker focus usually implies some or all of the following characteristics: a non-hierarchical organisational structure; flexibility in working methods; corporate cultures focussing on people orientation; continuous investments in learning & training; and innovative performance measurement and reward schemes. In addition, people focus goes beyond catering for workers as it also implies that the focus of business processes should be on optimally serving the customer.

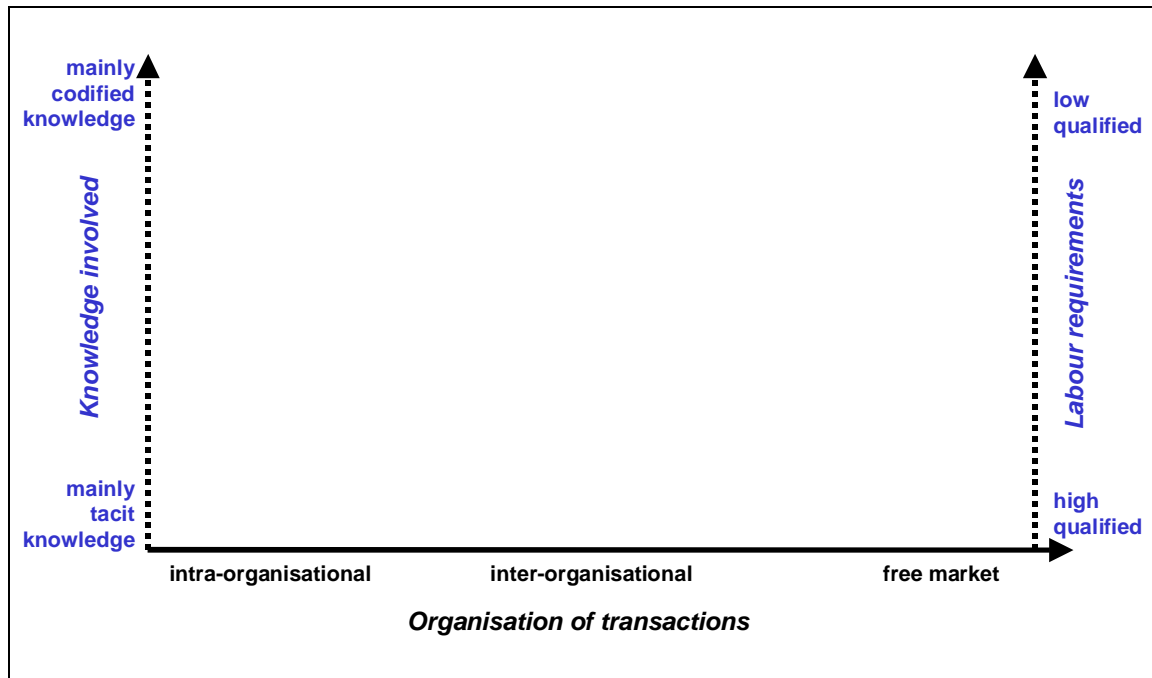
Technology: The type of collaboration outlined above is possible only with the support of advanced tools for computer supported collaborative work (CSCW). In essence, these tools enable easy access to knowledge resources and required communication channels at any place and any time, and are fully integrated in the working environment in order to support creative work as good as possible.

The type of NWE which is suitable for a given setting (including the degree of virtualisation) is mainly contingent upon **task complexity**. Higher complexity of the coordination task is associated with higher levels of tacit knowledge involved in the work process and higher skill requirements. Low task complexity, meanwhile, is usually associated with mainly codified knowledge, which allows the use of less qualified (i.e. cheaper) labour.

The discussion above implies that two major ways in which types of NWEs differ from each other are the type of knowledge (and related level of qualification) involved and the way it is organised in relation to formal organisational boundaries. These dimensions are used in Figure 12 for classifying real-world cases of NWEs according to organisational structure (whether collaborators are from the same organisations, from different organisations which are co-operating closely, or from the free market) and knowledge/skill requirements.

Note that an NWE requiring mainly codified knowledge (low skills) tends to involve a high degree of automation of work processes/ business processes, while NWEs requiring mainly tacit knowledge tends to imply a large degree of autonomy of workers. The latter are typically associated with knowledge work, high levels of product as well as process innovation, and good pay.

Figure 12: Matrix for describing NWEs according to organisational structure and knowledge/skill requirements



Source: Adapted from Stanoevska-Slabeva et al. (2005)

Stanoevska-Slabeva et al. (2005) extend the notion of NWEs to also include network production systems which substitute machines (ICTs) for labour. The more codified the knowledge required for a production system is, the easier it will be to automate whole parts of it, such as cashiers in the case of RFID technology implementation. Alternatively, low cost labour could be deployed.

The matrix can be used in order to assess trends in the ways NWEs are implemented in a national economy. As will be discussed later, different positions in the matrix are (roughly) associated with different implications with regard to labour market outcomes, impacts for skills requirements and demand for supportive regulatory structures.

A taxonomy of Networked Working Environments (NWEs) has been derived to describe the emergent phenomenon of NWEs and to present the case studies in a consistent framework. The taxonomy itself takes into account earlier approaches to categorise and describe the emerging phenomenon of new ways of working and attempts to capture those aspects of the types of knowledge involved in the working environment, which have not been utilised in earlier works.

The concept of automation aims for a new level of integration. Its goal is twofold to streamline information flow within processes by eliminating media breaks and by automatically connecting the real world with ICT, and by automating decision making within processes. It thereby bypasses human labour; in particular activities related to transformation of information from different media, as a cost intensive, error prone and time consuming factor when feeding data to the computer. These are important aspects in so-called real time enterprises [23] or self-organizing supply

chains. Recent research in automation is looking at the benefits of ubiquitous computing in preventing media breaks. Amongst other areas, technologies such as radio frequency identification (RFID) that support automation have the potential to create considerable benefits in supply chains and help to close the gap between the real world and ICT [24].

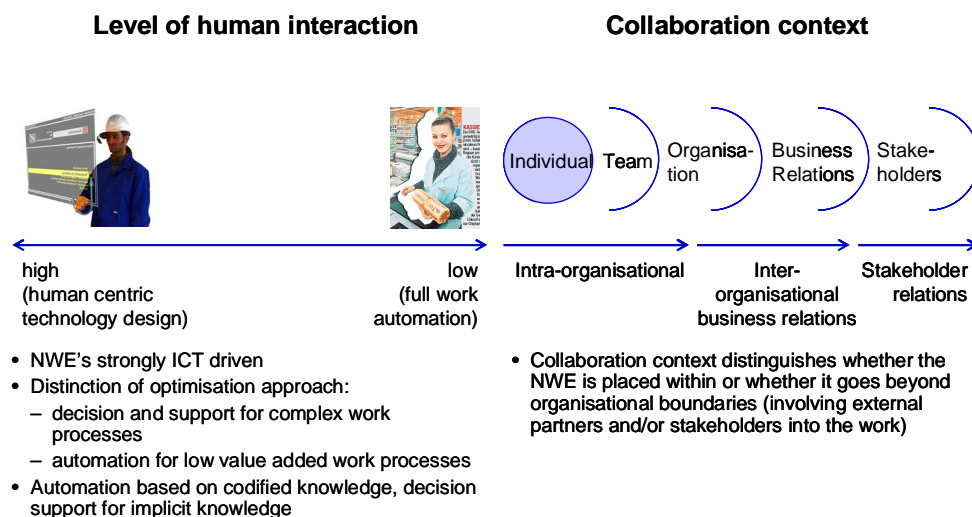
Taxonomy of Networked Working Environments - A Classification

As shown in the previous chapter, existing taxonomies of NWEs are strongly bound to depict existing human centric work environments, ignoring the manifest trend of increasing automation of work processes on the one hand, and the extension and augmentation of work environments into more peripheral and stakeholder-oriented realms on the other hand.

Therefore, the authors have developed a taxonomy that utilises two key dimensions of NWEs to categories new phenomena of networked working. The level of human interaction describes whether a NWE is human centric (i.e. displays high degrees of human/technology or human/human interaction) and primarily deals with implicit knowledge or whether it is highly automated (i.e. displays low degrees of human interaction) and focuses on codified knowledge and work processes. Settings with high human interaction put the human in the foreground and enable communication with other individuals, groups or information resources.

Both dimensions span a NWE-matrix which shows the level of human interaction on the y-axis and the collaboration context of NWEs on the x-axis.

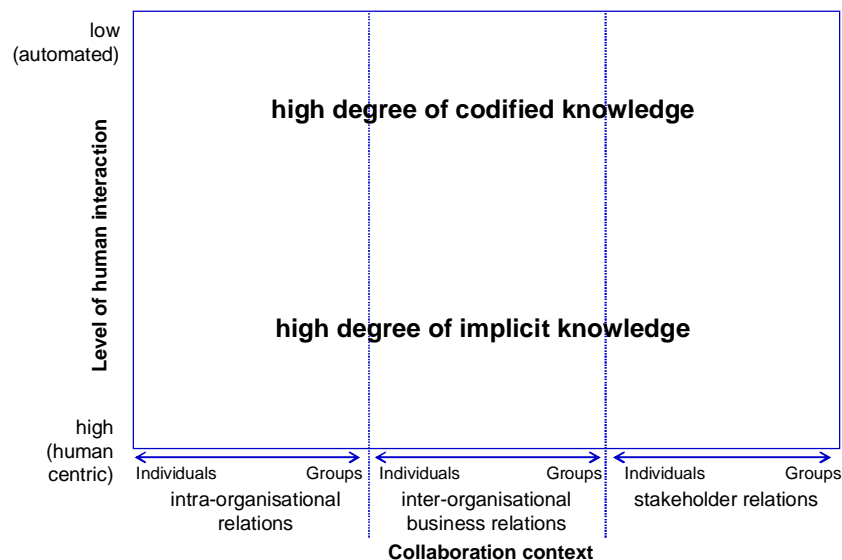
Figure 13: Dimensions for classification of NWEs



The collaboration context shows whether a NWE is placed within organisational boundaries or whether it goes beyond organisational boundaries, involving external partners and stakeholders and including them into the work process. Thus, the dimension is split into three segments: Intra-organisational relations, inter-organisational business relations and relations to stakeholders to whom no direct business relation exists. These three contexts can be split up further, according to

the number of core participants in the networked environment. Each sub-context differentiates if a NWE focuses on the collaboration of individuals or groups within organisations. Similar definitions have been used to describe e-Work settings [16, 25].

Figure 14: NWE taxonomy



Chapter 2: Impact of NWEs

2.1 Available Evidence on Impacts of NWEs on Different Levels – Introductory Notes

This chapter discusses evidence about impacts of NWEs and related phenomena, and reports about the success factors (value drivers) which have been identified as determining the success of NWE implementation.

For structuring types of impacts, two basic approaches are being deployed. Firstly, following common practice in research on impacts of ICT system implementation in organisations (cp. Van den Hooff et al. 2004), we can distinguish between:

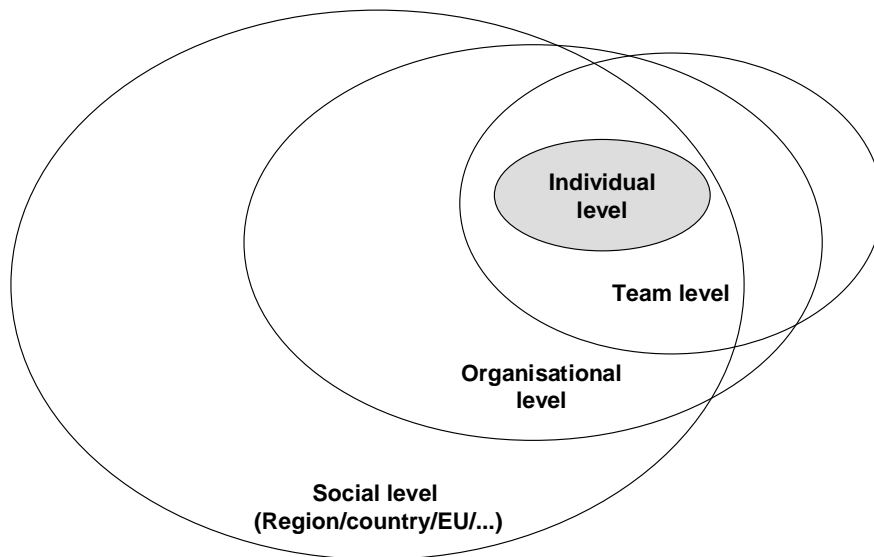
- **first order impacts**, i.e. affects on the main indicators of business performance including productivity and efficiency of business processes, but also consumer orientation, levels of innovative activity, etc. First order impacts mainly relate to the viewpoint of the organisation.
- **second order impacts**, i.e. effects on the social structure of the organisations involved (e.g. working culture, roles, trust) and on the workers as individuals (psycho-social impacts such as job satisfaction, work-life balance, health). Second order impacts mainly relate to labour as stakeholder. In the longer term, though, worker well-being is generally assumed to be in the economic interest of the employer as well.

- **third order impacts**, which are externalities, i.e. effects on parameters that are external to the organisation and do not directly affect its main forward and backward linkages, but which concern the wider labour market and the society at large, the environment, etc. Stakeholder here is the society at large.

In other words: First order effects are those which relate to the original intention of the innovation/re-organisation, which usually means improvements in efficiency, performance and measurable (short-term) productivity¹³. Whether these effects are exclusively direct consequences of the innovation or whether they are also indirectly affected by contextual factors (such as worker attitudes to new technologies) does not matter (and is often never found out). Indirect effects, however, are often more long-term in nature, for example when management only realises after all initial testing has been accomplished (and the innovation implemented) that it also has an effect on “soft factors” such as work morale, worker health and absenteeism, etc.

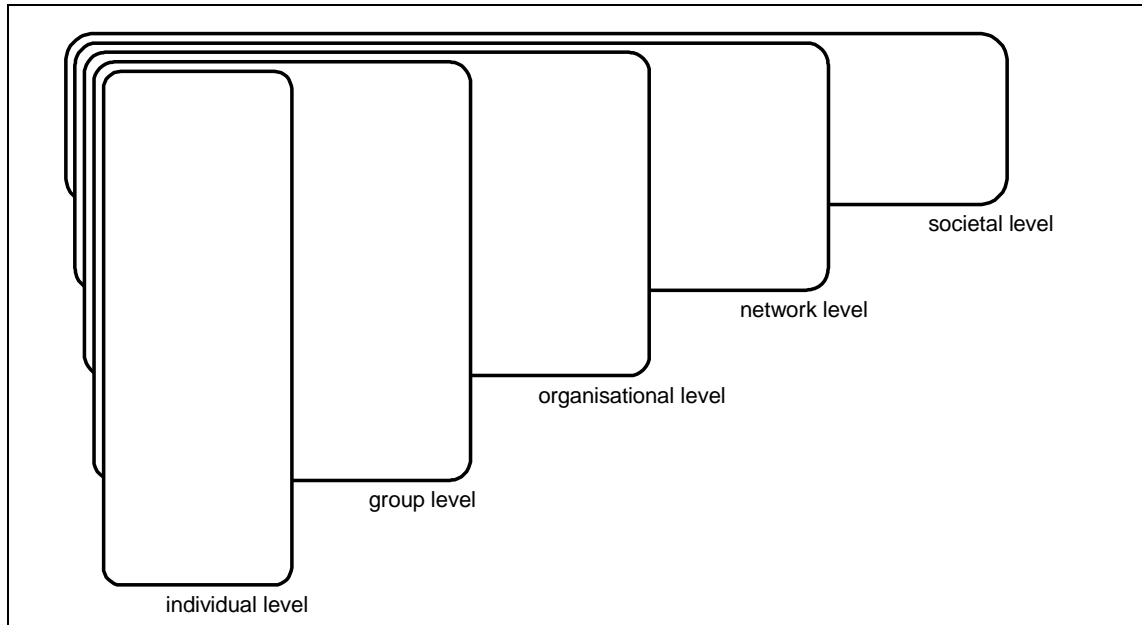
For this reason, such effects are here called second order impacts if they mainly relate to the organisation’s employees, and third order impacts if they mainly relate to the society at large as stakeholder. Second- and third-order impacts could also be called “side effects”, as they were not part of the original intention/risk analysis. However, one should be aware that third-order impacts can become first-order impacts if policies are put in place towards the internalisation of externalities (an example would be the recent implementation of a market for emission certificates).

Figure 15: Levels of analysis for measuring impacts of NWEs



Another way of structuring impacts of real-world applications of NWEs is to deploy different levels of analysis. Basically, these are the level of the individual (worker, workplace), the team, organisation and network levels, and the level of society, which usually means a region or country.

Figure 16: Alternative model of interrelations between different levels of analysis



It is important to recognise that impacts/outcomes measured at a lower level of observation (e.g. the individual or firm level) cannot simply be aggregated to arrive at the effect at a higher level of observation (e.g. a region or country), see Figure 15. This is because individual teams often stretch across the boundaries of single organisations, and many organisations stretch across the borders of regions, countries or continents. This is, of course, especially true for modes of virtual collaboration.

The picture is made more complex by the fact that individuals are often not members of one team and organisation only, but participate in various organisational contexts – for example in case of multiple jobs, voluntary work, etc. They can also be living in more than one region/country. Moreover, we need to be aware of the fact that not all individual-level effects will be measurable at the next higher level in this model: The work environment might have impact on the individual who are not reflected in any way in the activities and well-being at the team or organisational level. All of these are represented in Figure 16.

Therefore, care has to be taken when trying to estimate outcomes of NWEs at the level of society (e.g. a country) on the basis of firm-level evidence on impacts. This means that firm-level evidence needs to be supplemented (validated) by research based on representative samples of the whole working population. Such evidence is typically derived from surveys of the general population. Examples of surveys which cover issues of work quality and work-family balance include the European Foundation's European Survey on Working Conditions (ESWC) at the European level (EuroFound 2002), and the Finnish/Baltic Working Life Barometer at the national level (Antila & Ylöstalo 2003).

Combining both approaches to categorise impacts leads to the matrix depicted in Table 2. The table lists the key variables used in empirical research for impact assessment.

Table 2: NWE Impact assessment – analysis matrix

	First order effects	Second order effects	Third order effects
Individual/ workplace	Workplace productivity, work quality, throughput times, investment costs	Job quality, task discretion and job autonomy, job security, job satisfaction, work/life balance, subjective well-being (happiness), health impacts	Overall rates of labour productivity, economic growth, (un)employment levels, job tenures, social disparities, skills requirements, regional development (rural/urban), travel volumes and patterns, intercultural mobility, resource consumption, environmental sustainability
Team	Team productivity, team effectiveness, leadership effectiveness, time to action, levels of innovative activity	Social capital, trust, team cohesion, information openness, absenteeism	
Organisation / Network	Organisational productivity, time to action, time to market, value chain productivity, capacity to change (flexibility), investment costs	Knowledge management, innovative capacity (long-term), absenteeism	
Society			

As indicated before, there is very little available evidence about the diffusion and impacts of NWEs. This does not mean, however, that we cannot learn from available research about the likely effects of particular *features* of NWEs. In fact, a rich body of research exists which is of high relevance for the discussion of NWEs and their potential impacts. This research can be divided in two rough categories: (a) research on **flexible work organisation** and related concepts; and (b) research on **virtual collaboration** including CSCW and research into distributed team work. For each of these two fields of research, selected available evidence is presented, beginning with first order impacts, second order impacts and finally third order impacts.

2.2 New Forms of Work Organisation and the Pro-active Workplace

2.2.1 First Order Outcomes (Processes, Productivity and Performance)

For many observers it seems to be obvious that new, more flexible forms of work organisation are superior to traditional ones, and that the benefits to be obtained are worth the resources which are consumed for the implementation process. Against this background the OECD (2001: 28) warns that:

[...] there are also reasons to be sceptical about the possible economic impact of new work practices. Firstly, new practices are not necessarily more efficient than existing ones. There are advantages to traditional systems of job specialisation and

management-employee relations. For instance, the delegation of responsibility entails a weaker monitoring on the part of managers, possibly posing a risk in terms of product quality and overall coherence of the tasks of the different employees. Moreover, one should not neglect the costs involved in organisational restructuring (i.e. organisational change is not a free good). An enterprise operates on the basis of norms and arrangements established through time and any major change in these norms and arrangements will inevitably entail some adjustment costs. Secondly, what is efficient for an individual firm is not necessarily efficient for the economy as a whole. Even if new work practices may raise productivity of the firms that implement them, this improvement can well be accompanied with lower productivity in other firms (with little overall effect). This is possible, for example, in the case of outsourcing and when firms lay off "low-productivity" workers and reorganise production with remaining, "high-productivity" ones.

For these reasons, much care needs to be taken to establish valid evidence for the existence of benefits of such organisational forms. In particular, it is necessary to go beyond the simple collection of subjective perceptions about effects (often done through survey research), since these can be influenced by the opinions and value judgements which are prevailing in the public debate (e.g. in the management literature). In fact, many of the findings from research into new forms of work organisation need to be interpreted in this light.

With regard to the level of analysis, most of the studies quoted below made use of sample surveys or case studies with the observation unit being the organisation or – in case of larger companies – a corporate division. Different reporting units are used such as the division managers, HR managers. Only few studies used the individual workplace as the observation unit. The comparability of results is limited because, as Savage (2001: 4) points out in an EWON paper prepared for the European Commission, “despite the advances made in developing ‘Benchmarking’ models there are no estimates for performance of NWFO on an economy or sector wide bases. [...] Many different definitions of NWFO exist and it is therefore difficult if not impossible to compare company-level performance studies”.

Having said so, taken together the available evidence nevertheless gives a fairly comprehensive, if still tentative, impression of the impacts of new forms for flexible work organisation on key performance parameters, and of the factors upon which success or failure of NWE implementation is contingent.

Table 3 lists some of the main findings of recent studies looking into the effects of new forms of work organisation on business performance. Early research was carried out almost exclusively in the USA, and often assessed a bundle of reorganisation measures including modern HR management, but also production-related measures such as total quality improvement and just-in-time production. This makes it somewhat hard to isolate the effect of new forms of work organisation as defined in this document (section 0). Then, towards the end of the 1990s a growing body of evidence had been accumulated suggesting that key features of NWEs (such as employee involvement, decentralisation of responsibility, team work, flexible ways of working) are indeed associated with higher than average performance on key business indicators including productivity, Tobin's q and gross rates of return.

Table 3: Firm-level evidence on the effects of new forms of work organisation on process, productivity and performance

Author	Country	Key findings
Ichniowski (1990)	USA	"High-commitment" systems (encompassing flexible job design, formal training programs, formal communication systems and internal promotion) enhance firm productivity and Tobin's q.
Huselid (1995)	USA	In firms with employee skill development schemes and performance pay systems, Tobin's q and gross rates of return are high.
Greenan (1996a, 1996b), Greenan & Guellec (1996)	FR	Based on a classification of firms according to the degree of decentralisation of decision-making and communication structure, the study finds no correlation between different organisational systems and productivity.
Kelly (1996)	USA	Plants with strong employee involvement enjoy relatively high hourly labour productivity, especially among those plants using computer-controlled machines.
Black & Lynch (1997)	USA	Higher-than-average performance in unionised firms with new work practices. Greater employee voice in decision-making is what seems to matter most for productivity – rather than Total Quality Management per se. Labour productivity in unionised firms which adopt new work practices and use computers is estimated to be 20% higher than in the baseline case (non-unionised firms which have few new practices and do not use computers intensively). In unionised workplaces without employee involvement schemes, labour productivity is 15% lower than in the baseline case.
Ichniowski et al.(1997)	USA	A study of steel finishing lines shows that, compared with traditional" systems (with no innovative practice), lines adopting new work practices yield higher output levels (measured by actual output as a percent of potential output) and better product quality. The output differential between the lines with a complete set of new work practices and those with no new workplace practice is estimated to range from 7 to 11 percentage points.
Patterson et al. (1997)	UK	Factors such as employee attitudes, organisational culture and HR practices are more important as predictors of business performance than those traditionally thought of as being predictors – research and development, technology, quality and strategy.
Antila & Ylöstalo (1999a, 1999b)	FI	Strong positive correlation between "functional flexibility" and value added per employee.
Boer et al. (1999)	AU plus six European	Positive association between maturity of the firm in terms of high-involvement behaviour, and a number of key strategic areas including improvements of productivity, quality and delivery performance, lead time and product cost reductions
Bresnahan et	USA	New work practices are positively correlated with firm performance only when they are combined with heavy investments on either human

Author	Country	Key findings
al.(1999)		capital or ICT. For instance, productivity of firms with a high intensity of both ICT and new work practices is 7% higher than in competing firms. The productivity effect is practically nil when either new workplaces or ICT are weakly used.
Bryson (1999)	USA	Employee Involvement schemes enhance productivity only when combined with other new work practices.
Cappelli & Neumark (1999)	USA	A weak correlation is found between sales per worker and new work practices, whereas establishments using new work practices offer relatively high wages.
Caroli & Van Reenen (1999)	FR	Although changes in work organisation, as a whole, influence positively plant-level multi-factor productivity, the effect is strongest when the incidence of skilled labour is high.
Lay et al. (1999)	DE	Distinguishing between type and number of new working practices deployed (team work, continuous improvement, kanban, just-in-time production), the study found companies which made extensive use of a combination of new working practices to achieve the highest returns.
Nordflex (1999), NUTEK (1996)	DK, SE	Positive and marginally significant correlation between new work practices and productivity for Denmark. In the case of Swedish manufacturing industries, the correlation is positive and significant.
Addison et al.(2000)	DE, UK	Among non-union establishments in the United Kingdom, changes in employee involvement are positively and significantly correlated with changes in labour productivity and employment. In the case of unionised establishments, the correlation is often negative. In the German case, a positive and significant correlation is found between works councils and labour productivity among establishments with more than 100 employees.
Appelbaum et al. (2000)	USA	Study based on employee interviews in a sample of plants in three manufacturing industries. Positive effect of high-performance work systems (measured on separate scales for opportunity to participate, skill formation, motivation & incentives) on organisational performance (industry-specific performance indicators).
Askenazy & Gianella (2000)	USA	Re-organisation and computerisation have a positive and significant impact on multi-factor productivity growth when they are combined. On the contrary, the two factors have a negative impact on multi-factor productivity growth when each of them is introduced separately.
Black & Lynch (2000)	USA	High-performance workplace practices are associated with both higher productivity and higher wages. Profit sharing is associated with increased productivity. Employee voice has a large positive effect on productivity when it is implemented in the context of unionised establishments. These workplace practices appear to explain a large part of the movement in multifactor productivity over the 1993-96 period.

Author	Country	Key findings
Coutrot (2000)	FR	Establishments that use computers and are “innovative” in terms of changes in work organisation tend to report a strong expansion in their activities, relative to establishments that are “less innovative”.
Crockett (2000)	AU	Workplaces having undergone workplace reforms have recorded a rise in relative labour productivity according to both the 1995 Cross-section survey and the 1990-95 Panel survey. The index of workplace reforms includes formal training, semi-autonomous groups, income-bonus scheme, quality circles or team building, staff appraisal, Total Quality Management, Computer-Integrated Management, Skills audit and Just-in-time.
Ramsey et al.(2000)	UK	“High Performance Workplaces” (HPW) are identified based on an analysis of 24 human resource practices. HPW are associated with a relatively high performance in terms of labour productivity, financial results, product/service quality, and labour costs. HPW are also associated with a low job turnover rate.
Antila & Ylöstalo (2002)	FI	Pro-active workplaces were found to be associated with higher rates of job satisfaction, motivation and productivity, but also with bigger variations in time regarding employment (hire & fire). Openness in information flow was not found to differ between pro-active and traditional workplaces.
Felstead & Gallie (2002); Gallie et al. (2002)	UK	Strong association between high involvement working (defined as task discretion, direct participation and consultative commitment) and (a) level of generic skills exercised by those employed; (b) employment security; (c) use of ICTs – the latter depending on the complexity of applications.
Arvanitis, S. (2004)	CH	Positive effects of team-work and of delegation of customer contact competences to employees on labour productivity. In the manufacturing sector, negative effects of job rotation and overall delegation of competences from managers to employees on productivity.
Zwick (2004)	DE	Introduction of teamwork and autonomous work groups, and reduction of hierarchies, significantly increased average establishment productivity. The productivity effect of shop-floor employee involvement is stronger in establishments with works councils.
Hempell & Zwick (2005)	DE	Functionally flexible firms show higher rates of process and product innovation in the short and, more so, in the longer run. In comparison, numerically flexible firms only show higher rates of innovation in the short run, but no so in the longer run.

Source: Based on OECD (2001): 30-31, extended by the authors.

A study undertaken in Denmark, Finland and Sweden (Nordflex 1999) established robust evidence for the positive effect of functional flexibility on **productivity**. The Swedish part of the

study (NUTEK 1996), based on a survey of 700 private sector establishments, found a close association between the use of continuous learning and task delegation on the one hand, and levels of labour productivity on the other hand.

Similar evidence was reported from a study carried out in France and involving 7000 manufacturing companies (Greenan & Guellec 1996); and from a study of 1300 manufacturing companies in Germany (Lay et al. 1999). The latter study distinguished between the type and number of new working practices (team work, continuous improvement, kanban, just-in-time production) a company makes use of, and found that companies that made extensive use of a combination of new working practices achieved the highest returns.

Panel data from Australia (Crocket 2000) found that workplaces that have undergone workplace reforms have recorded a rise in relative labour productivity in the period 1990-95.

The positive effect of modern production methods which focus on **quality improvement** (such as TQM and kanban) on the quality of product output has been confirmed in numerous studies, including the influential early study of Womack et al. (1990) on the cause of the Japanese superiority which was evident back then in the car manufacturing sector.

A cross-country study, EPOC (Sisson 2000), focussed on team-work and other forms of group delegation exclusively. It found that the majority of managers of companies in Europe associate such forms of direct participation with reductions in **throughput times**.

There is also an increasing amount of evidence suggesting that companies which use new forms of work organisation show higher **levels of innovative activity** (Greenan & Guellec 1996; Nordflex 1999; Hujer & Radić 2003).

HRM practices which focus on **flexibility and decentralisation** have been found to impact significantly and positively on growth rates in sales turnover in the USA (study involving 968 workplaces across all sectors; see Huselid 1995); on levels of overall operational performance in service sector companies (study covering 310 companies in the USA and the UK; see Voss et al. 1997). Patterson et al. (1997) found similar patterns in a sample of manufacturing companies in the UK. Caulkin (2001) summarises the evidence collected in the UK and the USA as follows: "More than 30 studies carried out [...] since the early 1990s leave no room to doubt that there is a correlation between people management and business performance, that the relationship is positive, and that it is cumulative: the more and the more effective the practices, the better the result".

The CINet survey, carried out in six European countries and Australia and covering 1000 organisations, focused on **high-involvement innovation** practices in manufacturing companies (Boer et al. 1999). It found that about half of all firms made at least some use of high involvement practices, and there was a positive association between the maturity of the firm in terms of high-involvement behaviour, and a number of key strategic areas including improvements of productivity, quality and delivery performance, lead time and product cost reductions (cp. Bessant 2003: 26-27).

A recent review of the impacts of employee involvement programmes in the USA (Handel & Levine 2004: 39) comes to the conclusion that where employee involvement “is not used as a form of speedup, it gives workers more autonomy, recognises the value of their contributions, improves job satisfaction and feeling of voice and offers lower quit rates”. The study found no evidence of greater job security, which supports the findings from Anttila and Ylöstalo’s (2005) research in Finland.

For the UK, however, analysis of the 2001 Skills Survey came to the conclusion that high involvement working – establishments that have open dialogue with workers, involve them in decision-making and give greater emphasis to team working – is associated with greater *perceived* job security (Felstead & Gallie 2002). The study also found a strong association between high involvement working and the level of generic skills exercised by those employed (problem-solving, planning, peer communication and checking skills).

The evidence is somewhat mixed for **performance-related pay systems**. Theory suggests that these can be expected to raise productivity by better aligning financial rewards with personal or team performance, thereby increasing motivation to perform and effectively supporting decentralisation of responsibility. However, evidence for positive effects of performance-related pay on motivation and productivity is weak, at least for Europe. Bauer (2004), using the large dataset from the European Survey on Working Conditions, found evidence of a significant (but weak) association only for Portuguese workers. In the USA, Black & Lynch (2000) found that firms which incorporate more high-performance practices experience higher productivity. They also found, however, that increasing the usage of profit sharing results in lower regular pay for workers, especially technical workers and clerical/sales workers. There are other potential drawbacks in the social domain, discussed in the following section.

In recent years there has been growing interest in the **relationship between investments in ICT and re-organisation of work**. Whereas early research was not able to establish a positive correlation at firm level between ICT investments and productivity, more recent studies (e.g. Brynjolfsson & Hitt 2000) have clearly shown that such a correlation does indeed exist when using data from the 1990s to today (for an overview, see OECD 2004a). However, such positive impacts tend to only accrue if technological innovation is embedded in social and organisational innovation at the workplace. Technology, it seems, is not the cause of change, but an important enabler and facilitator, as well as (often) acting as a prompt to change traditional (often sub-optimal) ways of doing things. This means that for achieving the expected improvements in productivity and performance, ICT investments need to go hand-in-hand with organisational change:

“Organisational change, understood as the implementation of new work practices such as teamwork, flatter management structures and job rotation, tends to be associated with higher productivity growth. Interestingly, productivity gains of firms that combine new technology with organisational change are considerable, whereas there does not appear to be much economic benefit in implementing new technology alone. In other words, work needs to be re-organised to use ICT effectively” (OECD 2001: 4).

In a similar vein, a newer report from the OECD states, on the basis of the latest research findings from OECD countries, that “the impacts of ICT depend on complementary investments,

e.g. in appropriate skills, and on organisational changes, such as new strategies, new business processes and new organisational structures" (OECD 2003: 11).

This is born out, for example, by the research findings of Hempell and Zwick's (2005) who analysed large-scale panel data on businesses in Germany. They found that while ICT use was strongly correlated with functional flexibility (measured by share of employees working in teams, in job rotation, in quality circles, or in autonomous groups) and numerical flexibility (outsourcing), long-term effects on product innovations are only found for functional flexibility. The authors interpret their results as confirming "that organisational adjustments are a crucial way by which ICT contributes to innovation activities in the overall economy. In the longer run, these innovation effects persist only if the absorptive capacity is increased by team work, autonomous work groups, and decentralisation of decision power" (ibid.: 24).

But not only are ICT investments more effective if combined with organisational change. The dependence also works the other way around: There is much support for the suggestion that the productivity gains enabled by new workplace practices are higher if they are introduced together with new ICTs (OECD 2001). For example, a study in the USA (Bresnahan et al. 1999) found that industries with high incidences of new workplace practices have an average annual growth rate of labour productivity 1992-98 of 1.4% if they are characterised by low ICT intensity, while the figure is 7.8% for industries which have both a high incidence of new workplace practices and ICT intensity.

To sum up, the available evidence for the existence of positive effects from new forms of work organisation on key business parameters is powerful. The implementation of such organisational change, however, appears to pose considerable challenges to an organisation, especially if there is a strong organisational culture (Hofstede 2003, Schein 1992) which is not conducive to the intended modernisation process. As Bessant (2003: 38) notes about a strong organisational culture, "it not only takes a long time to develop but also [...], once established as the 'way we do things around here', it is extremely difficult to change". This is because such a culture is based on behavioural routines, i.e. "repeated patterns of behaviour, which [...] become 'the way we do things' and which operates on an almost automatic [i.e. subconscious] level" (ibid.).

Obviously, training can be expected to play an important role in the change process. Analysing findings from available research across the world, the OECD (2001: 5) found "some evidence that the rate of adoption of new work practices is positively associated with both the level of educational attainment and firm [= company-provided] training. This can be interpreted as a need for training workers in order to implement new work practices".

Various studies also discovered that new forms of work organisation are the more effective the more they are bundled together using a systems approach, rather than as a list of unrelated or purely integrated measures deployed in an unsystematic way (BDL 2002; Sung & Ashton 2005; Antila & Ylöstalo 2005).

Another factor which appears to be of importance is employee representation. The EPOC study (see Sisson 2000) found that "firms allowing worker representatives to be involved in the process of consultation, negotiation and/or decision-making adopt more intensively new work practices

than is the case of firms without institutions of worker participation. They are also more likely to provide training to the workers” (OECD 2001: 48), which in turn has found to be associated with the success of reorganisation measures. A study in the USA (Black and Lynch 1997) confirmed that worker representation (e.g. through works councils) is associated with a greater adoption of new work practices, and it also tends to make the adoption of new work practices more successful. Likewise, Zwick (2004) finds – using a representative German establishment data set – that the productivity effect in the period 1997–2000 of shop-floor employee involvement is stronger in establishments with works councils.

2.2.2 Second Order Outcomes (People and the Social Structure of the Organisation)

While most early studies about the impacts of new forms of work organisation had put their focus on effects on business performance indicators, since the second half of the 1990s an increasing number of researchers have started to analyse what these organisational changes mean for the workers themselves, and for the social structure of the organisations involved.

Job quality is one of the key issues in this respect. While there is an extensive literature on the subject, until now no consensus has been reached about how to measure this construct in a satisfactory and widely applicable way (Nierop 2003). Economists and policy-makers have for a long time understood job quality mainly as a question of pay. Recent years, though, have seen growing dissatisfaction with such a one-dimensional interpretation of job quality. One reason this is the empirical observation that while real incomes have risen drastically in the second half of the 20th century, self-reported subjective well being has stagnated or even fallen slightly (Frey & Stutzer 2002b).

Attempts to enrich traditional economics with the findings from diverse strands of research into job satisfaction have gained in acceptance among economists, especially so since the turn of the century (Frey & Stutzer 2002a, 2002b; Helliwell 2003; Van Praag & Ferrer-I-Carbonell 2004; Layard 2005). Some key results of these efforts – as far as they are of relevance for the subject of this report – are presented in the box below.

Happiness Research – Key findings of relevance for the study of NWEs

In early 2005, British economist Richard Layard (2005) published an overview account of the results from research into what explains happiness, taking full account of recent advances in a number of disciplines which have been looking into the subject: mainly psychology, neuroscience, sociology and economics. It came on top of a number of similar attempt to increase the credibility of research into satisfaction among economists and – by implications – policy makers (Frey & Stutzer 2002a, 2002b; Van Praag & Ferrer-I-Carbonell 2004). The following is a brief summary of some key findings which relate (in one way or another) to work organisation.

One basic proposition of these researchers is that subjective well being and happiness, as measured typically through surveys into life satisfaction, is a valid and empirically adequate measure for human well-being, i.e. for individual utility (Frey & Stutzer 2002b: 3-7).¹⁴

This can be considered a big step forward since “the concept of subjective happiness allows us to capture human well-being directly” (ibid.: 6) rather than via intermediate constructs such as job security, status, power, and money. While the latter are not ends in themselves (we want them to give us the possibility of making ourselves happier, not for

themselves), there is little disagreement that subjective happiness is a legitimate ultimate goal to which policy-making should direct much of its attention.

Against the background of this new-found confidence in the possibility of direct measurement of happiness, what can be said about the main factors determining happiness in an advanced capitalist country?¹⁵

Income

First of all, **income counts**. There is robust evidence that – at a given time and in a given country – richer people are happier than poorer, and that the causality runs from income to subjective well-being (and not the other way around).

It has also been shown, however, that the richer a person is, the lower is the increase in happiness yielded by a given income increase: the **marginal utility of income is diminishing** (Helliwell 2003). In addition, a phenomenon, which has been discovered in the early 1970s already, is that perceptions of a good or sufficient income are relative: The higher a person's income, the higher is the level of income which he or she considers to be "sufficient" or "good". This is what is called "preference drifting" or the "**hedonic treadmill effect**" (Van Praag & Ferrer-I-Carbonell 2004; Layard 2005).

What is more, it is not the absolute level of income which matters for happiness but **relative income**: individuals compare their own income with the income of others, i.e. a reference group. Easterlin (2001) has presented robust evidence that people's happiness increases from a rise in income only if this improves their relative income in comparison to others. Raising everybody's income does not increase happiness, if relative incomes stay the same. This is the basic explanation for the baffling paradox that in most European countries "since World War II real income has drastically risen but self-reported well-being of the population has not increased or has even fallen slightly" (Frey & Stutzer 2002: 2; see also Clark & Oswald 1996; Donohue & Heywood 1997).

Research into the "**relative income hypothesis**" has shown that people tend to compare their income with others who are richer than themselves – they look upwards when making comparisons, but not downwards. Establishing evidence for this phenomenon led to the finding that "wealthier people impose a negative external effect on poorer people, but not vice versa" (ibid.: 14).

The relative income hypothesis is part of the wider **aspiration level theory**: "One of the most important processes people go through is that of adjusting to past experiences. Human beings are unable and unwilling to make absolute judgements. Rather, they are constantly drawing comparisons from the past or from their expectations of the future. Thus, we notice and react to deviations from aspiration levels". The "process, or mechanism, that reduces the hedonic effects of a constant or repeated stimulus [such as purchasing a material good], is called adaptation. And it is this process of **hedonic adaptation** that makes people strive for ever higher aspirations." (ibid.: 18). According aspiration level theory, happiness is determined by the gap between aspirations and achievement.

Because people compare themselves upwards rather than downwards (see above), aspirations tend to increase rather than fall (**theory of rising aspirations**). The upward adaptation of aspirations has the effect that the utility people derive from increases in income (or other gains) is less than what they had expected beforehand. After a while, as a result from adaptation increases in happiness from gains in income tend to return to zero, i.e. the person reaches the same level in happiness than they had before.

This also help to explain what psychologists have known for a long time already (Kahneman 2003): people experience a cut in income as a bigger decrease in utility compared to the utility they gain from an increase in income by the same relative amount. This general rule also applies to non-pecuniary features of life. As Layard (2005) argues, it is the underlying reason for **loss aversion** and – by implication – **risk aversion**¹⁶.

All of the above helps to explain while in-depth research into cross-country differences in happiness has found no evidence that people in richer countries are, on average, happier than people in poorer countries (Helliwell 2003) – at least as long as the comparison does not include countries of the developing world (for which the data basis is still very weak; see Frey & Stutzer 2002).

Family, social relationships, social capital, politics

Humans are deeply social beings. Anything which endangers the quality of social relationships is very likely to diminish individuals' happiness. Helliwell's (2003) research based on World Value Survey data for 46 countries established a list of factors ranked by their relative effect on happiness. A worsening of **family relationships** (separation, divorce) turned out to have the biggest negative impact on happiness, followed by unemployment and bad health. **Personal freedom** (living in a democracy rather than an autocracy) and **personal values** (being religious rather than not) also play an important role. A household income one third below the reference level was found, in comparison, to have less of an effect than any of these.

Community and friends are of big significance, too. People feel happier if they live in a country, city or community in which they say they generally can trust others. Decrease in **trust** is related to growth in perceived crime levels in the community, among other factors. Membership in organisations such as charities, political & lobby associations, leisure organisations (arts, sports), and ethnic organisations, on the other hand, is used as an indicator for **social capital** (Putnam 2000). Cross-country comparisons (Helliwell 2003) find that both the level of perceived trust is one of the six factors which explain 80% of the variation in happiness between countries – together with the divorce rate, unemployment rate, membership in organisations, quality of government and the fraction believing in God.

As this shows, politics matter as well. The level of **political freedom**, **economic freedom** and **personal freedom** in a country are each strongly and statistically significantly correlated with average rates of happiness (Veenhoven 2000).

Finally, people want to be respected (Sennett 2003). The desire for respect means that people who enjoy high levels of **social status** are happier than those who tend to be disrespected, such as the unemployed.

Personal characteristics and health

Regardless of external experience, people differ with regard to the extent they feel happy. **Personality** – however formed – plays a significant role in explaining differences in happiness, as do the genes (Layard 2005. 55-58). Nevertheless, research has established robust evidence that only a certain share of variation in happiness can be explained by personal characteristics such as personality.

Health is correlated with some of the factors mentioned above as decreasing happiness (income, type of work, unemployment, family relationships), which means that in multivariate analysis, the detrimental effect of bad health on happiness is already accounted for to some extent by these variables. But even under *ceteris paribus* conditions, people which perceived themselves to be in bad health are significantly less happy than the rest.

Work and employment

Unemployment has repeatedly been shown to enormously reduce, for those affected, the likelihood of being happy. An influential study in the U.K. (Clark & Oswald 1994: 655) found that "joblessness depressed well-being more than any other single characteristic, including important negative ones such as divorce and separation" – with income (as well as other effects which can be expected to be correlated) being controlled for. The reasons for the unemployed being unhappy, therefore, need to be found elsewhere. Most research points towards psychological (depression, anxiety, loss of self-esteem and personal control) and

social factors (stigma of being not needed; social sanctions enforced on people who do not conform to the social norm of earning one's own income; see Stutzer & Lalive 2000).

In addition to the direct effect unemployment has on those who lost their job (or never got one), unemployment also affects the happiness of people still in work through its effect on perceived **job insecurity** (Layard 2005: 67-68). Worries about the security of one's job has been shown to cause unhappiness; as Blanchflower & Oswald (1999) have shown, people who are in jobs they perceive as insecure have – under ceteris paribus conditions – a significantly higher likelihood of being unhappy. This is confirmed by Green & Tsitsianis (2004) who analysed German SOEP data for the period 1985-98¹⁷.

New psychology as well as happiness research both strongly suggests that the **desire for security** is a central part of human nature. For this reason, frequent change in work organisation, if it reduces perceived security, can be expected to exert a negative effect on happiness. Happiness researchers (see Layard 2005) argue for change processes to be orchestrated so that they lead to new states of stability rather than a permanent status of flux.

The hedonic treadmill effect described above has the consequence that “there is a tendency to sacrifice too much leisure in order to increase income” (Layard 2005: 47). The underlying reason is that the rule of rising aspirations is much stronger for income and material possessions than for leisure time. This is partly conditioned by social norms and, for this reason, applies to different degrees in different cultures and countries.

With regard to the **job attributes** which are positively associated with job satisfaction, Clark (1998) – using data from the International Social Survey Programme – found that the job features which workers perceive to be of highest relevance for job satisfaction are (1) job security and the job being interesting; (2) job autonomy and opportunities for advancement; while (3) pay, flexible hours and “a lot of leisure time” are ranked lowest in all OECD countries. Clark contrasted this by looking into the job features which are correlated most strongly with perceived job satisfaction. Here, he finds that the largest impact on overall job satisfaction comes from having good relations at work, followed by good job content. High income and good promotion opportunities have roughly the same effect on satisfaction, while the smallest (although still significant) effect comes from perceived job security.

Findings such as these suggest that **job quality** (interesting job, job autonomy, social relations at work) plays an important role as well. These job characteristics seem to have become more important for job satisfaction in recent decades. Anttila and Ylöstalo (2005: 10), referring to the work of Ulrich Beck, state that: “it is characteristic of the present day that people want to decide themselves about their own lives [...]. Working life is no exception in this respect; nor is it an area situated outside of normal life and the associated hopes and aims – rather, it is an integral part of that. Generally, workers want to think, to solve problems; and they want to take part in a process that leads to achievement of results for which they, too, feel they are responsible”.

Indeed, Green and Tsitsianis (2004) found that **decreasing task discretion**, together with intensification of work, account for the decline in job satisfaction in the UK between 1992 and 2001.

Happiness research allows us to gauge the indirect effects of changes in work organisation, by explaining which aspects are of most importance for determining people's subjective well-being. In order to be able to gain a better understanding of how this related to real-world implementations of new forms for work organisation, it is necessary to gather more detailed data on the work environment and working conditions.

In Europe, the first systematic research of this kind was carried out in the Nordic countries by the Nordflex group in the years 1996-99 (Nordflex 1999). More recent evidence comes, for example, from a business survey undertaken on behalf of the European Commission (BDL 2002), and from survey research conducted in Finland (Antila & Ylöstalo 2005; Ylöstalo 2005).

This research has been able to establish evidence that new forms of organising knowledge-intensive work tend to impact positively on key variables of **worker well-being** and **job satisfaction**. These positive effects are mainly related to increasing possibilities for employees to exert influence and take responsibility in matters concerning their own work (cp. Antila & Ylöstalo 2002; Bessant 2003). Evidence about the contribution of perceived autonomy and influence at the workplace to job satisfaction was found in most studies looking into the issue (for recent examples, see Cohen & Bailey 1997; Staples & Cameron 2004: 88). Antila & Ylöstalo (2002: n.p.) caution, however, that such effects may dissipate in the longer run as management strives to re-exert control (cp. Gallie et al. 1998): They state that “it is unclear and open to question whether the decentralization of decision-making authority means a real decrease in managerial control, or merely a change in its form”.

Bauer (2004), using data from the European Survey on Working Conditions, found a strong and significant overall influence of flexible work systems on job satisfaction. This effect can be attributed mainly to a higher level of horizontal and vertical communication and higher autonomy in the way a worker can perform their job. Being involved in team work or job rotation, two other components often associated with flexible work systems, were not found to contribute significantly to job satisfaction.

These results support earlier evidence obtained from analysing US data, which also found that new forms of work organisation are positively associated with worker's well-being (see Appelbaum et al. 2000; Bailey et al. 2001; Freeman et al. 2000). The Nordflex study (1999) established evidence that organisations which make use of direct participation, decentralised decision-making and continuous learning report lower levels of absenteeism and lower levels of personnel turnover. The same result was found in the EPOC study (Sisson 2000).

At first sight, there seems to be a contradiction between these findings and other research which points out the “darker side” of flexible work forms. Indeed, there are a number of studies which find that flexible work organisation can have negative impacts on both companies and workers. However, such studies usually look at applications of **numerical flexibility** rather than functional flexibility (see discussion in section 0). For example, Nierup (2003) explores the effects of “flexible work arrangements” on the quality of life (using data from a large-scale German household panel) and finds that temporary work arrangements tend to decrease life satisfaction, while the shift from full-time to part-time work tends to increase quality of life.

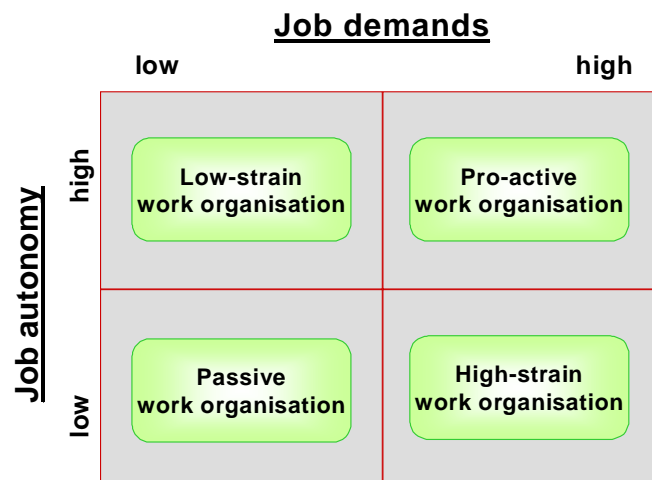
Goudswaard & de Nanteuil (2000), meanwhile, criticise attempts to draw a clear line between functional and numerical flexibility, since their research showed that both “flexibility strategies are very much combined together in all case studies [...] and] no specific type comes out as a type of ‘better value’ or ‘greater efficiency’ with regard to working conditions” (ibid.: 16). Indeed, a study by the OECD (2001: 36-37) also found evidence that firms that implement new working practices are slightly (but significantly) more likely to make use of forms of employment generally

associated with numerical flexibility (fixed-term contracts, temporary agency employees, part-time work, outsourcing). This shows that any over-simplification of relationships between new forms of work organisation and job quality needs to be avoided.

There are also potentially negative sides to decentralisation of control. It is certain that increasing responsibility and self-control at the shop floor level also tend to increase the **work pressure** as perceived by employees (Voß 1998, Gottschall & Voß 2005; Cullen et al. 2003). In particular, modern work organisation appears to be associated with high **work intensity** and **stress** (Boisard 2002, Houtman 2005), which themselves tend to increase the likelihood of **health problems** such as the widespread cumulative trauma disorders (Brenner et al. 2004; see also Askenazy 2001; Houtman 2005).

The literature (see Richter et al. 2006: 233) distinguishes between **mental workload** (“external factors impinging upon a human being”) and **mental strain** (“effects of mental workload within individuals, depending on their habitual and current preconditions”). Mental strain itself can have positive and negative consequences for the individual. It only leads to **stress** if an individual feels that their abilities are insufficient against set requirements and expectations (EUTC et al. 2004): “An event is likely to cause stress if a person perceives it as important with respect to his/her goals, while at the same time it exceeds his/her capability” (Richter et al. 2006: 234).

Figure 17: The “time constraints \circ job demands” model



Source: Adapted from Karasek/Theorell 1991; Dhondt et al. 2002

This means that the issue of workload “should not be approached from the angle ‘the less, the better’ (Antila & Ylöstalo 2002). There has to be some degree of mental strain in order for the job to produce good results and for the worker to feel motivated by it. Womack et al. (1990) use the term “creative tension” for this phenomenon. There is widespread agreement among experts that stress is particularly strong when a person’s ability to control the demands of work is threatened (Houtman 2005). In order to highlight this interrelation, Dhondt et al. (2002) suggest using a “time constraints \circ job demands” model as originally developed by Karasek & Theorell (1991).

Using the two dimension job demands (extent of time constraints) and job autonomy (extent of control over the job), four types of work organisation can be distinguished (see Figure):

- Active work organisation – workers experience high levels of demands but at the same time enjoy enough opportunities to control these demands. Using Antila and Ylöstalo's (2002) terminology, we could call this type "pro-active work organisation".
- Passive work organisation – workers experience no job demands and have no control of possibly changing features of the work situation.
- High-strain work organisation – workers experience high demands but have no way of controlling what happens. They have to passively adapt to ever-changing and possibly conflicting demands.
- Low-strain work organisation – workers experience low demands and have enough control to deal with problems.

Dhondt et al. (2002: 6) point out that the model "contains two predictions. First, psychological strain increases as time constraints increase, relative to decreasing job autonomy. Second, competency levels increase when demands are matched with the required levels of control. This means that passive work organisations might be attractive from a strain point of view, but in such work organisations, workers have no opportunities to develop their skills. Workers in high-strain work organisations are at risk of coronary heart disease, hypertension and arteriosclerosis." For empirical investigation, Dhondt et al. (2002) used data from the European Survey on Working Conditions (representative sample of EU15 working population). They found that:

- high strain work situations are correlated with stress-related problems, while there is no association between active work organisation and stress-related health problems;
- active work organisation is positively correlated with skill development opportunities;
- low-strain work organisation is also positively correlated with satisfaction with working conditions.

The study did not find, however, an association between active work organisation and satisfaction with working conditions. Hacker (2003) found that what is here called pro-active work organisation is correlated with workers' subjective well-being and their development of skills and knowledge.

Research findings from Boisard et al. (2002) and Houtman (2005), who used the ESWC and national data sources, suggest that work intensification is growing throughout Europe, and that "an increase in the pace of work can result in a deterioration of working conditions if it is not compensated by an increase in workers' autonomy" (Boisard et al. 2002: v). From a secondary study of survey data collected in Finland, France, Germany, the Netherlands and Sweden, as well as the European Survey of Working Conditions in 1991, 1996 and 2000, Dhondt et al. (2002: 39) follow that:

Overall, we can see that time pressure has risen quite considerably in the last decade and that in most of the countries job autonomy has not kept up with this development. This means that more and more workers are being confronted with high-strain working situations, which are detrimental to health. On the basis of our analysis of technological factors, we can see that a rise in the use of computers is not a cause of this.

Recent research has now started to shed more light on the relationship between increasing job demands (work intensity), job autonomy (participation in decision-making about one's work) and new forms of work organisation.

The latest study of Antila (2005) looked at the effect of "pro-active work organisation" (cp. Antila & Ylöstalo 1999) on job satisfaction, as expressed by the workers affected. One of his intentions was to explore whether a high degree of job demands can nevertheless be compatible with high job satisfaction. Indeed, Antila found that jobs which combine strong job demands (e.g. in terms of individual responsibility and work intruding leisure time) with a high level of worker control over the job (autonomy) are associated with above average rates of job satisfaction. A similar result was established in a large-scale survey on working life in Norway (Rønning 2002).

Antila (2005) stresses that "the blurring of the boundary between work and leisure is not in itself positive or negative. The practices of the workplace are crucial in determining how the employee experiences his [sic] situation. The extensive satisfaction among the employees of proactive workplaces is often due to good management; to the human treatment of the employees, interaction and more generally the experience of 'fair play' among the employees."

This confirms results from studies which made use of smaller, non-random samples from various European countries (e.g. Cullen et al. 2003).

There are, however, also more critical voices. Lehndorff & Voss-Dahn (2005) make the observation that health effects of new forms of work organisation are often negative, because the extent of control over the work is much smaller than often assumed – even in work settings which are characterised by project organisation and strong self-responsibility. The evidence gathered by Gerlmaier & Latniak (2005) about health effects of project work appears to support this view.

It appears that the degree to which workers are able to deal with mental strain and workload differs considerably between individuals and individual work settings. In this respect, Richter et al. (2006) stress the importance of **individual coping strategies**, which people use to manage the external and/or internal demands resulting from new forms of work organisation. The ability to cope depends on the **resources** available, which can be of organisational, personal and social nature. Social resources that help people cope with mental strain and workload are emotional, informational and instrumental support by co-workers, superiors, friends and family etc. In a wider sense, these resources can be subsumed under the term social capital as used by Bordieau (1986). In their study, Richter et al. (2006: 247) found that "especially in the context of mobile virtual work, where team members are at risk of feeling isolated or anonymous, social support plays a crucial role in employees' well-being".

With regard to the type of relationship between job demands (in the meaning of job enrichment) and job satisfaction, the vitamin model by Warr (1987) postulates that beyond a certain threshold, the marginal effect of increased workload turns negative; in other words, there is a **curvilinear relationship** between both: "Enriched job demands are thus believed to contain the risk of overload and therefore, stress. For example, only a certain range of decision latitude can be used in the workplace; if the decision latitude is too high it becomes difficult to keep all available alternatives in mind" (Richter et al. 2006: 234). Based on own research, Richter et al. (2006)

support this proposition, as does the research carried out by Borg & Kristensen (1999) on travelling salespeople.

Evidence is available for other elements of high-performance work organisation, as well. Results appear to be somewhat mixed for **performance-related pay systems**. Research into factors determining life satisfaction and happiness suggests that performance-related pay systems, especially if directed at the individual, increase levels of perceived stress and negatively affect subjective well-being (see Layard 2005: 156-160). Indeed, evidence for a positive effect of performance-related pay on job satisfaction, motivation or productivity is weak at best. Bauer (2004), using the large dataset from the European Survey on Working Conditions, found evidence of a significant (but weak) association only for Portuguese workers.

2.2.3 Third Order Outcomes: The Societal Level

Social level outcomes are defined in an economic sense as externalities, i.e. costs or benefits which are not internalised in prices of inputs and outputs of companies (at least in the short to middle term). At the level of society, we can distinguish between the following broad spheres which are likely to be affected by the implementation of NWEs:

- the labour market and employment structures (available jobs and their allocation across sectors and occupations; quality of jobs as measured by levels of skill required and pay);
- the systems of skills acquisition including the formal and informal education systems;
- economic growth (wealth generation);
- public welfare and social cohesion (quality of life at societal level).

The overall effects of new forms of work organisation on **levels of employment** in a nation state or region are very hard to single out from the more general trends in economic restructuring and changes to labour markets. Evidence from studies undertaken in Finland and Denmark (Nordflex 1999) suggests that private sector companies which practise new forms of work organisation have increased employment in the 1990s. There is, however, only very limited evidence about the effects of work modernisation on overall levels of employment in a regional or national labour market.

A labour-market related issue which has attracted much attention in recent years is the question whether new forms of work organisation are associated with lower **job tenures** and a lessening of job security. As we have seen in the previous section, job security is considered by workers as one of the main determinants of overall job quality (Clark 1998). Anecdotal evidence and studies focussing on selected sectors (e.g. the most dynamic ICT sectors) and regions (e.g. Silicon Valley) have indeed suggested that job tenures are decreasing dramatically, and that this is one of the main reasons for the strong growth in these sectors and regions, respectively (Saxenian 1996; Bresnahan et al. 2001; Benner 2002).

In spite of such observations, most aggregate data suggest that changes are not as significant as many observers assume (ILO 2001). Overall levels of job tenure are stagnant in most EU countries. Nevertheless, workers' perception of job insecurity – when controlled for the effect of the business cycle – has been increasing continuously. The OECD (2001: 22) suggests as an interpretation "that job insecurity may be related with firm reorganisation and changes in job

requirements – rather than lower employment tenure, for which there is no general evidence.” In addition, the OECD (2001: 22) found that the overall stability in employee tenure figures hide important underlying changes.

First, it appears that tenure for skilled workers has tended to increase, while tenure for unskilled workers has tended to decrease. In many OECD countries, the tenure for unskilled occupations such as “elementary occupations” and “plan and machine operators and assemblers” has been reduced whereas tenure for skilled occupations such as “professionals” and “Technicians and associate professionals” has increased in almost all countries for which data are available. Even in countries where the tenure for low-skilled workers increased, it has done so much less than in the case of skilled occupations.

This makes much sense given that the advantages of low tenures (higher adaptiveness of labour supply to labour demand) can be undone by disadvantages caused by lower long-term commitment between worker and employer – a factor which is likely to play a much bigger role for high-qualified knowledge workers than for unskilled labour.

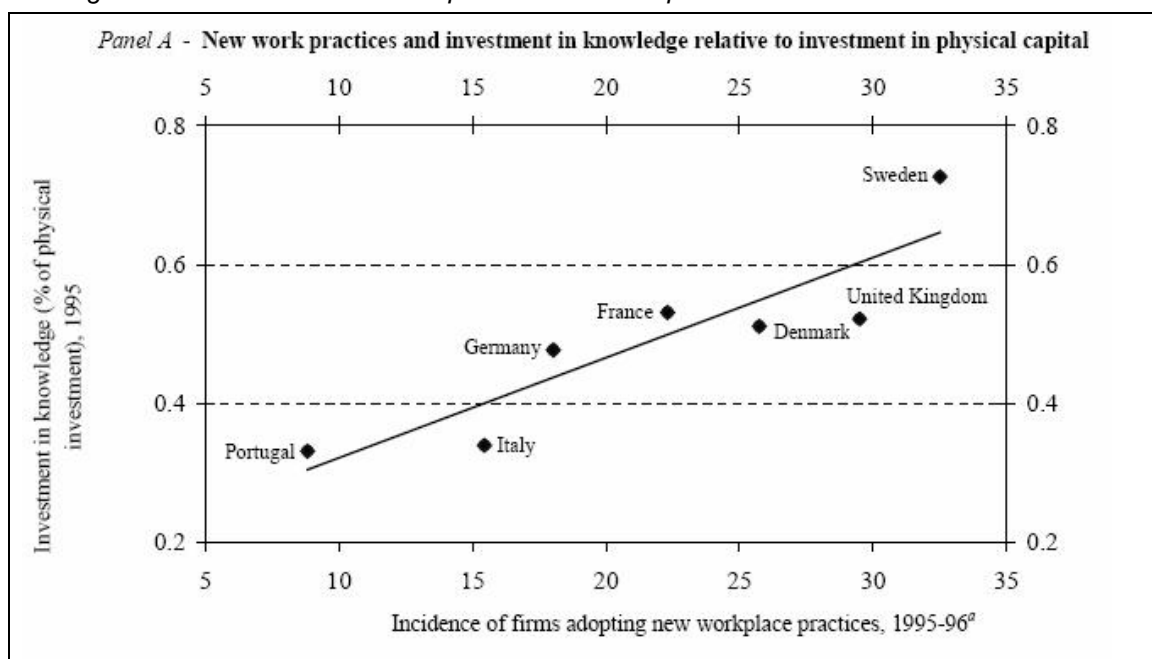
At the aggregate level, though, low tenures for unskilled workers is problematic because “While job turnover of skilled workers may be an enriching experience, this is usually not the case when unskilled workers change jobs – these workers tend to lose skills (since their human capital is often firm- or industry-specific), thereby depressing their actual productivity. Also, there is ample evidence that employees with short-term contracts and other non-standard forms of employment are less likely to receive training than their permanent-contract counterparts” (OECD 2001: 36).

A study by the OECD (2001: 36-37) found evidence that firms that implement new working practices are slightly (but significantly) more likely to make use of forms of employment generally associated with numerical flexibility (fixed-term contracts, temporary agency employees, part-time work, outsourcing) and, by implication, low job tenures.

Another key topic in the discussion about the national-level effects of new forms of work organisation are the impacts with regard to **skills requirements**. There are clear signs in all EU countries that the health of national labour markets is more than ever tightly interrelated to the adequacy of existing systems of education, as well as their regulation. It is very obvious that new, more flexible ways of working pose high demands on the workers themselves, not the least because in addition to increasing levels of formalised skills, flexible working requires a set of social skills which are not necessarily much wide-spread in today's labour force (cp. OECD 2001: 14). Only workers who are well equipped with such social skills will be able to successfully take more responsibility and deal with greater autonomy which is being promoted at every level of the company: “The success of technological and organisational innovation depends to a large extent on the ability of individuals to absorb change. It goes without saying that education and a well-functioning training system are of paramount importance in this respect” (OECD 2001: 42). Indeed, firms that implement new work practices are more likely to provide training to their staff, and countries with high investments in knowledge have a higher share of firms adopting new working practices (OECD 2001: 42-43, see also Figure 3).

As one consequence of these observations, the OECD (2001: 13) states that “the issue arises whether the diffusion of new technologies and changes in work practices will somehow impact on the relative demand for skilled versus unskilled labour. This is a major policy concern, not only because it raises issues of income inequality but also because certain skills may be regarded as complementary to new technology and work organisation changes – thereby raising efficiency concerns”. The evidence collected by the OECD itself indeed suggests that demand for highly-qualified “knowledge workers” has increased significantly across all OECD countries over the last two decades or so. This trend has, however, often been accompanied by strong demand for unskilled and manual labour as well, especially in the catering and health sectors.

Figure 18: Association between spread of new work practices and investment in education



Source: OECD 2001: 43.

The OECD study (2001: 27-35) also found that diffusion of new work practices in a national economy appears to be correlated with overall rates of **labour productivity**. In addition, the study identified an association with ICT expenditure.

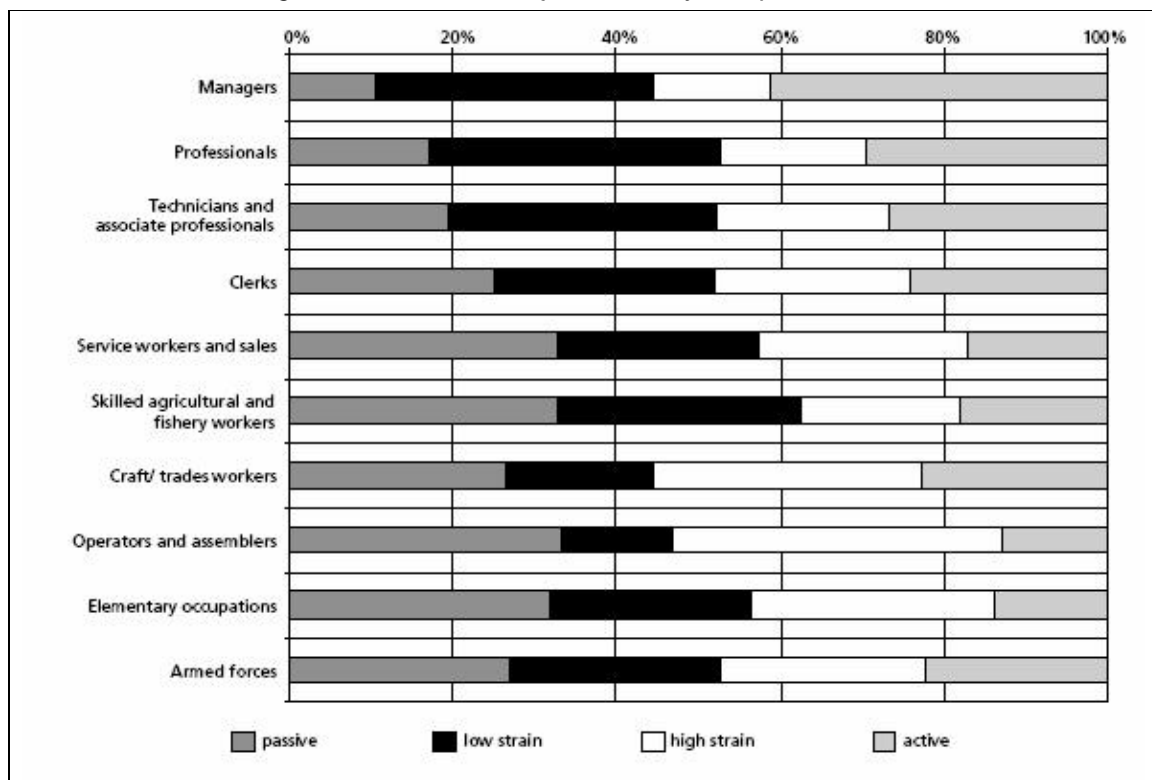
With regard to the likelihood of working in a high demand / high autonomy type work organisation, Dhondt et al. (2002) found, using the data from the European Survey on Working Conditions, that job position is a good predictor of categorisation in the time constraints/job demands model depicted in Figure 17. Highly skilled workers in higher positions (e.g. managers, professionals, technicians and associate professionals) have a better control on job demands than other workers (see Figure 19).

Antila (2005) comes to similar conclusions for Finland. Antila & Ylöstalo (2002) follow from their research that “it can be said that pro-activeness is not actually any help in the employment of long-term unemployed persons and other corresponding problem segments (those who have lost

their best market value)", one reason being that pro-active organisations tend to put high demands on job applicants (they pick only the "top of the crop"), and they also tend to shed workers faster in times of economic problems.

As has been discussed in the previous section, new forms of work organisation are often characterised by high work demands coupled with high job autonomy. While this combination appears to be perceived as positive by the majority of current workers in pro-active workplaces (Antila & Ylöstalo 2002, 2005), there are reasons to believe that not all workers are able to adequately cope with such a setting. Recent advances in stress research, such as the effort-reward imbalance model (Siegrist et al. 2004), have emphasised the importance of personal characteristics for the effects that high-demand working conditions may have. Self-confidence and intrinsic commitment to work seem to play a major in this respect. There is the risk, therefore, that people whose personal attributes are inappropriate for new forms of work organisation, are negatively affected by being exposed to them, or even lose access to high quality jobs altogether. This would imply increasing **social disparities**.

Figure 19: Job demand / job control by occupational level



Source: Dhondt et al. 2002: 15

In fact, most statistics appear to suggest that – in a parallel development to increasing numbers of people employed in “high-performance work organisation” settings (as outlined in section 0) – the share of workers employed in work settings which are more appropriately described as neo-Taylorist has been growing in recent years rather than decreasing (cp. Flecker 2005; Lehdorff & Voss-Dahm 2005).

Nordhaus-Janz & Pekruhl (2000) found that the number of workers in what they define as "Taylorist work organisation" has slightly increased in Germany in the period 1993-1998 (see figure Brödner & Latniak p. 14). Wengel et al. (2002) also analysed German data from large-scale employee surveys and found that what might be termed post-Taylorist work organisation is strongly and positively correlated with job position and household income. In Sweden, the national Work Environment Survey found that the opportunities of influencing one's own work have decreased for all socio-economic groups and all skill levels (!) (quoted in EuroFound 2005: 18). Houtman (2005:28) reports that "in many [EU] countries, there has been a combination of increasing and (by the end of the 1990s) stabilising job demands, together with decreasing job autonomy".

Likewise, Gallie et al.'s (2002) analysis of UK skills surveys found that in the U.K. during the 1990s, There was a decline in task discretion or immediate control at the level of the job, but a small rise in both direct participation and consultative involvement. Erosion of task discretion was most pronounced for professionals and for employees in construction, public administration and the health services. "The discretion of employees using relatively routine forms of computerised equipment was sharply curtailed, possibly reflecting an increased use of such equipment for monitoring and controlling employee performance." The study authors express concern about "the decline of task discretion [...] given the accumulating evidence of its importance both for employee motivation and well-being. It has been shown that rising skills impose higher work demands on employees. Their willingness to assume, and their ability to manage, such increased demands may well have been reduced by low (and falling) levels of task discretion." There can be no doubt that ICTs have dramatically increased the opportunities for neo-Taylorist work organisation (Bosch 2000; cp. Felstead & Gallie 2002), one popular example being call centre work (Bain et al. 2002).

With regard to **performance-related pay systems**, a paper by the OECD (2001: 35) points out that "increased recourse to performance-pay systems is likely to widen wage inequality between workers. At a macroeconomic level, wider wage inequalities can affect income distribution, thus possibly reducing social support for growth-enhancing policies".

2.3 Virtual Collaboration

2.3.1 First Order Outcomes (Processes, Productivity and Performance)

Companies do not implement virtual collaboration as an end in itself. Rather, ICT-enabled forms of collaboration are utilised to make possible what has not been possible (in the same way) before: To access and fully integrate remote labour markets, to get real-time access to new markets and to exploit previously unattainable opportunities for cost saving. The extent to which these goals are being reached depends, of course, on the context of the application and the business models on which these are based.

The costs involved in working in a mobile rather than fixed setting can be significant, as shown by Perry and Brodie (2006: 102-104) who call such costs "mobilisation work":

Mobile work, as with other forms of work, requires resources (most visibly, information, technologies and social networks) to be brought to bear on the tasks being undertaking. Work that involves the co-ordination and meshing of task activities (above and beyond the work itself) is known as 'articulation work' (Strauss 1985). Articulation work allows people to manage contingencies that arise out of the performance of work, and is contrasted against predefined work processes. [...] How can this research on articulation work be of relevance to mobile work? Well, there is a considerable co-ordination overhead to being mobile: mobile workers are often impoverished in terms of their social, informational and technological resources. They need to do additional work [to] be able to do work when they are mobile. This is a form of articulation work, but is sufficiently unique to warrant a unique term for itself, one that we will call 'mobilisation work', from the work required to mobilise resources that are not in themselves necessarily suitable for use outside of a resource-rich, static and unique work location. [...] There is an interesting point here in the choices that people make about going mobile: being mobile may be a less efficient way of fulfilling the work tasks than working at a fixed workplace. The required degree of mobilisation work may make their work so inefficient that the costs of being mobile exceed its benefits. [...] [This] explains why many workers have a workplace. Rather than thinking of the static workplace as the norm for a working environment, perhaps we need to think about it as being a necessary workaround for the failures of the mobile work environment.

Rather than going in any detail into examples of such cost savings, human capital and market related advantages – we will in the following focus on the fundamental differences between virtual collaboration and more traditional types of collaboration.

The basic reason for differences between collaboration in co-located settings compared to virtual collaboration at a distance lies, of course, in the communication channels which are deployed for the purpose: Collaboration in face-to-face modes requires that the persons who want to work together are located at the same place and at the same time. This luxury is not afforded to virtual collaboration, which therefore needs to make use of technical mediation – through ICTs.

Early empirical research based on **social presence theory** (Short et al. 1976) and **media richness theory** (Daft & Lengel 1986) has demonstrated that communication channels differ with regard to their suitability for different types of communication tasks. The two physical dimensions of most relevance in this respect are **bandwidth** (the extent to which information can be transmitted from/to all human senses) and **synchrony** (the time gap between sending and receiving a transmitted piece of information).

With regard to collaboration in teams, there is a fairly broad consensus that, as Fiore et al. (2003) point out, technology-mediated interaction increases the **level of abstraction** forced upon teams ("team opacity"). "Essentially, team opacity describes the experience of increased ambiguity and artificiality [...] associated with interaction in distributed environments. This decreases awareness of team members' actions, resulting from the distributed organizational structure, creates an environment lacking in rich visual, auditory, and social array of cues normally experience in co-located team member interaction" (Cuevas et al. 2004: 3). The effect of team opacity has been found to be most likely to be negative in situations of "high task complexity, high workload, time pressure, and environmental uncertainty" (ibid: 6).

The factors determining group or team performance have been conceptualised by Steiner's (1972) **theory of group productivity**, which specifies three critical components: the resources available to the group, the task demands, and the combination processes bringing both together. A concept which is of central importance for the discussion of NWE is what Steiner calls **process loss**: Moving from the individual level to the group level, performance tends to be affected by friction losses arising from problems in coordinating team members and from decreased social motivation. The effectiveness of virtual collaboration is determined to a large extent by the impact of ICT-mediated communication on the type and strength of such friction losses.

From the potential advantages of virtual collaboration discussed in section 0, it follows that the likelihood of an organisation making use of virtual teams increases with the degree of specialisation of the work activities involved (see also Bell & Kozlowski 2002). For types of collaboration which require less intensive interdependence arrangements (Van de Ven et al. 1976), the likelihood of utilisation of collaboration at a distance increases with the cost advantages expected, or with the extent to which advantages are expected in relation to access to markets.

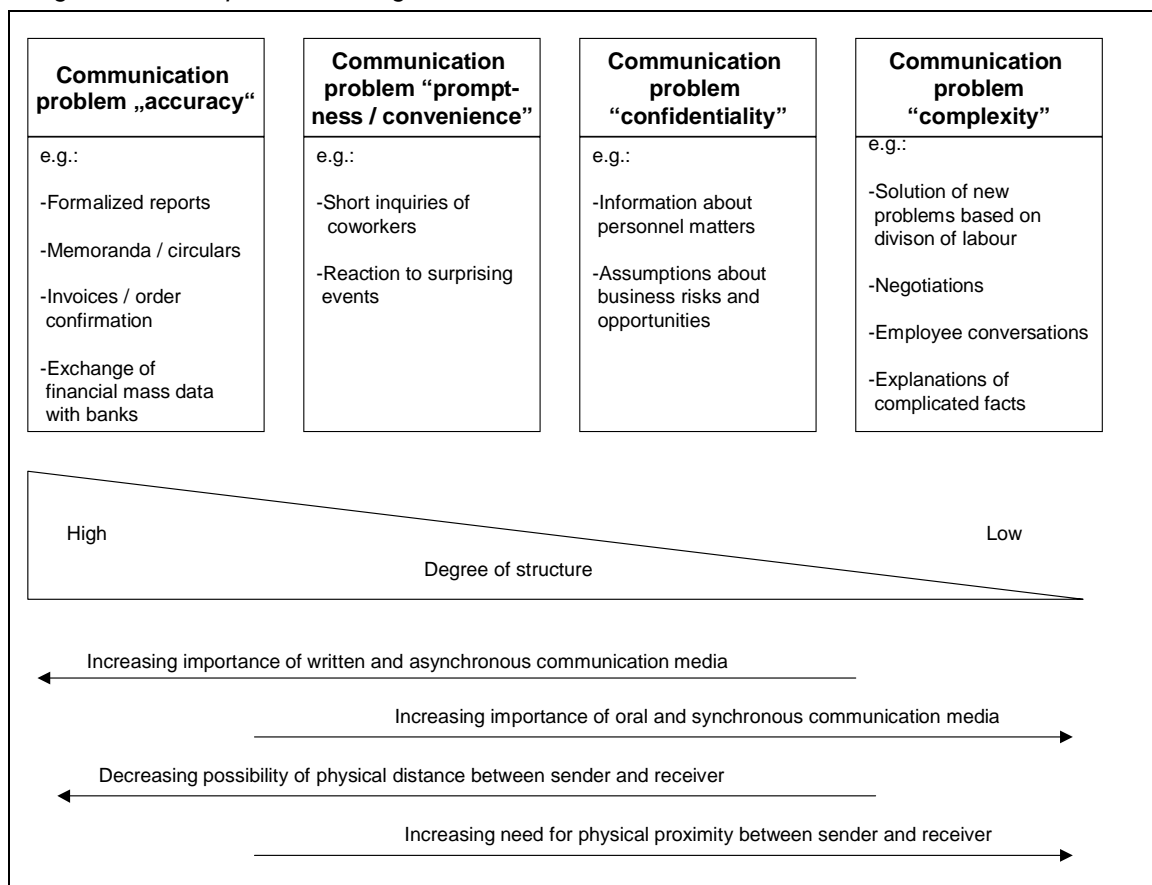
The problem with much of the existing research in the area is, as Leonardi et al. (2004: 159) point out, that it "largely positioned distance as an evil that must be overcome by the choice of rich media that restore social presence. Seldom is the distance inherent in virtual work seen as something positive". Indeed, as has been shown repeatedly, asynchronous communication tends to be very effective for less complex tasks that are essentially independent, such as idea generation (Bell & Kozlowski 2002: 24)¹⁸. It offers a number of advantages over synchronous communication in terms of accuracy, one-to-many information, and options for documentation. While low media richness may hinder the development of trust in virtual collaboration teams (as critical paralinguistic cues are filtered out), it may also offer advantages because "lack of visual cues may lead team members to focus more on task-relevant member attributes (e.g., skills, abilities) and to rely less on task-irrelevant attributes (e.g., gender, race) that promote stereotypes" (Cuevas et al. 2004: 5; see McKenna & Green 2002).

In fact, Leonardi et al. (2004: 161) found that "participants in [their] study actively engaged in the distance they experienced as distance workers and manipulated it through the use of communication technologies and through their own work practices". Any statement that equates rich media communication and proximity with "effective collaboration" and the use of ICT-mediated communication and distance with "impoverished collaboration" is therefore clearly misleading.

What appears to be true, however, is that synchronous communication is superior for complex tasks that require much sharing of non-codified information, idea generation and collaborative decision-making¹⁹. Social presence, which is the degree to which individuals perceive a medium to represent the physical presence of another communicator (Short et al. 1976), is impoverished in communication through (early) ICT channels. This means that certain types of collaboration, for example in distributed action teams (Sundstrom et al. 1990) or distributed decision-making teams (Kozlowski et al. 1999) are likely to pose more challenges with regard to the need for investment in team building and supporting structures and tools (Bell & Kozlowski 2002).

These aspects are shown in Figure 20. Depending on the time of communication problem, preferences with regard to written vs. oral communication, synchronous vs. asynchronous communication and the possibility of or need for physical distance between sender and receiver differ. So, while first generation computer-mediated communication (e.g. through e-mail) has, for example, been found to "lead to more uninhibited individual behaviour, such as strong and inflammatory expressions" (ibid.: 26)²⁰, it may very well be better suited for the distribution of written, formalised reports. In general, researchers should pay attention to possible disturbances caused by excessive information and the issues raised by inadequate information (Watt et al. 2002).

Figure 20: Basic problems of organisational communication and choice of communication media



Source: Picot et al. (2003)

Against this background, what can existing research tell us about the general impacts of virtual mediation on the effectiveness of collaboration?

A study by Balthazard et al. (2002) which directly compared 69 virtual and 78 face-to-face teams showed that "virtual teams typically do not perform as well as F2F teams and have much less propensity for achieving a better solution than either the average individual or the team's best member. Perhaps more important, virtual teams displayed significantly less team synergy, solution acceptance, cohesion, and group commitment. Members of virtual teams perceived their

interactions to be less effective than members of F2F teams. A lack of solution acceptance, poor cohesion, and weak group commitment are compelling predictors of longer-term performance difficulties of virtual teams" (Potter & Balthazard 2004: 41).

A negative effect of ICT-based communication modes on project effectiveness was also found in other empirical research (Boutellier et al. 1998; Lewis 1998; McDonough & Kahn 1996). A survey of the top 500 manufacturing, financial, retail and technology companies in the UK (Edwards & Wilson 2004) found that less than half of all organisations that used virtual teams considered their experience with these "good" or "excellent", while more than one in four had made "poor" or "acceptable" experience – a much higher figure than for co-located teams.

There are, however, also a number of studies which suggest that there is no clear relationship between communication channel (face-to-face versus ICT-mediated) and project success (Cerulo 1997; Van Engelen et al. 2001; Yoo & Kanawattanachai 2001).

As an explanation for these seemingly contradictory findings it can be argued that care needs to be taken when analysing different cases of virtual collaboration, as the communication and interaction requirements are likely to differ significantly between different types of projects, different stages in the team life-cycle, different team compositions, etc. It follows from this that, for the analysis of impacts of NWEs on performance, it is vital to distinguish not only between different sectors and fields of activity (e.g. high knowledge intensive versus less knowledge intensive), but also between the different stages of the team development process and/or of the project duration. For obvious reason, any discussion of the outcomes of NWEs based on virtual collaboration also needs to take into account what has been termed the "**degree of virtualness**" (Staples & Cameron 2004).

Keeping this in mind, a useful approach for the analysis of team dynamics is the **Team Evolution and Maturation Model** developed by Morgan et al. (1986). Cuevas et al. (2004) distinguish between pre-process, in-process and post-process interaction, and stress that all these stages must be properly supported to avoid the negative effects of lack of face-to-face interaction in NWEs. With regard to the initial phase of a collaboration process, e.g. a project, there is growing evidence that face-to-face interaction prior to teamwork (e.g. an initial meeting in a "real" place) leads to increased team performance in comparison to projects where such meetings have not taken place (Rocco 1998; Zheng et al. 2001). To a somewhat lesser extent, a positive effect has also been confirmed for initial (re-task) interaction taking place via video-conferencing (Bos et al. 2002).

Empirical research by Johnson (2004) suggests that **low equivocality projects** can utilise ICT-based communication modes extensively without adverse effects on team effectiveness. The necessary condition for this is that well-defined centralised goals associated with the project have been established. In the case that goal changes occur or conflicts arise among team members, such hard modes may not be sufficient anymore. This appears to be, in particular, because reliance on ICT-based communication makes it easier to reduce the overall amount of communication in times of conflict – which perversely often happens, with severe implications for project effectiveness (ibid.). However, tools are currently being developed for supporting conflict

resolution and difficult decision-making exclusively via hard modes (ICT based interaction) (e.g., see Van Engelen et al. 2001, Schmidt et al. 2001).

With regard to the organisational context in larger organisations, it can help to use the **classification of organisational types** developed by Creed & Miles (1996), which distinguishes between functional, divisional, matrix and network organisational structures. The last two of these types relate closely to the concept of flexible work organisation discussed in the previous chapter of this report. Organisational types which are characterised by strong hierarchies and/or strong competition between firm divisions clearly pose bigger challenges for the establishment of cross-boundary virtual teams.

Performance in virtual collaboration environments has been shown to benefit from what is called "**workspace awareness**", i.e. the ability of team members to monitor and track individual members' actions and interaction within the team (Gutwin & Greenberg 2004). The same applies for "telepresence", i.e. "the degree to which contextual factors typically present in co-located groups, such as voice, gesture, and body language, are found with distributed groups (Cuevas et al. 2004: 3), and "teledata", i.e. the "team and task artefacts, such as shared workspaces, that require effective collaboration" (ibid.)(see Anderson et al. 2000, Draper et al. 1998).

It is obvious that virtual collaboration poses a number of serious challenges for **leadership**. Based on an analysis of available literature, Bell and Kozlowski (2004) distinguish between two basic categories of functions for team leaders:

- the development and shaping of team processes;
- the monitoring and management of ongoing team performance.

In addition, **team member selection, composition, and task design** have to be accomplished, either by the team leader or outside the discretion of the team leader. For obvious reasons, virtual teams and virtual collaboration have an important role to play for each all of these functions. Connaughton & Daly (2004) distinguish four main ways in which virtual team leadership differs from the situation in co-located teams:

- social presence may be more difficult to achieve for team leaders;
- trust may be more difficult to achieve and maintain;
- ensuring members' identification with the team is a key challenge for virtual collaboration;
- communication may suffer from the different cultural and organisational backgrounds of team members.

Leadership has been found to play a key role for the success of virtual collaboration also in the research by Fjermestad & Hiltz (1999) and Kayworth & Leidner (1998). The latter found that leaders who were rated as effective by their team members were considered to have a number of core features including understanding, empathy and concern for individual team members. From their research they concluded that virtual collaboration poses challenges because it offers team leaders more less opportunity to project these qualities to team members (see also Connaughton & Daly 2004).

Team building and development need to make use of routines, processes and tools which are suitable for the purpose. **Direct control** of team members is still possible in virtual collaboration environments (and is becoming more so due to technical solutions being developed for that purpose), but tends to involve high costs. Direct control of remote workers can also cause significant damage to worker morale, trust and motivation, which – as will be shown below – form the very base on which the effectiveness of virtual collaboration is resting.

A common theme in the management literature on virtual teams, therefore, is the need to transform team management into team facilitation. If successful, facilitation means team members internalising norms, values and roles which are the base for high team effectiveness. It means coupling self-management with clear direction and routines, which need to be established. As Bell & Kozlowski (2002: 36) point out, “leaders of temporally distributed work groups [need] to devote additional resources to explicitly structuring performance management activities”. In addition, many researchers found that occasional face-to-face meeting, especially at times of key milestones in the project lifecycle, has a strong positive effect on outcome parameters of virtual collaboration (Cohen & Prusak 2001, Connaughton & Daly 2004, Geber 1995, Lipnack & Stamps 1997).

The research of Potter and Balthazard (2004) has demonstrated that the **personalities of team members** play a key role in influencing the effectiveness and efficiency of NWEs. This is hardly a surprise since traditional team research has repeatedly shown that a team’s interaction style has a great influence on its performance²¹, and “individual personality and its effects on others in one’s group do not go away just because the group or team is doing its collaborative work online rather than F2F” (ibid.: 43). The type and scale of such impacts varies, however, between virtual and co-located teams. Potter and Balthazard’s “research showed that expertise is not likely to drive team performance to its potential when the team is afflicted by negative interaction style. Negative interaction styles are more common when the team is virtual rather than F2F, and negative interaction styles can easily result in teams with a composition of personalities that is not harmonious” (ibid.: 37).

Group interaction is usually found to take one of three general styles: constructive, passive, or aggressive. Cooke and Szumal (1994) established evidence that “predominantly constructive groups produce solutions that are superior in quality to those produced by passive groups and superior in acceptance to those produced by either passive or aggressive groups” (Potter & Balthazard 2004: 38). These correlations were found in virtual collaboration environments as well (Potter et al. 2000). Interestingly, though, newer research by the same group (Balthazard et al. 2002) established evidence that in comparison to face-to-face teams, virtual teams have fewer tendencies to develop constructive or aggressive styles and are more likely to develop passive interaction styles. This is because computer mediated communication tends to reduce the salience of social presence of the team and its members.

When controlling for interaction style, the researchers found that mode of communication (i.e. virtual instead of face-to-face) has no significant effect on outcomes anymore. This means that “mode may contribute to outcomes only through its effect on interaction style” (Potter & Balthazard 2004: 42). For the practical development of NWEs this would suggest that most effort

has to be spent on supporting interaction styles which are related to above-average performance – which research suggests is more difficult in virtual settings than in face-to-face settings:

Reducing passivity and encouraging communication and participation are behaviors strongly associated with the constructive interaction style, the style associated with high-performance teams. Unfortunately, teams working via the CMC [= computer mediated communication] mode are significantly less likely to display this style. Why? These behaviors have physical components such as eye contact, vocal inflection, posture, and gesturing that are used to induce participation, diminish negative domination, and otherwise regulate and encourage healthy group participation and processes. These cannot easily be used to fight passivity or aggression in a mode that does not permit to be seen. (ibid.: 44)

The researchers stress that these findings are not supposed to dismiss the possibility of effective virtual collaboration, but that they point out the need for pre-emptive action. Rather than composing virtual teams just according to the best possible combination of complimentary skills/expertise needed for carrying out the project, it is necessary to consider personalities as well. There are tools available which allow for the ex-ante analysis of interaction styles in teams, based on the properties of the persons to make up the team. Potter & Balthazard (2004) make a strong case for using such tools to obtain better informed combinations of skills/expertise and personalities in project teams.

An attempt to summarise the existing evidence about virtual team effectiveness was carried out by Staples & Cameron (2004). They list a number of key determinants which have been found to exert a big influence on success (or lack thereof) of virtual collaboration. These are:

- task design;
- group characteristics;
 - group composition (team size, team member turnover, geographical distance);
 - group beliefs, group potency, group efficacy (collective belief in the capability of the group to meet a task objective);
 - group process (coordinating and carries (team spirit), sharing expertise, implementing innovations were all found to be associated with team effectiveness);
- supportiveness of organisational context (availability of resources including training, access to needed information, technical infrastructure, benefit systems that reward performance and are considered fair);
- encouraging supervisory behaviours (self-observation, evaluation, goal-setting, criticism, expectation).

An observation which can be found in most empirical studies is that the social relationship between collaborators is of utmost importance for the success of virtual collaboration. This is because of the key role which trust, understanding, motivation and shared common goals play in work settings in which the possibilities for direct control of behaviour are extremely limited (Ashleigh & Nandhakumar 2002). The conditions under which trust exists or can be created are at the core of research into social capital, which is therefore of big relevance for discussion of NWEs (see box below).

Social Capital and its relevance for NWEs

Of key importance for the discussion of outcomes of virtual types of interaction is the concept of **social capital**, usually understood as “the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit. Social capital thus comprises both the network and the assets that may be mobilized through that network” (Nahapiet & Ghoshal 1998: 243). “Social capital refers to network ties of goodwill, mutual support, shared language, shared norms, social trust, and a sense of mutual obligation that people can derive value from. It is understood as the glue that holds together social aggregates such as networks of personal relationships, communities, regions, or even whole nations” (Huysman & Wulf 2004: 1).

In an influential paper from 1998, Nahapiet and Ghoshal pointed out three distinct dimensions of social capital:

• a structural dimension (network ties, network configurations and organisation);

• a cognitive dimension (shared codes and language, shared narratives);

• a relational dimension (trust, norms, obligations, identification).

Adler & Kwon (2002) suggest a three-dimensional structure which bears much resemblance to the above and distinguishes between opportunity, ability and motivation.

Trust is a key component of any definition of social capital. Unfortunately, as Nandhakumar (1999: 47) points out, “the notion of trust is often seen by researchers as the most difficult concept to handle in empirical research because of the diverse definitions of trust used in each discipline and the multitude of functions it performs in the society”.

Interpersonal trust has been found to have a strong positive influence on group performance (Mayer et al. 1995; Kramer & Tyler 1996) and the ability of groups of co-workers to learn (Edmunson 1996; 1999).

A number of researchers found empirical evidence for negative impacts of virtual collaboration (when substituting for the co-located variety) on perceived levels of trust, see Bos et al. (2002), Nandhakumar (1999), Järvenpää et al. (1998), Järvenpää & Leidner (1999).

Because trust can be seen as one of the main building blocks for virtual teams and, in particular, virtual organisations, the temporariness of such groups of collaborators means that the usual process of trust-building through getting to know each other by working together would simply last too long to ensure effectiveness. Procedures to build “**swift trust**” (Meyerson et al. 1996) must be put in place. Järvenpää et al. (1998) found that virtual team members acted as if trust between them existed already from the beginning of team formation. This type of trust is based on members' prior experiences and related expectations, and supported by a situation of highly interdependent task orientation of the team. However, the same group of researchers (Järvenpää & Leidner 1999) later found out that swift trust in virtual teams can dissipate quickly if experience with first communication behaviour among team members is negative. Teams that maintain high levels of trust have the following characteristics: string initial communication, which is highly social; high levels of ongoing communication on task and social information; proactive orientation; positive tone; task goal clarity; role division and specificity; time management; substantial feedback on work; frequent communication with short response times. A study by Ashleigh & Nandhakumar (2002) comes to similar conclusions.

It is important to note that the majority of studies into the effect of ICTs and new ways of working on social capital start from the basic assumption that social capital has mainly

positive effects on the sharing of knowledge and expertise, on community building and the development of creativity.

Newer research, though, has stressed that social capital can have negative as well as positive effects with regard to, in particular, the **ability to innovate** (Florida 2002) and to respond to complex, changing environmental conditions (Prusak & Cohen 2001). In recent years, a number of researchers have emphasised the possibility for “**dysfunctional behaviour** within tight-knit social networks” (Huysman & Wulf 2004: 6; see Uzzi 1997) and the superiority of weak ties over close ties for regional innovation (Florida 2002: 267-282, see also Portes 1998). Huysman & Wulf (2004: 7) list the following potential problems in relation to networks which are characterised by well-developed social capital: “restrictions imposed on actors who do not belong to the network; a lack of perception concerning environmental changes outside the network; negative social dynamics within the network and a downward levelling of norms; a dependency on central actors and their loyalty toward the network; restrictions on autonomy and individuality resulting from demands for conformity; irrational economic behaviour due to a feeling of solidarity toward partners in the network; irrational economic behaviour due to personal aversion”.

Any attempt to compare or benchmark systems of work organisation with regard to their effect on social capital accumulation should be careful to take account of the possibility of both positive and negative impacts of networks characterised by “close ties” (Bresnen et al. 2004).

Social capital is a most important intermediary construct for assessing the impacts of NWEs on key parameters of success and well-being at the organisational, individual, and societal level. Different settings of NWEs can be expected to have different effects on the accumulation of social capital in a work setting, and the level of social capital will affect the ability of an organisation to successfully operate in the marketplace (and/or carry out its non-market related functions) as well as the personal life satisfaction (happiness) of the individual worker.

Bresnen et al. (2002) point out the contingencies that are likely to make social capital enable or inhibit learning and innovation in organisational settings. Small, newly established firms in industries which are characterised by high importance of tacit knowledge (e.g. high technology) are likely to rely heavily on social capital for the development of innovative products and processes (Powell 1998) and their distribution. The situation appears to be different in larger, well established organisations in mature industries for which the inward-looking aspect of social capital can result in a potentially dangerous insulating effect and over-dependence on established -connections (Bresnen & Marshall 2002).

Järvenpää et al. (1998) found that in addition to individual team members' perception about fellow team members (with regard to perceived ability, benevolence and integrity), the **personal propensity to trust** plays a key role. “The propensity to trust is viewed as a composite personal trait formed by experiences, personality type, culture, education, and socioeconomic factors” (Bradley & Vozikis 2004: 103). The authors follow that “selection of team members who have a high “propensity to trust” may improve the overall team trust environment” (ibid). Galvin et al. (2002) found that team members with prior experience in virtual collaboration are likely to positively influence high trust levels.

Communication training and initial organisational guidance has been found to have a significant effect on trust levels in virtual teams and, by implication, on team effectiveness, as empirical research by Warkentin & Beranek (1999) and Bradley et al. (2002) has shown. Empirical research by Galvin et al. (2002) established evidence that a system of “structural assurances” can support trust building by making opportunistic behaviour by new team members more difficult.

Collaboration in **cross-cultural teams**, for example groups which include members from vastly different national and cultural background, faces specific challenges (Hofstede & Hofstede 2005), which can be traced back to the difficulty to create social capital in very heterogeneous settings. As many companies have experienced, these challenges can be so big as to make effective collaboration all but impossible (Solomon 1995).

With regard to **motivation**, two theories have proved to be of most value as a basis for empirical research: Goal-setting theory and self-regulation theory.

Goal-setting theory (Hertel et al. 2004) distinguishes between four main functions of goals in influencing task-oriented behaviour (see Cuevas et al. 2004: 8). The main characteristics of goals are their intensity (importance, commitment to the goal) and content (difficulty, specificity, complexity, goal conflict etc.). A rich body of evidence supports the proposition that setting goals improves employee performance. In particular, setting difficult but realistic goals is imperative: Richter et al. (2006: 241) have counted more than 400 studies which “prove that there is a positive correlation between goal difficulty and performance”, which is due to the simple “fact that people adjust their level of effort to the task at hand”. The process of goal-setting, however, needs to be well managed in order to achieve its objectives (Locke & Latham 2004).

Self-regulation theory (Dietrich 2001) lists the three main components of self-regulation as (a) self-observation, (b) self-evaluation and (c) self-reaction. The way self-regulation is practised has a direct effect on the level of self-efficacy. Limited opportunities for monitoring and evaluating other team members' behaviour and for comparing it with own behaviour can lead to decreases in overall performance (Cuevas et al. 2004).

Research on virtual teams by Staples & Cameron (2004: 87) found that “motivation was positively associated with perceptions of task significance, autonomy, interpersonal skills, beliefs about the team's ability to the task, and team spirit”. The same applies for commitment (except for interpersonal skills) and satisfaction with own work (except significance of the task). Richter et al. (2006), in their research on virtual teams, found self-efficacy and trust (as aspects of motivation) to be positively correlated with job satisfaction. This supports findings from Sonnentag who established evidence that self-esteem and self-efficacy have a positive impact on individual's health and well-being.

De-individuation, “where the reduction in an individual's self-awareness produces feelings of anonymity” is a possible outcome of the “decreased awareness of team members' actions arising from the team opacity found in distributed environments” (McKenna & Green 2002). The effect of de-individuation on identification with the team and its goals, and therefore team performance, can be positive or negative, depending on the social context of members' interactions.

Confusing loyalties is a problem often found in virtual teams spreading across different organisations. The resulting low levels of commitment to the team task needs to be tackled. Social activities (Bradley & Vozikis 2004) and initial communication training (Warkentin & Beranek 1999) have been found to be effective tools towards this end.

2.3.2 Second Order Outcomes (People and the Social Structure of the Organisation)

Because of the central role that motivation and commitment play in determining effectiveness of virtual collaboration, short and medium term interests of workers engaged in virtual collaboration can be expected to be largely the same than the interests of their employers. Richter et al. (2006), for example, have shown that the quality of teamwork in virtual settings is closely associated with job satisfaction.

Variety of skill, significance of the task, autonomy and feedback – factors which have repeatedly been shown to be of central importance for effectiveness of team work, in general, and virtual collaboration, in particular – were found to be related to job satisfaction in the studies of Cohen et al. (1996), Spector (1997), Staples & Cameron (2004) and, again, Richter et al. (2006). Gardner & Price (1998) and Zellars et al. (2001) established evidence for the importance of team beliefs for satisfaction. In addition, organisational support, including training and good access to information, was identified as having a strong effect on satisfaction.

Individualised collaboration via ICTs (cp. Table 1), as is the case in traditional home-based telework, appears to have more ambivalent impacts on job satisfaction. Workers who spend only a minor share of their working time at home (and the rest in co-located settings) tend to benefit from increased job satisfaction (Cullen et al. 2003; Montreuil & Lippel 2003; Gareis et al. 2006), more permanent home-based eWork tends to have considerable negative effects resulting from social isolation and lack of access to social resources (Cullen et al. 2003; Dimitrova 2003; Treier 2003).

Research by Dimitrova (2003) suggests that one reason for this is that task discretion and job autonomy – contrary to popular assumptions – do often not increase as a result of remote supervision, as direct forms of control are replaced by more formalised interaction between superiors and remote workers. Dimitrova (2003) stresses, however, that remote management appears to benefit high-qualified workers in advanced job positions, while low-skilled workers carrying out, for example, clerical work, suffer from more formalised forms of control. She concludes that eWork “reproduced pre-existing social relations and inequalities” (ibid.: 191). In contrast, research by Treier (2003) found that the level of perceived stress is greater for teleworkers who have a lot of task discretion, which may be explained by stronger difficulties to “switch off” after the end of the working day. An alternative explanation is offered by Montreuil & Lippel (2003) and Richter et al. (2006) who found that perceived stress tends to be bigger for more enriched working tasks.

A key topic in the discussion of individualised forms of virtual collaboration is the impact on the balance between **work and family** commitments. As Antila (2005) observes based on data from a representative survey of Finnish workers, there can be no doubt that ICTs – in combination with new management practices – have enabled work from “slopping over” into leisure time, to the possible detriment of the interests of the family. The question is whether this blurring of boundaries (which have traditionally drawn a clear line between work and private life) impacts negatively on the individuals affected. Antila’s (2005) research showed that the large majority of knowledge workers who use ICTs (including mobile phones) to stay connected to their work during their leisure time do not mind. One explanation is that they realise that they in exchange benefit from the increasing flexibility in managing work and leisure-time schedules. Cooper et al.

(2002) find in their study that knowledge workers use ICTs to extend their working hours, in particular using spare time during commuting for work-related tasks, but this is not necessarily considered as a problem by those concerned.

Richter et al. (2006) undertook two studies of virtual teams and comparable reference groups co-operating in traditional ways. They found that virtual teams “have more enriched job characteristics: In virtual teams more organisational tasks and functions are transferred to members, group work was, to a greater extent, organised by the group itself, members faced significantly more learning demands and responsibilities and were more involved in planning processes” (ibid.: 238). On the other hand, increased symptoms of job stress were observed in virtual teams, which lead the researchers to suggest that the relationship between job demands and stress (under conditions of high job autonomy) is curvilinear.

Most studies into individualised virtual collaboration find longer working hours as a result of working remotely (Cullen et al. 2003; see Dimitrova 2003 for an overview). Lundberg & Lindfors (2002: 363) in their study into the psychophysiological effects of individualised eWork found that remote workers are often unable to “shut off the stress response after the end of the work day”, and that this “contributes to the wear and tear of the body.” They conclude that “lack of time for rest and recovery from work could be an even more important health risk in modern society than the actual level of stress during work”. Mann & Holdsworth (2003) studied two groups of journalists of which one was working from home. They found that teleworkers suffered from more negative emotions, and that they had higher levels of emotional ill-health than office workers carrying out the same job. Physical health scores, meanwhile, did not differ significantly between both groups. Importantly, the study also established evidence for more negative results for female eWorkers. This appears plausible given the fact that “the work-family conflict is a source of stress and has been correlated with negative experiences of emotional and physical ill health [...] as female teleworkers usually retain responsibility for the majority of the domestic chores, which can lead to feelings of frustration, inadequacy and stress” (ibid.: 207).

Perceived work/life imbalances are associated, as Johansson (2002) has shown based on a data from a comprehensive sample of the Swedish workforce, with higher likelihood of gastrointestinal and cardiac problems, and higher frequency of mood and sleep disturbances and headaches.

The issue of work/life balance also brings up the question of the relationship between job satisfaction and overall life satisfaction. Cullen et al. (2003) did in-depth interviews with 50 persons in flexible work patterns including home-based telework, mobile work and e-lancing. The research focussed on the implications of flexible, ICT-supported ways of working on family life, and on work/family balance in general. Results suggest that high job satisfaction can indeed go hand-in-hand with risks to family life and, as a consequence, stagnant or even deteriorating life satisfaction, at least in the longer term.

Because virtual collaboration is essentially computer work, findings from research into general effects of ICT-based workplaces on worker satisfaction and health are of relevance.

Most research suggests that ICTs have a positive impact on work quality. A 2001 communication from the Commission states, based on evidence from Eurobarometer surveys and the ECHP, that

“new technology appears to have contributed to making jobs intrinsically more interesting and satisfying with greater autonomy, and there is some evidence that women are beginning to achieve better access to more highly qualified jobs with, for example, similar levels of participation in appropriate training” (CEC 2001: 10).

In the long run, computer work does involve risks as well. A staff working paper by the Commission (CEC 2002a) lists a number of risk factors related to computer work in general:

- stress symptoms due to excessive working hours, workload and increasing complexity of tasks;
- negative side-effects in the form of information overload through email, difficulty in distinguishing significant and insignificant information, and being accessible all the time;
- stress of having constantly to upgrade skills;
- decrease in human relationships replaced by virtual contacts;
- physical impairments such as repetitive strain injuries and musculoskeletal illnesses due to inadequate or ergonomically insufficient equipment or due to forced postures, and the combined effects of both.

Research by Dhondt et al. (2002) using data from the European Survey on Working Conditions (representative sample of EU15 working population) showed that:

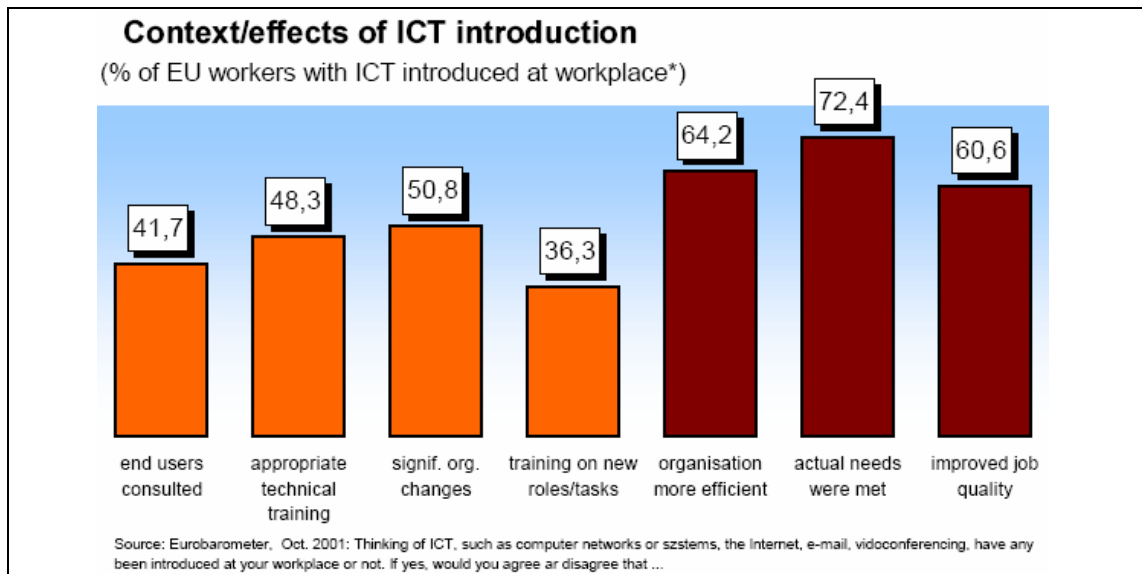
- use of computers at work is negatively associated with musculoskeletal health problems and allergies/asthma, while the opposite is true for workers using machine technology;
- use of computers at work is positively correlated with skill development opportunities.
- use of computers at work is also positively correlated with satisfaction with working conditions.

The European Commission (2003b) and the European Foundation (2005) stress the observation, based on empirical evidence from the EWCS and Eurobarometer, that investments in ICT are too seldom supported by investments in company reorganisation and in staff retraining. The data from the 2002 Eurobarometer clearly show that gains in quality and effectiveness, as perceived by workers, are significantly higher if combined with appropriate training.

As the CEC study shows, “According to Eurobarometer data only about half of the workers at workplaces where ICT have been introduced (i.e. about a fourth of all EU workers) indicate that significant complementary changes have been made in their organisations, with still a lower proportion in smaller companies. Even less say they had been consulted and/or had received training on new roles and tasks, missing important conditions for managing successful change” (CEC 2002a).

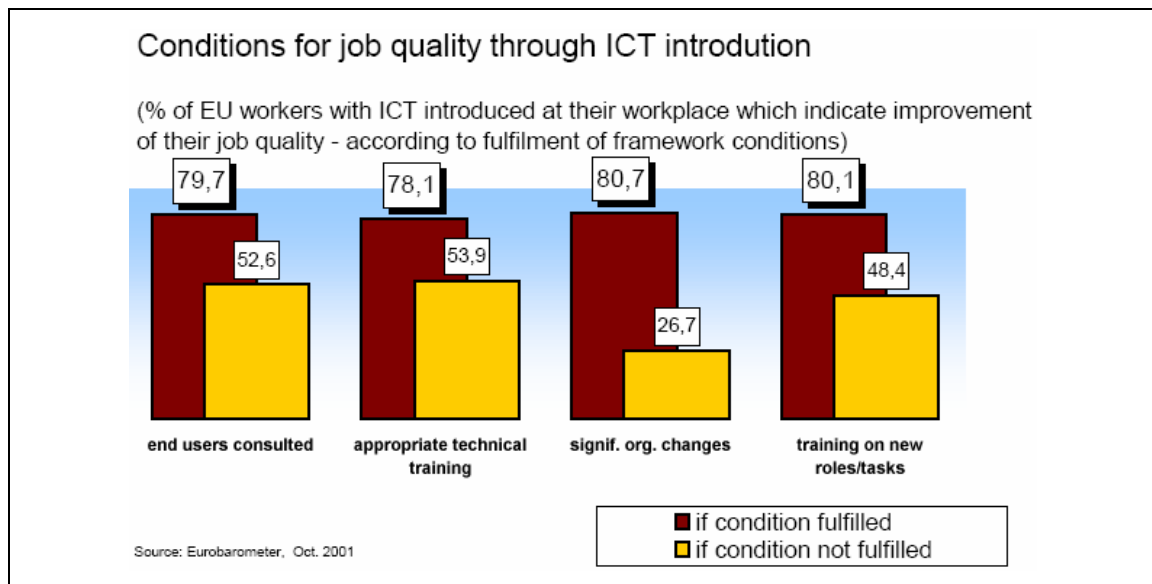
This appears of high importance because the data also confirm basic assumptions of work organisation theory: Workers that benefit from complementary measures, particularly an organisational change at the workplace, perceive the introduction of ICT much more satisfactorily, in terms of higher job quality (see Figure 21).

Figure 21: Conditions for Job Quality Through ICT Introduction



Source: CEC (2002a: 24-25)

Figure 22: Conditions for Job Quality Through ICT Introduction



Source: CEC (2002a: 24-25)

From the organisation's viewpoint, a key long-term concern when it comes to more volatile, virtual types of collaboration, concerns **knowledge management**. As a consequence, when designing ICT-based processes "it is important to consider if and how these tools support the structural opportunities, relation-based motivation, and cognitive ability to share knowledge" (Huysman

2004: 202). The type of knowledge which is of interest here is tacit knowledge (Polanyi 1966), i.e. knowledge which is not codified (yet) but contained in the heads of people.

There tends to be a consensus that what Huysman & de Wit (2002) term the “first generation of knowledge management systems” has failed to fulfil its initial promise. The authors summarise the main reasons for this widely perceived failure in the form of three fallacies or traps:

- the **IT trap**: Knowledge management initiatives tend to be technology-driven, but as numerous research has confirmed “knowledge only has meaning if it can be related to people” which for example means that “people want to know from whom they learn as this provides important ‘metaknowledge’” (Huysman 2004: 189). It appears necessary to “maintain the integrity of the social communities in which knowledge is embedded” (Boland & Tenkasi 1995: 359).
- the **management trap**: Most knowledge management initiatives appear to be driven by the managerial need to control and monitor knowledge, in order to “extract as well as collect people’s knowledge and make it accessible to others” (Huysman 2004: 190). The workers’ added value of sharing knowledge, on the other hand, is often ignored. This usually leads to workers showing very limited interest and motivation to use such systems.
- the **individual learning trap**: Existing systems, such as intranets and other groupware applications, often only support individual learning while being ineffective in providing the conditions for organisational, collective or group learning. To support the latter, “knowledge management initiatives need to acknowledge that most knowledge has a socially situated nature and cannot be uncoupled from the social community of which it is part” (Huysman 2004: 191).

Ackerman et al. (2003) point out that while the notion of human capital (i.e. individual knowledge and capabilities, and learning) was the core premise of an earlier wave of the knowledge management debate, recently social capital (see above) has been the focus of attention. The reason for this shift can be seen in the short-comings of knowledge management solutions developed during the first phase, many of which “neglected [...] the importance of people’s motivation to share their knowledge and learn from other people’s knowledge” (Huysman & Wulf 2004: 6). The concept of social capital is therefore of vital importance for the analysis and improvement of knowledge management in and between organisations (Cohen & Prusak 2001). Knowledge management poses particular challenges for organisation which deploy virtual teams because tacit knowledge is more likely to be transferred between workers or organisational units if strong ties exist, as Hansen (1999) and Uzzi (1997) found. Such strong ties are more likely to exist in co-location settings than in virtual environments.

On the other hand, Granovetter argued already in 1973 in his seminal paper of the “strength of weak ties” that “novel information is more likely to be obtained through weak ties than strong ones because weak ties are more likely to connect an information seeker with sources in disparate parts of a social network which are circulating information not known to the seeker” (Cross & Borgatti 2004: 140; see also Rogers 2003).

Cross & Borgatti (2004) assessed the relational characteristics which affect knowledge sharing in knowledge-intensive work settings. They found that in addition to knowing who might be able to

help, the accessibility of persons who could provide information is of prime importance. A second key factor is a knowledge source's willingness to engage in effective problem-solving with the information seeker. The safety of relationships, in the sense that information seekers felt it was penalty free to ask an information source for help, also plays a role, although a much smaller one.

Van den Hooff et al. (2004) stress the "two ICT routes to knowledge sharing"; the first is based on individuals' personal *eagerness* to share knowledge proactively, which is found to be stimulated by an individualist norm in a group; the second is based on *willingness* to share knowledge (passive), which is more likely to occur when there is a collectivist climate in a group. The authors found that ICT fosters knowledge sharing by those mainly eager to share knowledge because it greatly enhances the efficiency with which they can communicate their knowledge to other group members. ICT is much less likely to support the development of "common bonds" in a group in which a collectivist climate is salient, mainly because of the lack of social cues. They summarise findings by stating that "ICT can be a useful tool in knowledge sharing, but it should always be part of a much wider strategy (in which sufficient attention is paid to face-to-face interactions and other means of communication) in order to create a climate in which knowledge sharing really takes place" (Van den Hooff et al. 2004: 179).

2.3.3 Third Order Outcomes: The Societal Level

Employment and unemployment

Virtual collaboration enables new forms, and new intensities, of outsourcing. It is certain that outsourcing by European organisations today has considerable effects on overall levels of employment and, in particular, patterns of employment and the structure of labour demand. In general, there is evidence which suggests that most outsourcing and off-shoring tend to decrease demand for low-skilled labour, but increase demand for high-qualified labour (especially in advanced business services and R&D) in the source country. Any generalisations, however, should be avoided. For an in-depth exploration into the subject, see Dicken (2003), Houghton & Vickery (2004), Schaaf & Weber (2005), Falk & Wolfmayr (2005), Amiti & Wei (2005) and UNCTAD (2005).

Skill requirements

Research in the U.K., based on input-output data and the census of population, found that skills changes brought about by the use of ICTs were positively correlated with productivity growth, but led to a skills polarisation (Hwang 2000). The research examined the UK experience during the 1980s, based on 25 industrial sectors. It finds that the skills change associated with ICTs happened more through occupational change than educational improvement as the skills change was necessary for productivity growth. Overall ICT use is shown to have brought about a reduction in less skilled occupations and increased skills polarisation. Other negative effects are that gender differences in skills composition do not seem to have adequately improved and income dispersion is shown to have deteriorated as a result of the spread of ICT.

The rapid changes towards new, knowledge-based ways of working, often heavily relying on ICT, pose the risk of deepening social divides, of opening the gap between the well-educated and the poorly skilled and increasing the so called "Second-Level Digital Divide" between ICT-knowledgeable and not-knowledgeable persons. As a result, social problems could accumulate.

Regional development

Recent years have witnessed, across all Member States of the EU, developments in settlement and traffic patterns which are considered problematic from the viewpoint of sustainable development (see Committee on Spatial Development, CSP 1999). This refers, in particular, to the accelerating rate of urban sprawl and extension of built-up area, to high resource consumption, to increasing transport flows and congestion, to the persistence of strong disparities in economic activity and living standards, and to growing social segregation inside of agglomerations. Against this background, the overall policy aim of the European regional policy has been defined as "polycentric and balanced spatial development" across the whole territory of the EU. What evidence exists about the role of ICTs, in general, and ICT-based collaboration, in particular, in achieving this goal?

There is reason to be not too optimistic. Most evidence supports the proposition that real-life applications of ICTs have not yet diminished regional disparities in labour market structure and performance. Rather, the opposite is the case: These new technologies seem to have heightened the gap between economic well-being of the best and the worst performing regions (see Gillespie et al. 2001; Milicevic & Gareis 2003). This is, first of all, because neither enterprises in the ICT or multimedia sector (as defined above) nor workplaces which rely heavily on the application of ICTs ("information services"), are equally distributed over space (Gillespie et al. 2001). In line with general observations about the geography of diffusion of innovations (Fassmann and Meusberger 1997:126), supply as well as demand for ICT-based innovations tend to originate in the cores of large agglomerations, leading to very large spatial differences in use in the first stage of diffusion, and only then distribute to the hinterland and periphery. As opposed to other key innovations in recent decades and centuries, however, the pace of technological progress in ICTs is so fast that a phase of maturity is unlikely to be reached in the near future, meaning that the centre will go on to enjoy an advantage against the periphery in being at the forefront of technological and organisational innovation.

According to the little empirical evidence that is available, the spread of ICT-enabled new ways of working is highly uneven across space, with urban agglomerations accounting for a very high share of "new workers", while rural and peripheral regions are lagging behind (Levin 1998; Gould Ellen & Hempstead 2002; Gareis et al. 2004b).

The second, and more important reason why ICTs tend to strengthen regional disparities is because of their effect on spatial segmentation of labour markets. Via the application of ICTs in order to make possible new vertical divisions of labour, companies have been able to exploit spatial differences (e.g. in labour supply, wage levels, tax systems, attractiveness and quality of life for high-qualified workers) to an extent that was unthinkable only a few years ago. This leads to an increasing differentiation of space which often strengthens polarisation between advantaged and disadvantaged regions, rather than leading to equalisation of regional imbalances (Gillespie et al. 2001).

In addition, it does not seem until now that ICT-enabled increases in geographical mobility of workers (e.g. by the use of electronic labour markets, see Becher et al. 2005) will contribute to faster equalisation of spatial differentials between regions. Available evidence indicates that the already well-off, highly qualified labour force is most likely to exploit the potential of electronic

labour markets. Migration of high-qualified is, as has been stated above, believed to contribute to rather than attenuate polarisation between central and peripheral regions.

There are, however, examples of regions that formerly have been disadvantaged by their peripherality, but managed to catch up by benefiting from the possibilities opened up by ICTs. ICT-related new ways of working such as telework, tele-cooperation and multi-location work seem to play an important role here (Kotkin 2001).

For the four biggest EU Member States, research in the context of the BISER project (Gareis et al. 2003) compared the spread of multi-location eWork and tele-cooperation across regions which belong to the same country. Does the location of the pilot regions inside of these countries (with regard to centrality in the regional/urban hierarchy, sectoral structure etc.) explain differences in the values of indicators on ICT-based new ways of working? Diffusion theory would let us expect that capital regions, regions with top-level agglomerations (as well as regions which lie in between of important cities) are characterised by higher diffusion rates of the innovation, while peripheral, structurally weak regions and regions with insufficient access to the main transport corridors lag behind.

For looking into this issue we can use the peripherality index produced by the ASPIRE project (Schürmann & Talaat 2000). In this study, four indices were calculated for all NUTS 2 regions in the EU15 as well as in the Candidate Countries (using NUTS 2 equivalents): Peripherality Index by car to population, Peripherality Index by car to GDP, Peripherality Index by lorry to population, Peripherality Index by lorry to GDP.

Indicator values are standardised at the EU+CC level, which means they measure peripherality not with respect to the distribution of a country's population, but of the whole European population. High values on these indices signify a low level of peripherality and vice versa (in this respect it would be more appropriate to speak of an accessibility index).

Looking at Germany first (Table 4), the picture emerging is quite differentiated. A general disparity between the more central and the more peripheral regions is discernible. The region of Darmstadt (which contains Frankfurt as a global service metropolis, and the cities of Wiesbaden and Darmstadt which are both concentrations of service sector employment in Germany) has the highest rates of multi-location workers and incidences of tele-cooperation. With increasing peripherality, the percentage of home-based teleworkers and persons tele-cooperating decrease. Mecklenburg-Vorpommern and Magdeburg, both in the part of Germany which belonged to the GDR until 1989, have the lowest incidence of new ways of working.

Table 4: Spread of multi-location eWork and tele-cooperation in BISER regions

Region	Peripherality ²² (ASPIRE)	Multi-location work	Tele-cooperation
Germany			
Mecklenburg-Western P.	89.6	11.3	41.5
Magdeburg	158.7	10.8	38.4
Braunschweig	195.8	12.2	43.0
Stuttgart	229.0	15.7	53.5
Darmstadt	264.2	22.7	55.6
United Kingdom			
Tees Valley and Durham	76.7	11.0	38.6
Greater Manchester	118.6	13.4	46.1
Leicestershire, Rutland	156.7	16.0	43.4
Berkshire, Oxfordshire	168.6	26.7	61.0
France			
Brittany	52.7	2.6	29.1
Languedoc-Roussillon	76.3	5.6	26.8
Ile-de-France	231.9	6.3	47.2
Nord/Pas-de-Calais	236.7	7.6	34.4
Italy			
Sicily	9.7	5.9	21.5
Lazio	73.7	10.7	27.1
Tuscany	102.7	6.1	30.5
Lombardy	145.3	11.0	38.7

Source: Gareis et al. (2004b: 39-40).

In the United Kingdom, there is a similar disparity between Berkshire, Buckinghamshire and Oxfordshire and the other regions in the sample. The former lies in the South-East of the country, in the vicinity of London, which means close to central nodes of the main transport networks. The region also has reasonably good access to the London labour market, while at the same time offering a quality of life which has attracted high-qualified services and R&D activities. Again, with increasing peripherality the percentage of home-based teleworkers and persons tele-cooperating decrease. The same applies here for mobile teleworkers which seem to be heavily concentrated in the UK regions of high accessibility.

The picture is less clear when looking at the French regions in the sample. Not only do the French regions have low numbers of multi-location workers and workers who tele-cooperate in general; also, the capital region does not perform better than the other regions, with the exception of tele-cooperation. Peripherality seems to be of less value to explain differences in the take-up of multi-location work in this country.

In Italy, disparities between the regions with respect to the spread of home-based telework are small enough to be statistically not significant anymore. Mobile teleworking, however, is much more wide-spread in Lazio (which includes the Rome conurbation) and Lombardy (the economic centre of Northern Italy). It seems that centrality at the *national* (rather than European) level is better possible to explain differences in mobile telework take-up in Italy. The share of workers tele-cooperating, however, increases with decreasing peripherality as measured by the ASPIRE index.

Recent experience with **call centre locations** in the UK as well as the USA suggest that rural and structurally disadvantaged regions areas can attract ICT-based jobs of rather low-qualified nature if they are well equipped with telecommunications infrastructure and (attractively priced) human capital (Richardson & Gillespie 2002; Taylor et al. 2002). These jobs tend to be, however, insecure as they can easily fall victim to relocation to lower wage countries or automation (Huws et al. 2001).

We can conclude that, if exclusion resulting from geographical disadvantage is to be prevented, dedicated political action is required, for example for making advanced technologies available to peripheral and structurally disadvantaged regions, and for improving the absorption capacities of these territories.

Ecological sustainability

In a number of ways, the concept of virtual collaboration is related to research into the ecological impacts of ICTs and ICT-based applications. This is due to the very concept of virtuality, which suggests that the flow of materials (including people themselves) is substituted for by the flow of data streams across space and time: weightless and intangible.

First of all, it is important to realise that virtual processes and products also have physical impacts. Two studies carried out in the context of the Digital Europe project²³ demonstrated that eBanking and digital music downloads also both have a sizeable “ecological backpack”, mainly caused by the electricity required for operation of the computer networks and end devices needed to produce, transfer and use the service/product. Still, in both cases the electronic substitute was estimated to cause less environmental damage than the traditional alternative (bank services supplied face to face at branch office; music purchased on CD medium).

A new report from the European Commission states, however, that despite of the widespread adoption of ICTs throughout the economy and wider society “there is little evidence of greater resource-use efficiency in the ‘new economy’. [...] The sustainable use of ICT alone will not deliver the goal of social and environmental sustainability if systemic approaches are not introduced at all levels of policy-making” (CEC 2005: 4). The same report also states one of the key explanations for the wide gap between ICT’s potential for ecological sustainability and current unsustainable trends: “While the ‘end products’ of economic activity are being de-materialised in the emerging knowledge economy, the overall use of resources continues to grow” (dito: 10). A major underlying cause for this trend is the existence of “rebound effects” (Rademacher 2001), i.e. the fact that increases in efficiency and lower consumer costs always tend to lead to increased consumption. For example, rapidly falling costs for physical transport due to better

infrastructure and leaps in technological efficiency have been a decisive factor behind the steep increase in overall transport demand to be observed in recent decades.

Against this general background, a number of micro studies have tried to explore the effect of ICT-related organisational innovations on traffic levels, and on resource consumption in more general. Home-based telework has been subject of a large number of studies looking into impacts on travel to work (commuting). Most of this research found that workers' total miles travelled decreased considerably after taking up home-based telework. Unfortunately, long-term studies which could take into account possible decisions to move residential location as a result of telework are still missing.

In a study on home-based teleworkers working in the insurance industry, Schäfer (2004) took account of the ecological effect not only of commuting trips and substitution travel, but also of other factors such as energy consumption for heating at the workplace and the total resource consumption for equipment manufacture, operation and disposal (computer, peripherals, etc.). He found that in most cases, home-based telework does indeed lead to a decrease in ecological footprint. More importantly, he was able to identify the conditions which determine whether home-based work is preferable to office based work.

Among the most important conditions for ecologically sustainable eWork is that office space is being re-organised in order to distribute it more effectively across staff. As Harrison et al. (2004) point out, the active use of office workplaces in Europe is less than 10% of total time. There are countless accounts of organisations which have reduced their operating costs sizeably through innovative workspace management schemes including hot-desking, hotelling, touch-down offices and the like (dito.).

Evidence about the impacts of home-based telework on traffic levels appear to have become less relevant since it has been found out that most eWork actually takes place in mobile settings, i.e. it is often not restricted to any one location (such as the home office) but by multi-location (Gareis 2003). This suggests the possibility that the liberation of work from the constraints of time and space may also imply rebound effects, i.e. increasing levels of work-related travel: Once restrained by the necessity to stay in contact with peers and have access to resources, eWork and virtual collaboration allow knowledge workers to become more physically mobile than ever before. If this was found true at the aggregate level (no robust data are available yet), it could mean that eWork is not leading to overall decreases in transport (yet), but rather to a shift in transport patterns from regular commutes to less regular work-related travel (Pamlin & Thorslund 2004).

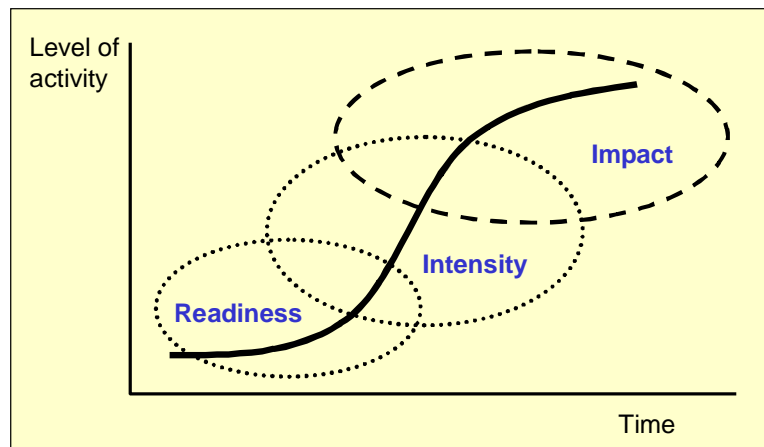
The end of the 1980s is also the time when virtual meeting facilities became available on the market at affordable prices. A body of (tentative) evidence is available on the effects of video conferencing on travel demand and total resource consumption. Research in Sweden by Eriksson and Östermark (1999) found that virtual meetings have vastly lower environmental impact than a trip (by air or car) for meeting face-to-face. A trip by rail compares more favourably, but is still likely to consume more resources than the virtual alternative. Estimates about the total physical travel saved by video-conferencing are scarce and also, more importantly, would not add much insight since video-conferencing is also being used complementary to traditional face-to-face and

phone-based interaction. In any case, there is much agreement among observers that video conferencing and more sophisticated types of virtual meetings are not used nearly enough to make a difference to overall levels of transport in Europe and beyond.

2.4 Indicator Requirements for Measuring NWE

An issue of particular importance with regard to indicators for the Information Society is the question of relevance. It has been argued that most statistics available until now mainly focus on the conditions and take-up of ICTs, while a more holistic assessment of the Information Society requires a shift of attention towards the ways (and the ends to which) ICTs are used, and societal outcomes. This is also true with regard to eWork and other phenomena related to NWEs. Figure 23 which stems from Simpson (1999) puts this requirements into context. It shows that the focus of statistical analysis should shift according to the stage of diffusion of a certain techno-social innovation. Hence, innovations which are quite new and not wide diffused yet (e.g. e-government applications today) should be analysed by focussing on whether the preconditions for a further diffusion are sufficiently developed (using readiness indicators), whereas innovations that have reached higher rates of penetration (e.g. the Internet) would better be analysed by looking into intensity (how much, in which ways, for what purposes is the innovation applied) and impacts/outcomes (e.g. economic effects such as changes in productivity; or social effects such as changes in the accessibility of services to different segments of the population).

Figure 23: Market maturity determines research interest and needs: OECD Working Party on Indicators of the Information Society Model for IS indicators



Source: Simpson 1999

Following Eurostat (see Gärdin 2002), we define these groups of indicators as follows: **Readiness indicators** indicate the potential for use of ICT and describe variables such as ICT infrastructure, access to and availability of Internet, email, PCs and IT-skills. In a wider sense one could also include what was termed “drivers for change” above, i.e. company external factors which drive organisations to take up NWEs. **Intensity indicators** indicate the actual use and applications of ICT and describe variables such as ICT investments, the extent of use of Internet, email, PCs, e-commerce, for what purpose they are used by different user groups – people and households, businesses and government. In a wider sense, what is called value drivers or

management levers above can also be subsumed under intensity indicators insofar as these factors are decisive for the intensity with which the organisation adapts to the requirements of NWEs.

These two families of indicators represent the basic indicators for the Information Society and typically provide the main basis for cross-country benchmarking and analysis of the digital divide. They relate mainly to the infrastructure and the transfer of possibilities and participation of the people. The following two families of indicators relate to economic and social changes.

Impact indicators relate mainly to the micro level, enterprises and governments, but also to the industry level. They describe

- new ways of organising work, referring to the relations between individuals as well as between individuals and the enterprise;
- new ways of organising production, which refers i.e. to inter-enterprise relations such as outsourcing, joint ventures, licensing etc;
- knowledge supply/human investment/human resources;
- mobility;
- innovation/R&D and spin-offs.

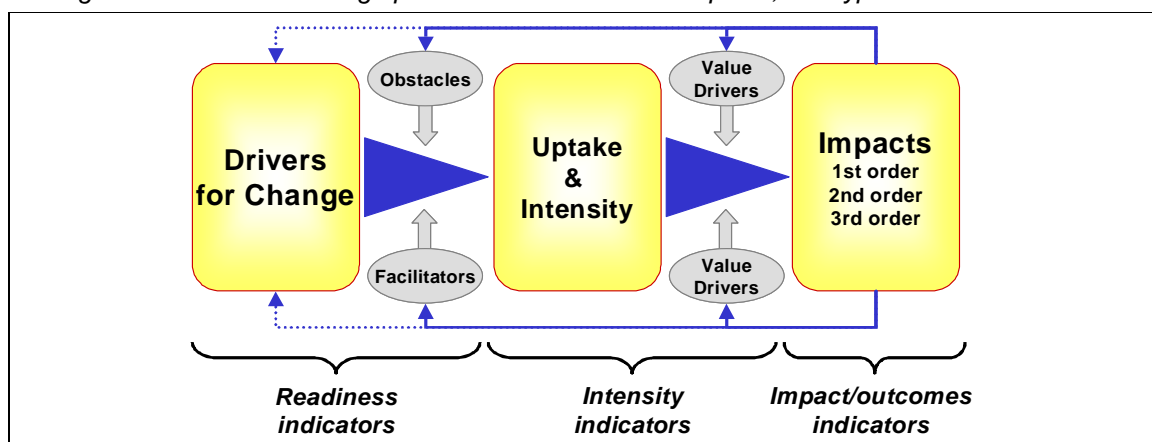
Outcome indicators relate mainly to the macro or societal level and describe

- economic growth, productivity and competitiveness;
- employment and the labour market;
- social inclusion and participation.

It is on the latter level the issues about sustainable economic development can be approached. However, the factors measured by impact indicators do of course directly affect the variables measured by outcome indicators. As such, both are strongly related.

For network4value, a clear distinction between impact and outcome indicators is not useful because depending on the level of data capturing, the latter are often simply aggregates of the former. For a more detailed discussion see below.

Figure 24: Factors affecting uptake of NWEs and their impacts, and types of indicator needs



Source: The author

Figure 24 shows the relation between types of indicators, as discussed above, and the main elements which have been identified in earlier stages of the network4value project as of relevance for the topic of NWEs. Making sense of NWEs, and of the role policy-making can play in guiding the ways these are applied across the European economy, will require sufficient statistical coverage of these aspects. Ways how this goal could be reached will be discussed in the remaining parts of this document.

2.4.1 Readiness Indicators

In the preceding sections, a number of factors were identified which tend to drive the development and implementation of NWEs. In addition, we listed related facilitators and obstacles to the uptake of NWEs which may be able explain differences (for example between countries) in the diffusion of these new, collaborative forms of work organisation. Because of the general nature of many of these factors, the following discussion will only deal with readiness indicators which are of specific relevance to the diffusion of NWEs.

Technological infrastructure

In general, the technological infrastructure requirements for uptake of NWEs are very much related to the development of anywhere/anytime potential or actual access to a high quality **Internet connection**. High quality, in this context, means **broadband** Internet – although narrowband access remains of some relevance for highly mobile access, e.g. through 2G or 2.5G mobile phone networks.

Because of the central role of mobility in the concept of NWEs, indicators need to cover conditions for:

- access at the main workplace(s);
- access at other sites of the same organisation (if applicable);
- access at home;
- access at mobile locations.

The latter may mean near-ubiquitous mobile broadband access through 3G networks, or punctual access through local WiFi networks or public Internet access points (PIAPs).

Because of the pace of techno-economic change, indicators in this area need to be carefully constructed to ensure that they stay relevant over an as long stretch of time as possible. This may also imply that the definition of broadband in the sense of bandwidth needs to be adapted dynamically to industry standards. Alternatively, measurement could focus on the **applications used most widely for collaborative purposes** (e-mail, voice over IP, video-conferencing, application sharing etc.) and then analyse to what extent these are available at different types of work locations.

Firms: Co-operation, collaboration, teamwork, staff physical mobility

Organisations differ with regard to the need for collaboration and the potential effects thereof on performance and short and long term competitiveness. In general it seems fair to assume that organisations that operate in an area which is traditionally characterised by large degrees of co-operation and inter-firm networking are more likely than the rest to take up virtual collaboration

and NWEs. They are also more likely to have acquired the necessary know-how and skills which are needed for managing intra-firm partnerships and collaboration. For these reasons, the overall **degree of inter-firm co-operation and collaboration** is a key readiness indicator for NWEs.

For these phenomena, organisation/firm-level indicators are required. In addition, collaboration intensity and complexity need to be measured at the level of the individual worker/workplace, which is the level at which NWEs are being implemented. Here, collaborative working inside organisations is of as much importance as collaboration across the boundaries of the firm. Involvement in **team work** and work organised in **projects** are indicators for the readiness of a worker to take up work in virtual teams and modes of virtual collaboration.

Collaboration complexity is of vital interest, too, since experience in more complex types of working in teams and projects is likely to improve the skills needed for ICT-mediated collaboration. Collaboration complexity is the type and character of such relationships and their strategic role for the organisations involved. Factors of what in this context has also been called “**people complexity**” include:

- Team scope: Whether the team stretches across organisations or includes staff from one company or even site (establishment) only.
- Team size: More people means more communication – and exponentially so as potential conversations rise with the square of the numbers of people.
- Duration and team member turnover: Long-term teams tend to operate radically different from short-term teams. A high member turnover tends to reduce the effects of long-term team stability.
- Cultural diversity: Team members from different cultural areas (such as countries) imply challenges to communication due to different languages, values, norms etc.
- Geographical distance: Large distances between team members make it more difficult to meet face-to-face, with implications for interaction patterns and group cohesion.
- Group cohesion: Groups in which no common beliefs, goals and loyalties have been agreed upon are harder to manage. Low cohesion means that more effort needs to be invested on striking an acceptable balance between the different interests of group members. Moreover, more formalised systems for rewarding goal consistent behaviour may have to be installed.
- Power balance: Groups with an established power balance between members are less complex than groups in which different members/segments strive for changing the power balance.
- Personalities of team members: Empirical research has shown that the extent to which personality styles are suitable for working in teams differs; and that the mix of personality styles in a group matters a lot (Potter & Balthazard 2004).

A final factor to be mentioned here is **physical worker mobility**. Workers whose job requires them to be physically mobile are more likely to be affected by developments in the area of virtual collaboration than others. This is mainly for the reason that physical mobility, without exception, involves sizeable costs – what Perry & Brodie (2006) call “mobilisation costs”. Decreasing these costs (while at the same time boosting the value generated through mobile work) is one of the

main driving forces behind the development of applications for mobile collaborative work environments.

Firms which traditionally deploy physically mobile staff are also likely to have a different attitude towards virtual forms of collaboration compared to firms which use ICT-based collaboration in order to become geographically more mobile. Degrees and patterns of physical worker mobility are necessary statistical indicators for analysing NWE readiness.

Skills

NWEs put high demands on the generic skills of workers. Felstead et al (2002), through In-depth analysis of the UK Work Skills Surveys, identified ten categories of generic skills and how these can be operationalised. In Table the relevance of each of these ten skill categories for NWEs is discussed in brief.

To summarise, as far as readiness indicators for uptake of NWEs are concerned, four categories of skills are of most importance: **digital skills, communication and collaboration skills, self-management skills** and **problem identification/solving skills**.

In addition to the current endowment with NWE-related skills, access to and utilisation of offers for continuous, **lifelong learning and training** are of prime relevance. This is because today in the future, skills will become outdated faster than ever before. Constant renewal and updating of work-related sets of skills is therefore becoming a core requirement for keeping workforces adaptable to the increasing speed of change in working tasks and environments.

Table 5: Skills categories of particular relevance for NWEs

Skills category	Description	Relevance for NWEs
Literacy Skills	Both reading and writing forms, notices, memos, signs, letters, short and long documents etc.	Mainly of relevance in the context of written communication through electronic channels (see below)
Physical Skills	The use of physical strength and/or stamina	Low relevance
Number Skills	Adding, subtracting, divisions, decimal point or fraction, calculations etc., and/or more advanced maths or statistical procedures	No specific relevance
Technical 'Know-How'	Knowing how to use tools or equipment or machinery, knowing about products and services, specialist knowledge and/or skill in using one's hands.	Computer-related skills ("digital skills") are of prime relevance for NWEs. The degree to which specialist know-how is needed is, of course, dependent on whether and how the supply-side will make progress in usability.
High-level Communication	Top-down communication skills, including persuading or influencing others, instructing, training or teaching people, making speeches or presentations and	Some relevance as NWEs and virtual teamwork will mean that a higher share of workers will be carrying out management tasks.

	writing long reports. This skill is also linked to the importance of analysing complex problems in depth.	
Client Communication	Selling a product or service, counselling or caring for customers or clients.	No specific relevance
Horizontal Communication	Working with a team of people, listening carefully to colleagues.	Very high relevance and interrelation with "technical know-how"
Planning	Planning activities, organising one's own time and thinking ahead.	Very high relevance (self-management)
Problem-Solving	Detecting, diagnosing, analysing and resolving problems	High relevance for work in virtual teams as responsibility is distributed more evenly across workers.
Checking Skills	Noticing and checking for errors.	High relevance for work in virtual teams as responsibility is distributed more evenly across workers.

Source: First two columns from Felstead et al. (2002: 34)

The indicator needs in this area have been defined in a number of documents, including European Commission policy papers. For inclusion as readiness indicators in an indicator system for NWEs, the total uptake and intensity of work-related lifelong learning are of most importance. In addition, **provision and financing arrangements** as well as **total investments in training** should be measured, since these indicate the degree to which (a) companies invest in lifelong learning of their staff and (b) workers themselves take responsibility for their own learning.

In addition to engagement in training measures (= structured, purposeful learning), recent years have seen some of the attention shift to incidental, experiential, non-structured training (Dohmen 2001, eUSER 2005). Incidental learning is very hard to measure in survey research, as the experience of Livingstone (2001) shows. It appears that the best way to do so is to avoid focussing on the learning process itself, as this is elusive and often taking place unconsciously. Rather, a measurement could focus on the (perceived) ability of the working environment to enable and induce learning: what might be called the extent to which a **workplace is enabling experiential learning**.

Attitudes and awareness of the benefits of new work organisation and (virtual) collaboration

Awareness of the possible benefits of collaboration can be seen as a necessary condition for uptake of (more complex types of) NWEs. The same applies to **awareness of the possible benefits of pro-active work organisation** (see above), as both are considered to be closely related in the definition applied for the network4value project.

In both cases, awareness of potential advantages to be achieved needs to be analysed against the context of a firm's strategic plans and the market area it operates in. Strategic goals which are

likely to have a major effect on whether a firm can expect potential benefits to be obtained from NWEs include:

- to improve the innovative capacity of an organisation;
- to create more flexible configurations of human capital (task-specific, temporary combinations of core competencies);
- to improve time-to-market and/or time-to-action;
- to organise R&D and/or production on global scale (economies of scale) while preserving/creating economies of scope;
- to improve the responsiveness to client needs;
- to get access to labour markets which have been out of reach before;
- to offer valued members of staff more attractive working conditions;
- to enable cooperation with remote high-qualified staff or sub-contractors.

Readiness is also affected by the type and strength of **obstacles perceived** by decision-makers in firms.

At the level of individual labour force members, **attitudes towards entrepreneurship** (which does not necessarily have to imply self employment) are a good indicator of readiness for the willingness to work in a position which involves high self-responsibility and job autonomy.

Firms: Participative organisation

Confusingly, many accounts of technology-related organisational change make the assumption (implicitly) that more participative, decentralised forms of work organisation follow from implementation of technology. Most evidence, however, suggests that the causal relationship works the other way around: Technology has the most beneficial effect in situations in **participative organisations** (OECD 2003).

It is important to distinguish between different types of participation, as they have distinctly different implications for the way in which decision making is executed in practice. Following the EPOC study (see Sisson 2000: 3) we can distinguish between:

- Individual consultation: 'Face-to-face': arrangements involving discussions between individual employee and immediate manager, or 'arms-length': arrangements which allow individual employees to express their views through a 'third party',
- Group consultation involving 'temporary' groups who come together for a specific purpose and for a limited period of time, or 'permanent' groups who discuss various work-related topics on an ongoing basis.
- Individual delegation: Individual employees being granted extended rights and responsibilities to carry out their work without constant reference back to managers (e.g. 'job enrichment').
- Group delegation: Rights and responsibilities are granted to groups of employees to carry out their common tasks without constant reference back to managers (e.g. group work).

2.4.2 Intensity Indicators: Uptake of NWEs and Value Drivers

Task Complexity

Indicators for task and job complexity are required, since a high task complexity is expected to make it more difficult to execute task interfaces via electronic communication channels – at least under the assumption that these are characterised by low media richness, such as in the case of e-mail. Different indicators have been developed and piloted for describing the complexity of work tasks. They often make use of scales with one or few dimensions, since these are preferred in survey research. An example is the indicator applied in the European Working Conditions Survey (conducted since 1990 in five-year intervals by the European Foundation for the Improvement of Living and Working Conditions), which measures work complexity using a two-dimensional scale:

- 0=Monotonous tasks, no complex tasks
- 1=Both monotonous and complex tasks
- 1=Neither monotonous and complex tasks
- 2=Complex tasks, no monotonous tasks.

Closer inspection reveals, however, that task complexity is composed of a larger number of dimensions. For this reason measurement either requires in-depth comparative research or is burdened by problems of validity of measurement. The main elements which need to be taken into account for assessing job complexity include the following²⁴:

- Number and variety of tasks: The more different things there are to do, the more complex managing the job as a whole is. If there are lots of similar tasks, then similar tools, management methods, etc. may be used.
- Variability of tasks: If tasks change often and unpredictably, managing them becomes more difficult.
- Difficulty of tasks: Routine tasks are considered easy to carry out, although they may require highly specialist knowledge (i.e. they are only easy to carry out for somebody who is properly trained for the task). More difficult tasks require greater attention and have more ways to fail. It also makes it more difficult to verify.
- Nature of knowledge required: Tasks which require tacit knowledge are harder to manage than tasks which are based on codified knowledge input. Creativity is an example of know-how which is particularly hard to codify.
- Verifiability of work: If you cannot see what has been done, then it is difficult to track progress and check that things are done correctly.
- Location-specificity of tasks: Tasks which can only be carried out in a certain place or type of place make coordination more difficult.
- Interdependencies between tasks: When one change depends on others or can affect many things, coordination is more complex than when changes are independent of one another.

Vartiainen in his survey research uses five categories of task complexity: "Team members' jobs consist of both routine and complex tasks. Please, think of your job as a whole and evaluate, how

many percent of your job includes tasks with different demands named below so that their sum is 100%. My job consists of ...% (sum should be 100%)

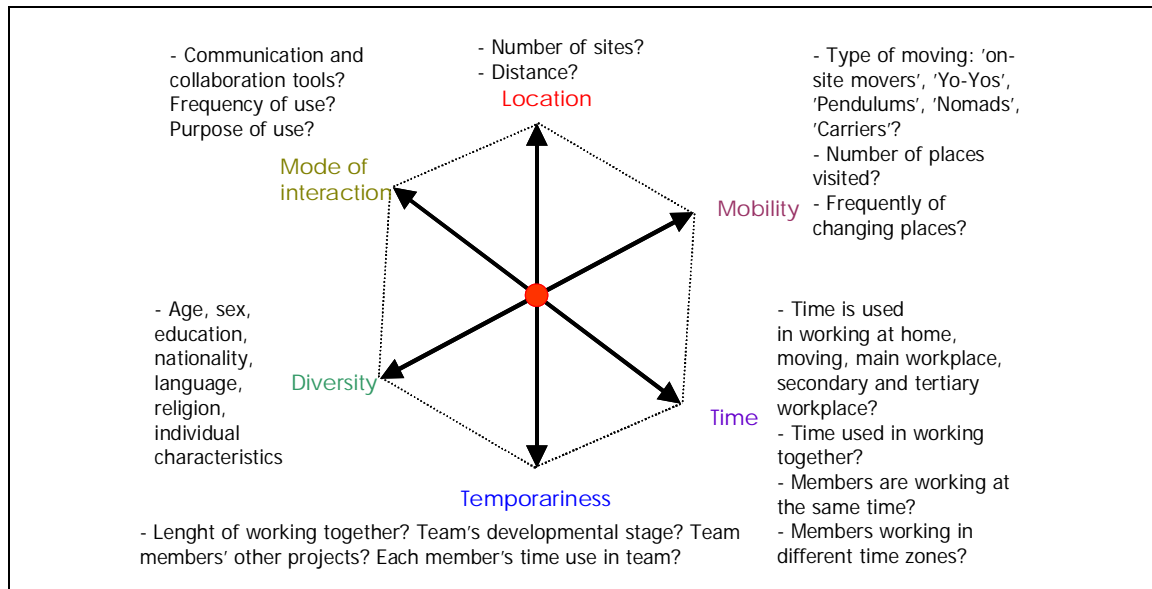
- doing routine tasks
- working based on familiar rules and guidelines
- applying rules and guidelines in many familiar contexts
- combining familiar rules and guidelines in new contexts
- creating new plans and solutions

More research is required to construct simple, valid indicators for measuring task complexity across the whole workforce through labour force surveys.

Contextual Complexity: Mapping NWEs

- Vartiainen (2005, 2006) identified the following six dimensions which determine the contextual complexity of a work system that includes collaboration. He distinguishes between (see Figure 2):
- (a) Location: actors are working in a same location face-to-face or geographically dispersed in different places. A part of team members or teams in a project are working one place and a part in different places.
- (b) Mobility: actors may be physically mobile and change their workplaces or they stay in a fixed place working mainly in one location.
- (c) Time: actors work either synchronously or asynchronously in different time zones or sequentially in a same time zone. In addition, actors work only for one team or project or divide their time between several teams and projects.
- (d) Temporariness: the collaboration of actors and their social structure may be permanent or temporary. Most of teams are projects having their life cycle.
- (e) Diversity: the background of actors, i.e. their age, education, sex, nationality, religion, language, etc, is more or less similar or different.
- (f) Mode of interaction: communication and collaboration take place directly face-to-face or mediated via different media and technological systems.

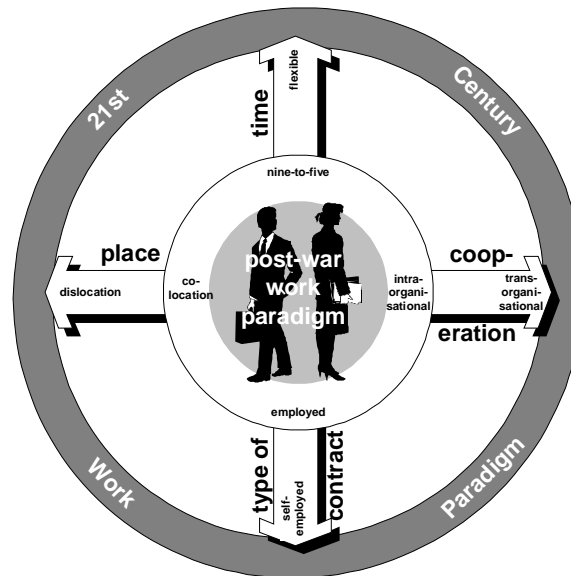
Figure 25: Physical, virtual and mental context features of work systems



Source: Vartiainen (2006)

Similar dimensions can also be used for analysing change processes in work systems in general, i.e. without explicit reference to collaboration. In this context, the ECATT project (2000) distinguished between only four dimensions as "parameters of the change in the organisation of work": time, place, contract and co-operation mode.

Figure 26: Dimensions of change in work organisation

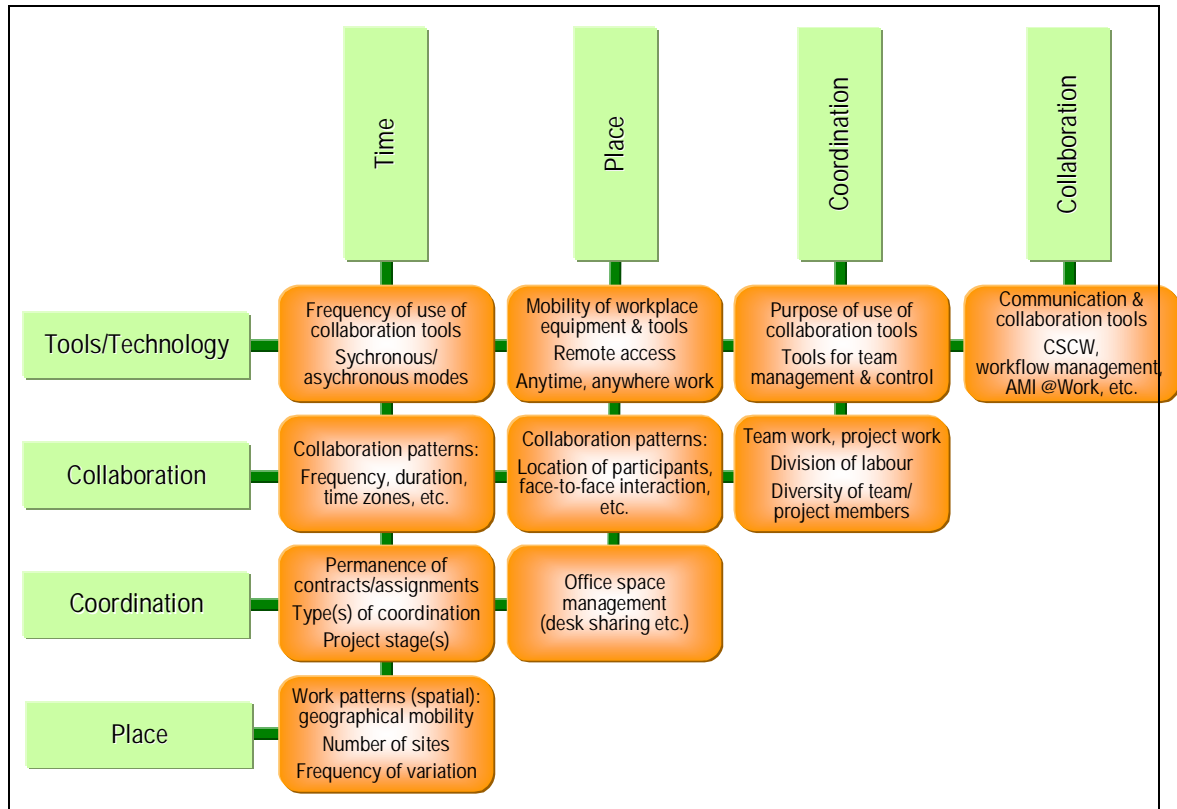


Source: ECATT 2000

Combining both approaches, and referring back to the list of defining features of NWEs as discussed in the previous section, we arrive at five dimensions which are of prime relevance for describing work systems while taking full account of the collaboration element therein:

- **Time** – the temporal dimension;
 - **Place** – the geographical or spatial dimension;
 - **Coordination** – the dimension of coordinating and managing work tasks and labour inputs in order to achieve the intended objectives (e.g. creating a product);
 - **Collaboration** – the dimension of people “interacting and exchanging knowledge in order to pursue a shared, collective, bounded goal”;
 - **Tools/technology** – the dimension of work tools and technological infrastructure required by workers to carry out work tasks.
- Rather than separating these dimensions from each other, we prefer a matrix approach since there are multiple relations between each of the dimensions (see Figure 27). This approach allows us to single out the phenomena (and related indicators) at the interface between each of these five dimensions. These are the following:
- **Time ∩ tools/technology**: Frequency and intensity of use of communication and collaboration tools, differentiated by types of purposes; (Pattern of) Use of synchronous and asynchronous communication modes.
 - **Time ∩ collaboration**: Collaboration patterns: frequency and type of collaboration, team members’ joint working time, duration of real-time communication as opposed to asynchronous communication, number of co-workers available at the same time, distribution of co-workers across different time zones, overall lifespan of teams/projects (average, min/max).

Figure 27: Matrix of Indicator Dimensions for Describing Contextual Complexity of New Work Environments



Source: The author

Time \leftrightarrow coordination

- Permanence of contracts/assignments: contractual status: fixed-term, permanent, self-employed, etc.; duration of team membership (average, min/max); variation in tasks/roles inside of organisation;
- Project lifecycle stage(s);
- Type(s) of coordination according to the typology of interdependence arrangements by Van de Ven (1976): pooled/additive, sequential, reciprocal, intensive (most complex: distributed action teams, distributed decision-making teams).

Time \leftrightarrow place

- Work patterns (spatial): Number and type of working locations, geographical distance between them, and frequency of change;
- Time spent "on the move", time at "fixed mobile" locations (clients' premises, PIAPs, etc.), working time at home, time at other locations, ratio time away from main place of work/ time at main place of work;
- Type of mobility according to typology of Lilischkis (on site movers; yo-yo's, pendulums, nomads, carriers).

Place \leftrightarrow tools/technology

- Mobility of workplace equipment and tools (applications depending on fixed versus mobile end devices);
- Uptake and patterns of multi-location eWork and anytime, anyplace eWork (intensity and applications used; locations);
- Remote access to digital company resources (quality, availability, use);
- Mode(s) of transport for work-related travel.

Place ↔ collaboration

- Collaboration patterns: Location of co-workers (geographical distance), share and purpose of face-to-face interaction, frequency of change.

Place ↔ coordination

- Office space management: Desk sharing, hotelling, hot-desking, etc.
- Physical workplaces/staff ratio.

Coordination ↔ tools/technology

- Purpose of use of communication and collaboration tools, differentiated by frequency and intensity of use;
- Tools for team management & control (uptake, intensity).

Coordination ↔ collaboration

- Work in semi-autonomous teams and ICT used for the purpose;
- Work organised in projects;
- Division(s) of labour;
- Diversity of team/project members according to nationality, language/culture, educational background, function, interaction styles, age, gender, personal attributes.

Collaboration ↔ tools/technology

- Communication & collaboration tools used and purposes of use (including groupware, CSCW and workflow management applications);
- Advanced application used (AMI@Work etc.).

Regulative Social Processes

Following Vartiainen (2005), we differentiate between the following types of regulative social processes which are highly relevant for any process of NWE implementation, as they influence success as well as all other impact dimensions of NWE uptake.

- Fairness: Workers' perception of the extent to which decisions are made in an unbiased way, based on accurate information, and involving all those who are likely to be affected. In addition, elements of perceived fairness include consideration, kindness, respect and truthfulness in the treatment of oneself by co-workers and superiors; and the extent to which resources and rewards are distributed fairly according to work performance, effort invested, and stresses and strains endured.
- Control: The extent to which each team/project/unit member's work progress and performance is monitored.
- Trust: The extent to which persons believe that the motivations of co-workers etc. towards them are benevolent, "honest", truthful, reliable, considerate, amicable, dedicated, competent, careful. In a wider sense, the concept of trust can also be extended to include trust in technological appliances such as computers.

- Team spirit: The extent to which team members have joint interests and values, and to which they consider that the team's success is their own success.
- Leadership: Workers' perception of the effectiveness and efficiency of team/unit leadership, as reflected in: dealing with problems, support of employee's career development, allocation of workload and resources, guidance to staff members, team development and support of team cohesion, information flows, joint decision-making, monitoring.
- Goals and motivation: The extent to which goals and objectives are properly defined, planned and communicated within the team/project/unit, and to which these are shared by all team/project/unit members. In addition, the degree to which resources are sufficient to allow goals to be reached, and the feeling by all co-workers of being motivated for jointly working in order to reach the goals defined.
- Cooperative behaviour: The willingness to invest in helping co-workers without the formal obligation to do so.

It is important to note that these factors are neither purely causes nor simply outcomes of applications of NWEs. Instead, regulative social processes, task complexity and contextual complexity are mutually interdependent factors.

2.4.3 Impact / outcomes indicators

In the companion document¹, we have presented and discussed a classification of impacts/outcomes into three categories (1st level, 2nd level and 3rd level) and four levels of analysis (individuals/workplaces, team, organisation/network, region/country), see Table 6. Table entries are not meant to be exhaustive.

Table 6: NWE Impact assessment – analysis matrix

	First order outcomes	Second order outcomes	Third order outcomes
Individual / workplace	Workplace productivity, work quality, throughput times, investment costs	Job quality, task discretion and job autonomy, job security, job satisfaction, work/life balance, subjective well-being (happiness), health impacts	Overall rates of labour productivity, economic growth, (un)employment levels, job tenures, social disparities, skills requirements, regional development (rural/urban), travel volumes and patterns, intercultural mobility, resource consumption, environmental sustainability
Team/unit	Team productivity, team effectiveness, leadership effectiveness, time to action, levels of innovative activity	Social capital, trust, team cohesion, information openness, absenteeism	
Organisation / Network	Organisational productivity, time to action, time to market, value chain productivity, capacity to change (flexibility), investment costs	Knowledge management, innovative capacity (long-term), absenteeism	
Society (country)			

Source: The authors

First Order Outcomes – Processes, Productivity and Performance

First order outcomes are, first of all, the effects of NWEs on traditional performance measures including **labour productivity** at workplace, team or firm level, **total factor productivity**, **gross rates of return** and **Tobin's q** at firm level, **throughput times** at individual or team level, and **time-to-action** or **time-to-market** at team or firm level, to name the most established. Newer concepts which try to take account of the nature of modern business processes and industry structures include **value chain productivity**. The level of **pay/remuneration** (which needs to be put in relation to total working hours) should also be considered as outcome indicator.

Quality measures play an increasingly important role not only as secondary, but as core performance indicators. **Output quality** can be measured in a number of ways – more or less well – depending on the type of product at hand. In heavily customer focused market segments, **customer satisfaction** can be a 1st order outcome indicator, as well.

For organisation which are heavily relying on innovation to maintain competitiveness, the **level of innovative activity** is a further 1st level outcome indicator, as is **capacity to change**, which denotes the ability of an organisation (or part thereof) to adapt flexibly to changing market conditions (in the widest sense).

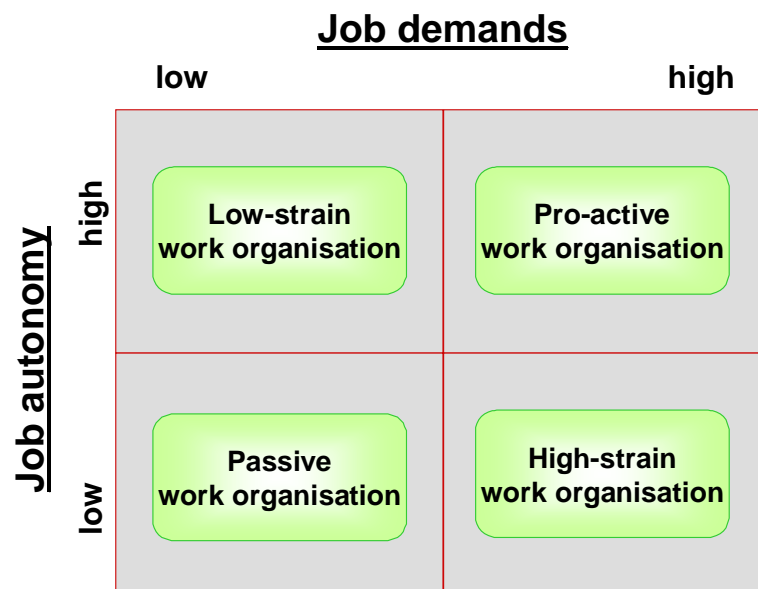
The exact choice of performance indicators depends, of course, on the type of product and sectoral environment the organisation is operating in (see Appelbaum et al. 2000).

Second Order Outcomes – People and the Social Structure of the Organisation

Second order outcomes concern, in particular, effects on the **quality of work** from the viewpoint of workers. Established outcomes indicators for job quality include, apart from levels of pay/remuneration (see above), **job satisfaction** and the existence of negative impacts on **worker health**.

The extent to which staff has a say in decisions which affect their work (participation) has been identified by recent research as having a direct influence on job satisfaction. The same applies to **job autonomy**. It is necessary, though, to put job autonomy (**task discretion**) in relation to job demands (**workload, work strain**): Recent research has shown that the relation of both decides about job satisfaction, and economic sustainability (see Figure 28).

Figure 28: The “time constraints \cap job demands” model



Source: Adapted from Karasek/Theorell 1991; Dhondt et al. 2002

Combinations of high (albeit not excessive) job demands with high job autonomy are referred to as **pro-active work organisation**. They are typically associated with high work **motivation** which has proven to be a core factor in any attempt to permanently increase labour productivity in high-qualified knowledge-based occupations.

High-strain work organisation is usually associated with **stress**, which is defined as an event which a person perceives as important with respect to his/her goals, but which at the same time exceeds his/her capabilities (Richter et al. 2006: 234).

Low-strain and passive work organisation, on the other hand, are often associated with workers being/feeling overqualified for the job they do. This is not only a waste of resources from the society's point of view, but also negatively impacts on job satisfaction. A good match between

jobs characteristics and worker characteristics must be regarded as a key goal of labour market policies.

A perception of job security is another, often used indicator for job quality. Against the background of labour market paradigms gradually shifting from “life-time employment” towards “life-time employability”, job security appears to be of decreasing relevance for gauging quality of work at the aggregate level. For this reason, an indicator on **perceived employability**, i.e. perceived individual **labour market opportunities** appears to provide better value.

The recent emphasis in the public debate on the issue of work/life balance means that more attention is being paid today to the effect of working conditions on life satisfaction or, more generally, happiness (**subjective well-being**). Indicators for work/life balance are hard to define without resorting to overcome notions of what is (or should be) important in life (such as family, children, civic participation etc.). Such indicators may make sense from society's point of view (see following section) but should be avoided when analysing personal outcomes of work. A more non-judgmental indicator would have to focus on the extent to which work limits individuals to use their spare time for the things which are most important to them.

At the level of the team/group/unit level, secondary outcome indicators need to include measures of **social capital**, such as the degree to which (different types of) **trust** are being perceived among team members. The notion of social capital also includes **team and goal cohesion**, perceptions of effective **leadership** and **co-operative behaviour**. Care needs to be taken, since these variables can be outcomes of changes in work organisation as well as they can be causes or integral components of such work-related change. It may, therefore, be better to regard them as intermediate factors which need to be taken into account in any analysis of the preconditions, intensity and impacts of implementations of NWEs. Care needs to be taken, since these factors can be preconditions as well as outcomes of the implementation of NWEs. Here, they are featured under the subsection “Regulative social processes” (see 0).

At the firm level, secondary outcomes which have been identified in the companion document²⁵ include impacts on an organisation's ability to manage its knowledge. This applies, in particular, to configurations of human capital which are short-term, temporary and at-arms-length all at the same time. In these cases, **knowledge management** can be expected to be negatively affected unless innovative solutions are implemented to counteract such tendencies. Further firm-level outcome indicators need to cover changes to a firm's (longer term) **innovative capacity**. Both indicators are extremely difficult to translate into policy indicators. More research in this area will be necessary.

Apart from these, additional firm-level outcome indicators can be seen as aggregates of the individual and team-level aspects discussed above. For example, total rates of **absenteeism** are directly related to health effects at the workplace level, albeit also influenced by external factors such as job insecurity and intrinsic motivation.

Third Order Outcomes – Societal Outcomes and Sustainability

At the level of society, we can distinguish between the following broad spheres which are likely to be affected by the implementation of NWEs:

- the labour market and employment structures (available jobs and their allocation across sectors and occupations; quality of jobs as measured by levels of skill required and pay);
- the systems of skills acquisition including the formal and informal education systems;
- economic growth (wealth generation);
- public welfare and social cohesion (quality of life at societal level, including long-term environmental sustainability, regional balance, etc.).

With regard to labour market related indicators, **total rates of employment** as well as **unemployment rates** are of prime importance as structural indicators for the health of European economies. Because of the well-established fact that women and older citizens are the population groups whose participation in the labour market needs to be strengthened more than anything else, specific indicators should be deployed to measure the effects of NWE related developments on the **employment rates of older people** and of **women**. In this context, there is much talk of work/life balance as a challenge which needs to be tackled in order to attract more people into the labour market. An interesting country-level indicator on work/life balance could be the **employment impact of parenthood**, since it can be used to measure the effectiveness of political initiatives to decouple labour force participation from parenthood for women and men.

The value of indicators on **job tenures** appear to mixed: Evidence collected by the OECD (2001) suggests that aggregate numbers tend to overshadow often dramatic change at sectoral and or regional level, and it is anyway much up to debate whether shorter or longer job tenures are more favourable for long-term economic and labour market development. In its place, we suggest to use an aggregate indicator on **perceived individual labour market opportunities** (see above).

With regard to skill needs and the appropriateness of the structures of skill acquisition (i.e. the systems of formal, non-formal and informal education), more comparable, consistent and relevant indicators on the **skill requirements of companies** are much in demand. Skill requirements indicators need to detach themselves from existing taxonomies of occupations/ qualifications in order to be more flexible in reflecting shifting demand for skills. This applies, naturally, especially to generic and “soft” skills – the relevance of which for recruiting companies seems to have increased considerably in recent years.

With regard to economic growth, a number of well established indicators are readily available to be used in econometric analysis to single out the effect of NWEs – once better data is available on uptake and intensity of usage. Examples include **total factor productivity** and **GDP growth**.

Finally, with regard to public welfare and social cohesion, established social inclusion indicators could be applied. Because of the special relevance which NWEs can have for regional development, innovative indicators may be required to reflect the degree to which there virtual collaboration is being utilised by the centre on the one hand, and by the periphery and rural hinterland on the other hand.

Insofar as environmental impacts of NWEs are concerned, indicators on travel volumes and patterns (such as **total miles of work-related travel**) and the **relation between wealth production and resources consumed for transport**) may be required. It will, however, prove extremely hard to disentangle the effect of NWEs on such parameters from other influence factors, as all of these tend to be heavily interrelated.

2.4.4 Summary: Policy Indicators Required

It becomes obvious that for a full coverage of all core features of NWE settings, a large number of variables would need to be collected. For policy purposes, such an in-depth picture is not required. What, then, are the core indicators which can be extracted from the list of features discussed above and which are needed to produce a representative picture of NWE related developments at the regional/national/European level?

Table 7: Core indicators required for statistical coverage of NWEs

Core Indicators	
Readiness Indicators	Outcome Indicators: 1st Order
Broadband access (firms)	Gross rates of return
Mobile broadband availability	Overall rate of innovative activity
Mobile broadband access	Labour productivity
Work in team/ project structures	Pay levels / remuneration (per hour)
Collaboration at the workplace	Capacity to change
Inter-firm collaboration	Outcome Indicators: 2nd Order
Physical worker mobility	Job satisfaction
Digital skills	Job-related health complaints
Collaboration & communication skills	Job autonomy/job demands: Pro-active work org.
Self-management skills	Perceived stress
Participation in lifelong learning	Individual labour market opportunities (perceived)
Workplaces enabling experiential learning	Subjective well-being
Attitudes towards entrepreneurship	Outcome Indicators: 3rd Order
Direct participation	Levels of (un)employment
Uptake & Intensity Indicators	Employment rates of older people / of women
Task complexity	Employment impact of parenthood
ICT use for team/ project work	Skill utilisation (invisible underemployment)
Multi-location eWork (spread)	Unmet demand for generic/specialist skills
Virtual collaboration at the workplace	Total factor productivity (growth)
Cross-border virtual collaboration	GDP growth
Virtual communities membership	Virtual collaboration in rural/peripheral regions
Electronic freelancing (eLancing)	Total transport volumes per unit of GDP
NWE tools (uptake, patterns of use)	Total miles travelled for work
Physical workplaces/staff ratio	
Social structures for team work	

Source: The authors

2.5 Existing indicators on NWE-related phenomena

The European Statistical System, which is made up by the Member States' National Statistical Institutes (NSIs) and the European Commission's statistical agency Eurostat, has in recent years

made considerable progress in the establishment of a framework for measurement of ICT related issues, and the implementation of systems for harmonised data collection and integration. As we will see, however, the coverage of issues related to NWE as defined in the network4value project remains sketchy at best.

A number of other sources of cross-country and national data on related issues exist. They can provide valuable insights into how progress can be achieved in covering issues new forms of work organisation, pro-active workplaces and virtual collaboration.

2.5.1 Basic Challenges

One of the basic challenges with regard to indicator development for virtual collaboration is presented by the very *elusiveness* of the phenomenon: Whereas traditional notions of (mostly home-based) telework can be operationalised in a straight-forward way (by reference to the working location of survey respondents), no such clear-cut working definition exists for virtual collaboration.

As a consequence, telework has been subject of much research and is today, as will be shown today, fairly well represented in national statistics, while collaboration at the workplace or team level is hardly covered at all.

2.5.2 Progress in Indicator Development on Related Phenomena

Telework and eWork

The question of how to measure **telework** has been dealt with extensively (Pratt 1987; Gareis 1999; Huws 1999; Gareis & Hüsing 2002; Lilischkis & Meyer 2003) in the last three decades. Because of the availability of good overviews over available indicators and remaining challenges for measurement (Altieri et al. 2005; Pratt 2005; CEC 2005), we will in this report not review the multitude of measuring approaches which have been used for the purpose.

In recent years, telework-related research has not only looked into home-based, ICT-enabled work but also into what has been termed “**ICT-supported multi-location Work**” (CEC 2003, Gareis et al. 2004; Altieri et al. 2005), which exploits the possibility of ICT-based work to fully liberate work from space-related constraints. The term of “multi-location work” suggests that more and more persons spend working time at more than one or even multiple locations, and work wherever it suits their work tasks, business schedule, and/or lifestyle choices.

Table , based on data from a random-sample European survey conducted in 2003 as part of the BISER project²⁶, shows how this looks in practice.

Table 8: ICT-supported multi-location work – working locations

ICT-supported multi-location work					
Base è	(a) at home or the same grounds	(b) at second location of employer	(c) at customers/ clients	(d) at a hotel/ meeting venue	(e) on the move
at home or the same grounds	100.0	40.4	42.2	39.1	42.5
at second location of employer	11.5	100.0	52.5	57.4	55.6
at customers/ clients	17.4	76.0	100.0	64.6	71.9
at a hotel/ meeting venue	9.2	47.4	36.9	100.0	50.1
on the move	14.2	65.2	58.3	71.0	100.0

Base: all multi-location workers. Source: Gareis et al. 2004.

The interview asked in detail for time spent at each of five “atypical” working locations. The table now shows the share of those teleworking from one of these locations (columns) who also work at each of the other locations (rows). For example, of persons teleworking from the home (a) 11.5% also work at a second location of their employer and use online connections to stay in contact when doing so. Another example: 42.5% of those who telework from mobile locations (e) also spend time teleworking from home. The figures in the table provide evidence that multi-location work has indeed become a normal way of working for a considerable share of total employment. It seems that once workers have access to mobile computing equipment, they seem to choose any of a number of different working locations, including a second location of their employer, the premises of customers or clients, hotels and meeting venues, and temporary locations while travelling. This is confirmed by evidence collected through a pilot survey in the STILE project²⁷, which developed an eWork module to be included in national labour force surveys (Altieri et al. 2005).

The European Statistical System has not yet taken on board a fully-fledged indicator on eWork, as defined above. The ICT Usage Household Survey includes a variable on “proportion having undertaken specified work related activities at home, as percentage of all persons having accessed the Internet in the 3 months prior to the survey”²⁸.

Did you use the Internet for work-related activities outside the premises of your employer (e.g. at home) in the last 3 months?

Yes, No

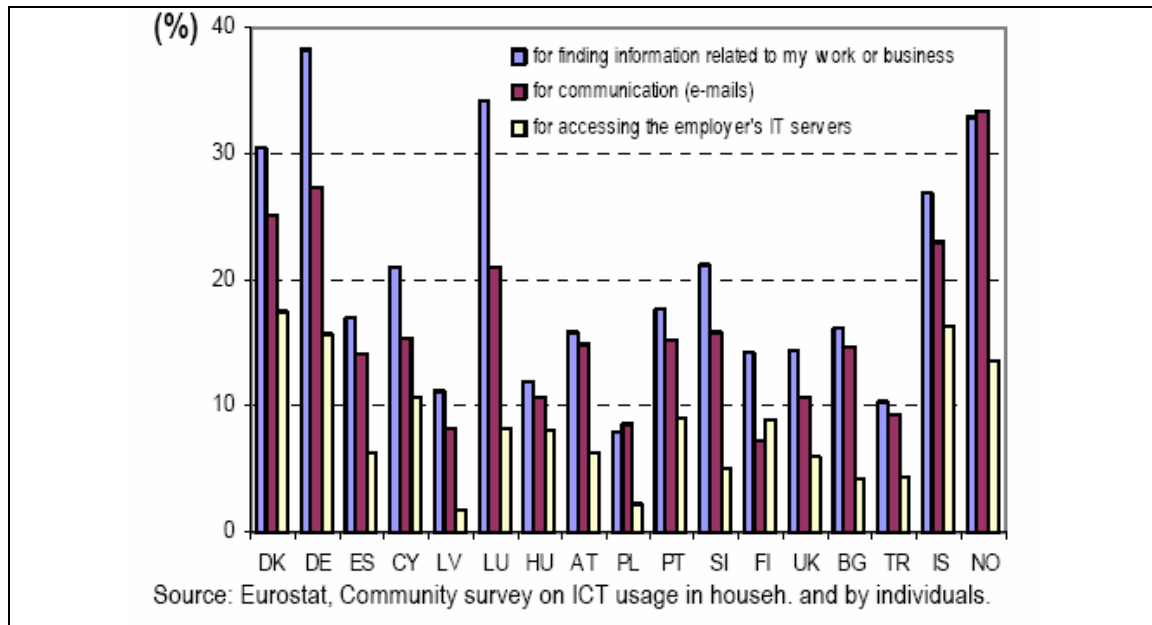
Which ones? (multiple choice)

a) Finding information relating to your work or business

b) Accessing the employer's IT systems

c) Communication (exchanging and accessing e-mails)

Figure 29: Proportion of Internet users performing selected work activities outside the premises of their employer (2004)



Source: Eurostat 2005

About the use of the Internet at the workplace, the Eurostat master questionnaire includes the following question:

Where have you used the Internet in the last 3 months (using a computer or any other means)? YES, NO

- a) At home
- b) At place of work (other than home)
- c) At place of education
- d) At other places
- d1) Public Library
- d2) Postal Office
- d3) Public Office, town hall, government agency
- d4) Community or voluntary organisation
- d5) Internet Café
- d6) Neighbour, friend or relative's house

Another indicator sourced from this survey is "percentage of persons employed using computers connected to the Internet in their normal work routine".

More in-depth data is available from the European Survey on Working Conditions, but this is only carried out once in five years, and analysis of the data is decentralised, which means that no set of core indicators has been defined yet.

Collaboration at Workplace Level

While these approaches open up various possibilities for producing statistics on multi-location, ICT-supported work, it is restricted to remote work in the sense of working taking place “outside the traditional workplace” and remotely from the location of the employer. In contrast, what has been termed tele-cooperation (Gareis & Hüsing 2002) would not (necessarily) be covered by such definitions. Such tele-cooperation is conceptually closely related to telework, which is why it has been dubbed ‘in situ telework’: Although the majority of white-collar workers today appear to be co-located in central office buildings, in fact they are often working closely together with value chain and project partners at far away locations. Theory suggests that tele-cooperation can boost worker productivity and innovative performance throughout the EU economy by allowing flexible configurations of human capital without actually moving people from one place to the other.

One attempt to collect data on tele-cooperation was undertaken by the SIBIS project (Empirica 2002). It was operationalised for survey research as “communicating with external business contacts via e-mail, video-conferencing or electronic data transfer”. For further explanation, external persons were described as “customers, clients, suppliers, other business contacts, but also colleagues working at other locations of the same company”. Table 9 shows the results from the pilot survey carried out in 15 EU Member States.

It becomes obvious from comparing the share of workers involved in tele-cooperation (as defined above) with the number of teleworkers that tele-mediated work practices are affecting many more people than only those who actually work from a *remote* place. It has often been observed that ICTs enable work to be brought to the worker (telework) instead of transporting workers to work (commuting). But work inputs and outputs are also increasingly transmitted between traditional workplaces via ICTs. This is a process which involves all parts of the economy and, as the SIBIS pilot data show, already more than a third of the EU workforce.

Table 9: Spread of tele-cooperation as defined by SIBIS (in %, EU15 averages for 2002)

Tele-cooperating = Persons using e-mail, video-conferencing or electronic data transfer when communicating with external contacts	37.8		
thereof (multiple response):			
Using e-mail		96.5	
Thereof			
10 or more times a day			34.0
less, but at least once a day			39.0
less, at least once a week			15.4
less often than once a week			8.0
never			2.8
DK			0.7
Total			100
Using video-conferencing		19.3	
Thereof			
10 or more times a day			0.4

less, but at least once a day			0.6
less, at least once a week			4.7
less often than once a week			13.6
never			80.0
DK			0.6
Total			100
Using electronic data transfer		81.9	
Thereof			
10 or more times a day			20.0
less, but at least once a day			33.9
less, at least once a week			19.3
less often than once a week			8.7
never			17.1
DK			1.1
Total			100
Not tele-cooperating	62.0		
Tele-co-operation: DK	0.2		
Total (all employed)	100		

Data base: All persons employed (N=5,100); weighted by EU15 population. SIBIS GPS, 2002.

In the future further steps will become necessary to gather data on the nature of tele-mediated cooperation. This is likely to require special surveys which analyse working processes in much detail. Existing surveys such as Germany's "Qualification and Employment Situation Survey" (BIBB/IAB) can act as bases for this.

Co-operation and Collaboration at Organisational Level

The data situation at the level of the firm / organisation is somewhat more favourable, due to the indicators provided by the European Community Innovation Survey (ECIS). This covers firm-level collaboration which is being practised in the area of R&D or other activities related to innovation. The definition given in the (postal) questionnaire is: "Innovation co-operation is active participation with other enterprises or non-commercial institutions on innovation activities. Both partners do not need to commercially benefit. Exclude pure contracting out of work with no active co-operation."

A key indicator from the ECIS is the "percentage of all innovative firms that co-operate with other firms or organisations". Distinctions are made between the types of co-operating partners:

- Other enterprises within your enterprise group;
- Suppliers of equipment, materials, components, or software;
- Clients or customers;
- Competitors or other enterprises in your sector;
- Consultants, commercial labs, or private R&D institutes;
- Universities or other higher education institutions;
- Government or public research institutes.

For each category, respondents are required to state its location (same country; other Europe, United States, all other countries). The survey also asks for the type of co-operation partner which the respondent firm found most valuable for its innovation activities. The data on these indicators is collected only from “innovative firms”, which themselves are defined as those that “have introduced technologically new or improved products or services on the market, or technologically new or improved processes. The product should be new to the enterprise, but does not necessarily have to be new to the enterprise’s market”.

Additional ECIS indicators of interest include:

- Share of enterprises which introduced organisational innovations in the reference period. An organisational innovation is defined as the implementation of
 - New or significantly improved knowledge management systems to better use or exchange information, knowledge and skills within your enterprise;
 - A major change to the organisation of work within your enterprise, such as changes in the management structure or integrating different departments or activities;
 - New or significant changes in your relations with other firms or public institutions, such as through alliances, partnerships, outsourcing or sub-contracting.
- Organisational change in enterprises – Share of enterprises that have changed their organisational structure in the reference period in any of the following ways:
 - New or significantly improved knowledge management systems to better use or exchange information, knowledge and skills within your enterprise;
 - A major change to the organisation of work within your enterprise, such as changes in the management structure or integrating different departments or activities;
 - New or significant changes in your relations with other firms or public institutions, such as through alliances, partnerships, outsourcing or sub-contracting.
- Outcomes of organisational change in enterprises: Degree of observed effect: high, medium, low, not relevant.
 - Reduced time to respond to customer or supplier needs;
 - Improved quality of your goods or services;
 - Reduced costs per unit output;
 - Improved employee satisfaction and/or reduced rates of employee turnover.
- Sources of information for launching new innovation projects or contributing to completion of existing projects: information sources within the enterprises; other enterprises within the enterprise group, suppliers, clients or customers, competitors and other enterprises from the same industry, universities or other higher education institutes, government or private non-profit research institutes, professional conferences, meetings, journals, fairs, exhibitions.

The European Commission also collects similar data through the annual Innobarometer, which is a telephone survey in the Eurobarometer framework.

The drawback of the ECIS indicators is the focus on collaboration for innovation purposes, and the lack of data on the extent to which ICTs are used for collaboration purposes. Having said that,

the ECIS should provide a very useful platform for integration of variables which are of direct relevance for the analysis of NWEs.

2.6 Synthesis: network4value Concise List of Policy Indicators

The brief overview in the preceding section over existing indicators which come closest to painting a picture about the spread and importance of NWEs has shown that there are only scarce data available on the subject. Comparison with the indicator needs laid out in section 0 let us conclude that there are considerable gaps in indicator availability.

The table on the following pages lists suggested indicators for statistical coverage of NWE-related constructs / developments. There are four different types of indicators:

⊕ indicators which are already established in the European Statistical System, but have not yet been utilised for analysing NWE related developments;

- indicators which have already been piloted in cross-country, European surveys (for example in one-off academic or industry studies), but are not yet established in the European Statistical System, and may need refining for analysing NWE related developments;

⊗ indicators which are already in use in national contexts but not yet for cross-country studies, and which may need to be refined for the analysis of NWE related developments;

- indicators which do not exist yet (i.e. for which no data exists yet) but which are deemed necessary for coverage of NWE-related developments.

The table also includes information on relations to existing indicators and on the observation and reporting units to be used. The last column, finally, includes our suggestion for the data collection instrument/framework to be chosen for carrying the indicator in question.

NWE Policy Indicators

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Readiness Indicators				
Broadband access (firms)	Share of organisations having broadband access to the Internet <u>Add.</u> : Share of staff having broadband access to the Internet at their workplace	Enterprises/ IT managers (or other)	⊖ Existing indicator – ICT Usage Enterprise Survey (add. indicator not yet collected)	Already contained in ICT Usage Enterprise Survey
Mobile broadband availability	Share of total population who live in areas which are covered by 3G networks or WiFis	Population by location across the country / Administrative data collection	• Not existing yet apart from industry sources at national level	Administrative data collection from national regulatory agencies
Mobile broadband access	Share of organisations having mobile broadband access to the Internet <u>Add.</u> : Share of staff having mobile broadband access to the Internet for work purposes	Enterprises/ IT managers (or other)	Ž Indicator may exist in some national surveys, but not included in the ICT Usage Enterprise Survey yet	ICT Usage Enterprise Survey

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Work in team/ project structures	Share of workers whose job involves doing work in a team <u>Add.:</u> Degree of autonomy of work in teams <u>Add.:</u> Share of workers a major part of whose work is organised in projects	All in paid work / all in paid work	<ul style="list-style-type: none"> Work in teams is covered by ESWC (Q26.B + 26B.1) and by national working conditions surveys Ž Project work not covered by indicators yet 	Upgraded European Survey on Working Conditions
Collaboration at the workplace: frequency, duration and intensity	Share of workers who collaborate with persons at other (a) sites (b) organisations <u>Add.:</u> Frequency and duration of collaboration per unit of time	All in paid work / all in paid work	<ul style="list-style-type: none"> Not existing yet (related to earlier indicator on tele-cooperation piloted in SIBIS and BISER) 	Upgraded European Survey on Working Conditions
Inter-firm collaboration	Share of firms involved in collaboration in innovation related activities <u>Add.:</u> Share of firms involved in collaboration in other activities (not related to innovation) Operationalisation of “collaboration”: “Collaboration means active participation in joint R&D and other innovation projects with other organisations (with other enterprises or non-commercial institutions). It does not necessarily imply that both partners derive immediate commercial benefit from the venture. Pure contracting out of work, where there is no active working together towards the same goal, is not regarded as collaboration.”	Enterprises/ Senior managers responsible for R&D	<ul style="list-style-type: none"> • Collaboration for innovation related activities is covered by the ECIS. Similar variable included in EB “Innobarometer”. Operationalisation of collaboration similar to ECIS. 	European Community Innovation Survey

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Physical worker mobility	Share of workers spending part of their working time away from their main place at work <u>and</u> (if applicable) their home office. <u>Add.:</u> Frequency and percentage of working time spent away from main place at work and home office.	All in paid work / all in paid work	Ž Related to variables about worker mobility piloted in SIBIS and BISER surveys.	Upgraded European Survey on Working Conditions
Digital skills	Self-reported confidence in: <ul style="list-style-type: none"> o using a search engine to find information on the Internet o using e-mail to communicate with others o downloading and installing software onto a computer o identifying the cause for computer problems o understanding text written in English 	All in paid work / all in paid work	Ž Adapted from eUSER; similar variables are contained, for example, in the SIBIS and BISER surveys	European Union Adult Education Survey (in preparation)
Collaboration & communication skills	Self-reported confidence in <ul style="list-style-type: none"> o working with a team of people; o listening carefully to colleagues; o selling a product or service; o counselling or caring for customers or clients; o persuading or influencing others; o instructing, training or teaching people; o making speeches or presentations; o writing long reports. 	All in paid work / all in paid work	Ž Similar question contained in the UK 2001 Skills Survey	European Union Adult Education Survey (in preparation)

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Self-management skills	Self-reported confidence in <ul style="list-style-type: none"> o planning activities; o organising one's own time; o thinking ahead; o detecting, diagnosing, analysing and resolving problems; o noticing and checking for errors. 	All in paid work / all in paid work	Ž Similar question contained in the UK 2001 Skills Survey	European Union Adult Education Survey (in preparation)
Participation in lifelong learning	Share of population in paid work who have participated in adult education and training in the reference period <u>Add.</u> : Time spent on adult education and training in the reference period (in classes)	All in paid work / all in paid work	Œ Similar indicator included in the CFLS. Improved variables included in SIBIS, BISER and eUSER surveys.	European Union Adult Education Survey (in preparation)
Workplaces enabling experiential learning	Share of persons in paid work who have a workplace in a knowledge-intensive environment. [to be operationalised as follows: "Not all learning takes place intentionally or via learning-by-doing. One can also learn new things by observing what people around oneself are doing and talking about. Would you say that at your workplace it is easy to learn from observing what people around you are doing and talking about?]	All in paid work / all in paid work	<ul style="list-style-type: none"> • Not existing yet. Related to ESWC items: <ul style="list-style-type: none"> o I can get assistance from colleagues if I ask for it o I can get assistance from superiors if I ask for it o I can get external assistance if I ask for it o At work, I have opportunities to learn and grow (5-point scales for each)	Upgraded European Survey on Working Conditions

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Attitudes towards entrepreneurship	Share of the labour force who have positive attitudes towards entrepreneurship (compound indicator)	Total labour force / total labour force	<ul style="list-style-type: none"> Component variables are included in Eurobarometer Flash "Entrepreneurship" 	Upgraded European Survey on Working Conditions or other
Direct participation	Share of workers in jobs with high participation in decision-making, meeting both of the following criteria: <ul style="list-style-type: none"> having discussed work-related problems and job performance with boss having been consulted about changes in the organisation of work and/or one's working conditions 	All workers with contract of employment / All workers with contract of employment	<ul style="list-style-type: none"> The component questions are included in ESWC (Q30.A,B,D) and by national working conditions surveys 	Upgraded European Survey on Working Conditions

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Uptake & Intensity Indicators				
Task complexity	<p>Share of persons in paid work whose job has a high / medium / low task complexity.</p> <p>Task complexity index to be calculated from replies to scaled questions:</p> <ul style="list-style-type: none"> ○ Tasks stay basically the same / change very often ○ Tasks change predictably / unpredictably ○ Tasks are of routine / non-routine nature ○ Tasks can / cannot be easily carried out by others with same formal education background ○ It is easy / hard for others to judge whether my tasks are carried out well or not well ○ Tasks are strongly / not at all interdependent on each other 	All in paid work / all in paid work	<ul style="list-style-type: none"> • /Ž Different variables on task complexity are included in the ESWC and national surveys on skills and working conditions 	Upgraded European Survey on Working Conditions
ICT use for team/project work	Share of workers whose job involves doing work in a team/project, and who use online ICTs for coordinating work in the team	All in paid work / all in paid work	<ul style="list-style-type: none"> • Not existing yet. 	Upgraded European Survey on Working Conditions

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Multi-location eWork (spread)	Share of persons who spend part of their working time away from their main place of work, and use ICTs for transferring work outcomes to co-workers / the employer when doing so. <u>Add.:</u> Frequency and percentage of working time spent eWorking at each location category (mobile, clients' premises, home, other), and technologies used.	All in paid work / all in paid work	• /• Principal-agent type eWork is covered by the LFS module developed by the STILE project; see also BISER survey.	Upgraded European Survey on Working Conditions
Virtual collaboration at the workplace: frequency, duration and intensity	Share of workers who collaborate with persons at other (a) sites (b) organisations, and who use mainly or exclusively online ICTs for the purpose. <u>Add.:</u> Frequency and duration of virtual collaboration per unit of time <u>Add.:</u> Share of workers who collaborate virtually with partners in foreign countries	All in paid work / all in paid work	• Not existing yet.	Upgraded European Survey on Working Conditions
Cross-border virtual collaboration	Share of firms involved in online collaboration in innovation related activities <u>Add.:</u> Share of firms involved in online collaboration in other activities (not related to innovation) <u>Add.:</u> Share of firms involved in online collaboration with partners in foreign countries.	Enterprises/ Senior managers responsible for R&D	• Not existing yet, but related to indicator in ECIS	European Community Innovation Survey

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Membership in (work-related) virtual communities	Share of persons in paid work who are active members in virtual communities which are (at least partly) related to their work. Virtual communities to be operationalised as follows: A virtual community is a group of people who communicate exclusively or mainly via the Internet on specific topics which are of interest to them.	All in paid work / all in paid work	<ul style="list-style-type: none"> • Not existing yet 	Upgraded European Survey on Working Conditions
Electronic freelancing (eLancing)	Share of self-employed persons who conduct part or all of their work exclusively via online media and the telephone.	All self-employed / all self-employed	<ul style="list-style-type: none"> • /• Piloted in SIBIS survey 	Upgraded European Survey on Working Conditions
NWE tools (uptake, patterns of use)	Share of persons in paid work who use certain groups of communication & collaboration tools, to be classified according to media richness and synchronicity.	All in paid work / all in paid work	<ul style="list-style-type: none"> • /• Some related variables included in earlier surveys on ICT use at the workplace. 	Upgraded European Survey on Working Conditions
Physical workplaces/staff ratio	Number of full-time equivalents employed (including freelancers and external staff) divided by number of full physical workplaces installed.	Enterprises/ human resources manager	<ul style="list-style-type: none"> • Not existing yet 	to be established
Social structures for team work	Share of persons working in teams/project who rate their work in team(s) positively, using the following scaled items: <ul style="list-style-type: none"> ○ Fairness of work in team ○ Effective control and leadership ○ Trust ○ Goals and motivation ○ Co-operative behaviour 	Persons in paid work who are involved in teamwork / dito.	<ul style="list-style-type: none"> • Not existing yet – based on pilot survey developed by Vartiainen (2005) 	Upgraded European Survey on Working Conditions

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Impact Indicators: 1st Order				
Gross rates of return	Ratio of gross operating surplus to the gross stock of fixed reproducible assets.	Enterprises/ senior manager	⌘ Existing indicator (OECD)	Established enterprise surveys
Overall rate of innovative activity	Overall innovation intensity index constructed from firm-level data on innovation activities and expenditures	Enterprises/ senior manager responsible for R&D	⌘/• Component data available from ECIS.	European Community Innovation Survey
Labour productivity (per hour)	GDP in reference year divided by total hours worked in same year	Enterprises/ senior manager	⌘ Existing indicator (OECD)	Established accounts
Pay levels / remuneration (per hour)	Seasonally adjusted average total earnings paid per employed person per hour, including overtime pay and regularly recurring cash supplements.	Enterprises/ senior manager	⌘ Existing indicator	Established enterprise surveys; Community Labour Force Survey
Capacity to change	Share of enterprises using virtual collaboration which report a positive impact on the capacity to change in the reference period. Time to action to be operationalised as follows: The effect on your organisation's ability to adapt quickly <ul style="list-style-type: none"> to fluctuations in demand, to unexpected changes in the market environment (if applicable), to lack of available skills on the labour market (if applicable), to new market opportunities. 	Enterprises using virtual collaboration / senior managers	• Not existing yet.	to be established

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Impact Indicators: 2nd Order				
Job satisfaction	Overall job satisfaction, 6-point scale (not satisfied at all to fully satisfied) <u>Add.:</u> Satisfaction with elements of the job: <ul style="list-style-type: none"> o satisfaction with type of job o satisfaction with distance to job o satisfaction with working times o satisfaction with job security o satisfaction with working conditions. 	All persons in paid work / all persons in paid work	• included in ECHP and ISSP; ESWC contains a question on overall satisfaction with working conditions	Upgraded European Survey on Working Conditions
Job-related health complaints	Share of persons in paid work who were absent from work in the reference period due to health problems caused by their work	All persons in paid work / all persons in paid work	• included in ESWC	Upgraded European Survey on Working Conditions
Job autonomy / job demands: Pro-active work organisation	Share of workers with contract of employment who <ul style="list-style-type: none"> o can choose/change their methods of work, o <u>and</u> their order of tasks or their speed or rate of work, o <u>and</u> who have high participation in decision-making (see above), o <u>and</u> who are participating in adult education and training (see above), o <u>and</u> who do part of their work in teams (see above), o <u>and</u> who can adapt their working hours within certain limits or entirely by themselves. <p>Various degrees of "pro-activeness" can be distinguished using a scale to be devised.</p>	All workers with contract of employment / All workers with contract of employment	• /Ž Component variables are included in the ESWC.	Upgraded European Survey on Working Conditions

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Perceived stress	Share of persons in paid work who report being affected by stress.	All persons in paid work / all persons in paid work	• contained in ESWC	Upgraded European Survey on Working Conditions
Individual labour market opportunities (perceived)	Share of persons in paid work who consider it "very easy" or "fairly easy" to find an acceptable new job if they were looking actively (5-point scale)	All persons in paid work / all persons in paid work	• included in ISSP	Upgraded European Survey on Working Conditions
Subjective well-being	On the whole, are you very satisfied, fairly satisfied, not very satisfied or not at all satisfied with the life you lead?	All persons in paid work / all persons in paid work	• Contained in the Standard EB as well as in World Value Survey.	Upgraded European Survey on Working Conditions
Impact Indicators: 3rd Order				
Levels of (un)employment	Persons in employment as share of total population (Eurostat definition)	Total labour force / total labour force	⊕ Existing indicators	Established accounts
Employment rate of older people / of women	Persons in employment in age bracket 55-64 as share of total population in same age bracket Women in employment as share of total female population	Total population 55-64 / total population 55-64	⊕ Existing indicator	Established accounts
Employment impact of parenthood	Absolute difference in employment rates without the presence of any children and with the presence of a child aged 0-6	Total population 20-50/ total population 20-50	⊕ Indicator was suggested in an earlier Commission report ²⁹ and can be calculated using CLFS data	Community Labour Force Survey

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Skill utilisation (invisible underemployment)	Share of persons in paid work who believe they have skills or qualifications to do a more demanding job.	Persons 16+ whose main activity is paid employment (min. 15 hours/week) / dito.	⌘ Existing indicator (ECHP), but frequency and data availability insufficient	Upgraded European Survey on Working Conditions
Unmet demand for generic/ specialist skills	Share of enterprises that could not fill at least one vacancy in the reference period (12 months) due to lack of the required <ul style="list-style-type: none"> specialist skills; generic skills available on the labour market. 	Enterprises/ human resources manager	Ž Featured in many national enterprise surveys on skill needs, e.g. in Germany. No comparable cross-country indicator available yet.	Eurobarometer or other regular enterprise surveys
Total factor productivity (growth)	Ratio of a measure of total output quantity to a measure of the quantity of total input.	Member State / established accounts	⌘ Existing indicator (OECD)	Established accounts
GDP growth	Gross domestic product, change between reference years	Member State / established accounts	⌘ Existing indicator (OECD)	Established accounts
Virtual collaboration in rural and peripheral regions	Ratio between share of virtual collaborators in rural and peripheral NUTS2 regions and share of virtual collaborators in all other NUTS2 regions. Virtual collaborators are persons who collaborate with persons at other (a) sites or (b) organisations, and who use mainly or exclusively online ICTs for the purpose.	All persons in paid work / all persons in paid work	• Not existing yet. Regional typologies for classification of NUTS2 regions available from various sources.	Upgraded European Survey on Working Conditions
Total transport volumes per unit of GDP	Ratio between passenger-km plus tonne-kilometres (inland modes) and GDP (Gross Domestic Product in constant 1995 EUR). It includes transport by road, rail, air and waterways.	EU territory/ Administrative data collection	⌘ Existing indicator	Eurostat databases on transport statistics

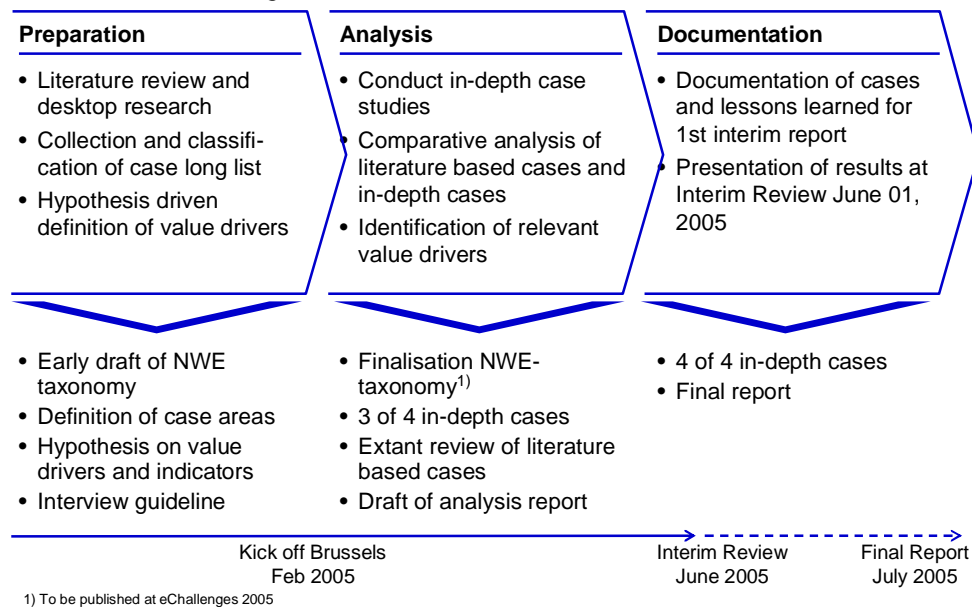
Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Total miles travelled for work	Total miles travelled per unit of time for work-related purposes, differentiated by commuting trips and other work-related trips. <u>Add.</u> : Frequency and percentage of working time spent away from main place at work and home office.	All in paid work / all in paid work	<ul style="list-style-type: none"> • Not existing yet. 	Upgraded European Survey on Working Conditions

Chapter 3: State-of-the-Art NWEs

3.1 Case Studies for Best Practice Assessment

The case study analysis was structured in three distinct steps as depicted below. In a preparation phase the team conducted a first literature research to establish a draft on a possible NWE taxonomy, define case areas and derive hypothesis on NWE-value drivers and indicators. These results were discussed at the project kick off meeting in Brussels in February 2005. In the analysis phase, the NWE-taxonomy was finalised, an analysis of extant cases was prepared and 3 of the 4 in-depth case studies were conducted.

Figure 30: Task 2 activities and deliverables



Case logistics

Each case should identify the key factors for the success of NWEs. As such, for each case we defined the following areas of special interest in an interview guideline:

- Case description
- Implementation effort
(e.g. duration, degree of change)
- Technology used to support the NWE
(e.g. infrastructure, personal equipment, applications / software)
- Processes and organisation
(e.g. inter-/intra-organisational, roles and tasks, hierarchy)
- NWE Performance Measurement / Controlling
(e.g. business case, KPIs, qualitative/quantitative impacts, internal/external impacts)

- Social impact
(e.g. skills, motivation, work/life-balance, culture)
- Enablers and barriers
(e.g. organisation redesign, communication/involvement, controlling)
- Outlook
(e.g. plans/needs for future improvements)

To ensure an effective data collection and consistency of results, multiple interviews per case were conducted (to allow triangulation) and at least one feed-back loop was initiated for authorisation of results by the case company.

NWEs industrial area and case selection

In cooperation with the EC the research consortium defined four key industrial areas for the research of NWE case-studies³⁰. The selection of industries was based on industry size, the industry adoption of NWEs and its relevance to EC-funded research. Furthermore, the industries had to be complementary and access to research resources had to be available at reasonable cost (e.g. from corporate partners in the networks of the conducting research institutes).

The four areas of interest that were selected are:

- Global product development in high tech industries:
- Health care service delivery
- NWEs in Media
- NWEs in Supply Chains

Based on the industry selection, the research consortium identified suitable case studies based on literature and based on real life examples. The cases are listed in the following figure.

In global product development two in-depth cases were conducted by use of personal interviews with managers of the global product development process at Nokia and with managers of the Forum Nokia. These cases were complemented with literature based case research on virtual project delivery, virtual and remote working at a telecommunications provider and an eSourcing initiative, which resembles the automation of processes in collaboration networks. Apart from seven interviews with Nokia representatives, this case research was complemented with interviews with virtual and mobile work experts from Helsinki University of Technology.

Since literature provides a vast base of healthcare service delivery cases that provide insights on NWEs it has been decided to perform a meta-analysis of selected healthcare cases in the area of networked hospitals and regional networks of surgeries. For complementation and validation two expert interviews (one researcher and one practitioner) have been conducted as well.

For the media industry, one in-depth case has been documented based on interviews with TeleZüri, the biggest private TV station in Switzerland that applies highly advanced NWEs to maintain their competitiveness. Another in-depth case study was conducted with Deutsche Welle TV. In addition to that literature based cases were documented.

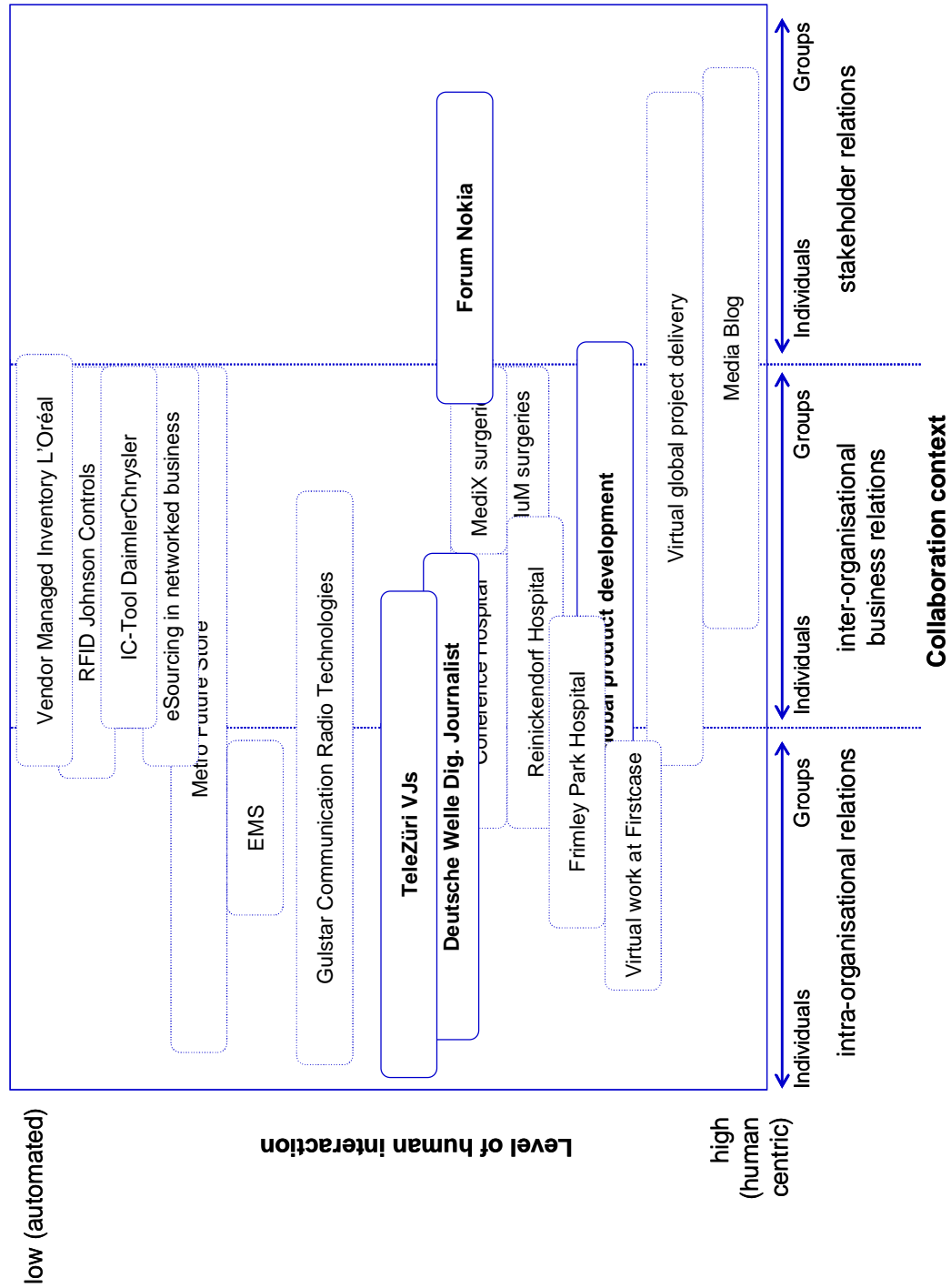
In the area of Supply Chain Management four complementary, literature-based cases were documented. The findings were validated with an expert interview.

Figure 31: Case overview³¹

Industry	Case Study	Type	References
Global product development	Forum Nokia	In-depth	
	Global Product Program Development	In-depth	
	Virtual global project delivery	Literature	Edwards & Wilson (2004)
	eSourcing in networked business	Literature	Klueber & Österle (2000), IDATE (2004)
	Virtual work solutions at Firstcase Telecommunications	Literature	Edwards & Wilson (2004)
Health Services	Reinickendorf Hospital (GER)	Literature	Mueller-Albrecht (2000)
	Coherence (F)	Literature	Silver (2003)
	Frimley Park Hospital (UK)	Literature	Brodt et al. (2005)
	MuM Network of surgeries (GER)	Literature	Tiska (2005), Krüger (2005), Schmidt (2002)
	MediX Network of surgeries (CH)	Literature	Götschi & Weber (2003), Thalmann (2001), Weber (2005)
	Emergency Medical Service (CH)	Literature	Brodt et al. (2005), Schlatter & Blaser (2003), Swisscom Mobile (2003)
Media	TeleZüri Video Journalists	In-depth	
	Deutsche Welle Journalists	In-depth	
	Technology in Radio industry	Literature	Nellessen & Brady (2000)
	Newspaper Network	Literature	Lahenius, Immonen & Järvenpää (2001)
	Joint Value Creation in the film sector	Literature	Gaustad (2002)
Supply Chains	Information Control DaimlerChrysler	Literature	Graf & Putzlocher (2002)
	Vendor Managed Inventory L'Oréal	Literature	Senger & Österle (2003)
	RFID Johnson Controls	Literature	Collins (2003)
	Process Portals ETA SA	Literature	Alt et al. (2002), Alt, Reichmayr & Zumühlen (2002)

The figure below classifies all evaluated case studies in terms of levels of human interaction and collaboration contexts into the general taxonomy of NWEs.

Figure 32: Case overview in NWE Taxonomy

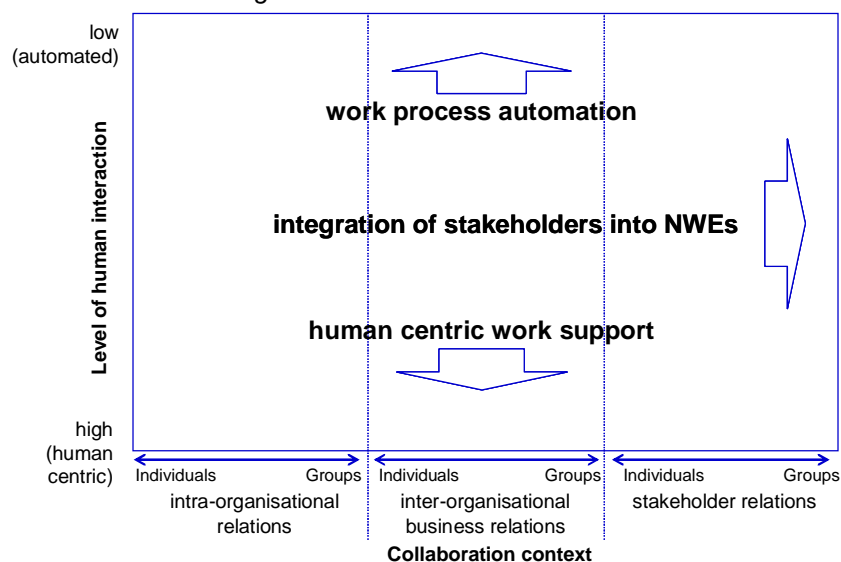


Generally, three main trends become visible, when analysing the NWEs based on the suggested taxonomy (also refer to figure below):

- Increasing automation of Working Environments that base on codified knowledge about processes
- ICT as a context aware support technology for Working Environments that base on implicit knowledge support
- Increasing active extension of corporate networks (and the respective work environments) to comprising various groups of stakeholders that are not in a business relation with the company. Examples of such stakeholders are NGOs, consumer organizations, regulatory authorities and similar.

From each of these trends we can identify critical implications for the design of NWEs: (1) NWEs with increased automation have the tendency of a reduced need for human work for highly structured routine activities. On the other hand existing job profiles change profoundly. The tasks require different - typically more advanced - sets of skills as routine work is taken over by machines. (2) NWEs with a strongly human centric dimension can be seen as augmented working environments because they allow for interactions that would have never been possible before. This allows for greater efficiency but also for the new types bundling of resources. With the advances of ICT and further codification of implicit knowledge they too may be automated over time. (3) Networking technologies and activities allow the active inclusion of non-business partners. The figure below depicts these developments in context of the NWE-taxonomy.

Figure 33: NWE immanent trends



3.2 Summary of Findings from Cases

The following sections describe the various lessons learned from different perspectives. The enablers and barriers identified in the various case studies are presented in an aggregate form, indicative aggregated conclusions of the different case studies are shown and several commonalities of NWEs in various industries are identified. Based on these findings key value drivers were identified and research gaps were identified. For detailed information on the specific cases please refer to the special task 2 report.

Aggregate value drivers

In the various case studies a number of key value drivers could be identified.³² These enablers and barriers are related to different topics and need to be taken into account, if a company wants to foster successful NWEs. The list of topics below is to be seen as the generalized lessons learned from the long list of value drivers.

In general today companies have to sustain and create growth in dynamic, changing, converging and global markets and competitive environments. In order to achieve that, companies in particular need dynamic innovation processes and flexible structures capable of sensing and replying to market needs dynamically and by taking in consideration personalized needs and requirements. Networks and their core components networked working environments are key enablers in this context. Further key value drivers are:

- 1) Strategic alignment of intra- and inter organisational network partners
To reduce borders between organizations the relations to all stakeholders need to be looked at. This may - in some cases - mean that the stakeholders first need to be identified. For a common "way of doing things" common values and goals must exist. The basis of such relations can be found in mutual trust and transparency.
- 2) Effective network coordination and network-wide process definitions
For effective coordination open communication (for good and bad news alike) is compulsory. Partners need access to information early and incentives have to be effective as well as efficient.
- 3) Leverage complementary knowledge resources in network to increase quality of outcome
Exchange of knowledge can be vital in networked working environments. This may often mean that face-to-face meetings are necessary however advanced the communication technology is. Networked working however also means that knowledge of experts around the world can be tapped into whenever necessary.
- 4) Network wide deployment of collaboration and communication tool infrastructure
Communication and collaboration tools not only need to be efficient (aspects are: performance, compatibility, functionality and security) but also need to be used in a sensible manner. An effective mix of online and offline services and tools need to be looked for. If used right, such tools support networked working and can prevent error provoking media breaks. New type of collaboration processes need to be designed taking into consideration a proper mix of online and offline elements. Such generic networked processes cumulating available knowledge are not available yet.
- 5) Effective performance controlling and quantifiable outcomes

- The performance of NWEs may be measured in various ways. The outcome may be measured in cost savings (travel, overhead, relocation, and time), risk reduction or even the advantage of being able to work 24h a day through globally networked teams. However, tools to measure direct or indirect returns of NWEs must often be developed.
- 6) Sustainable top-level support for NWE implementation and activation
NWEs need sufficient funding and resources to sustain until long-run benefits can be realized.
 - 7) Continuous people motivation, entrepreneurship and trained networking skills
Motivation and personal commitment of employees to the network is a vital asset of NWEs. The case studies showed that an open culture with open communication and a participative approach are successful. But individual skills of employees are equally important. Due to the increased complexity of the network they need to be flexible and often capable of "multitasking". Continuous support and training may therefore be needed.
 - 8) Professional implementation and change management.
NWEs often bring along fundamental changes in working environments. Therefore detailed process analysis and stakeholder management are crucial. Early involvement of everybody affected by the changes has shown to be a successful approach. If possible, a stepwise rollout may be considered.
 - 9) Enhancement of capabilities of employees with technology.
Information technology and new applications as wearable computing, the digital equipment of Video journalists and similar are examples how technologies enhances capabilities of humans and empowers them by providing structured access to available knowledge.

Aggregate Barriers

Most of the barriers identified in the case studies could be found in a variety of cases and have therefore influenced the definitions of the value drivers. Some however were found to be very case specific and therefore didn't find their way into the aggregate conclusions. Since they might have some general significance nevertheless they should be mentioned here.

1. Cultural and Social Aspects
 - Differences in cultural backgrounds and language issues
 - Lack of face-to-face contacts
 - Lack of socialising among the partners and teams
 - Lack of trust in the technology performance and de-humanisation of business relationships
 - Skills - both in terms of IT and in terms of training staff
 - Cultural factors - reporting of risks
 - There will always be people who do not embrace the new technology
 - An early involvement of the team in the decision and implementation process would have helped to increase acceptance for the system from the start. Both the limited acceptance and the early malfunctions of the technology caused self-enforcing negative effects onto the pace of implementation.
 - Limited / wrong skills

- Unions - the fear that the new job profile might render other professions obsolete
- Combined training of people with different backgrounds may cause problems
- Higher stress factors
- Lack of personal relations between collaborating partners

2. Geographical Issues

- Limited availability of people due to global differences in time zones and working hours (esp. in case of critical situations)
- Intensive travel

3. Management Issues

- Information and meeting overload
- High number of partners
- Remain network of a manageable size
- Being the first adopter of the solution caused longer and more expensive implementation than planned
- Various emergency medical technicians share the philosophy that “every cent, which is not invested in medical technology and equipment, with direct use for the patient is lost money”. Therefore the benefits of ICT in the medical environment must be made clear from the start.
- False incentives through inefficient funding system

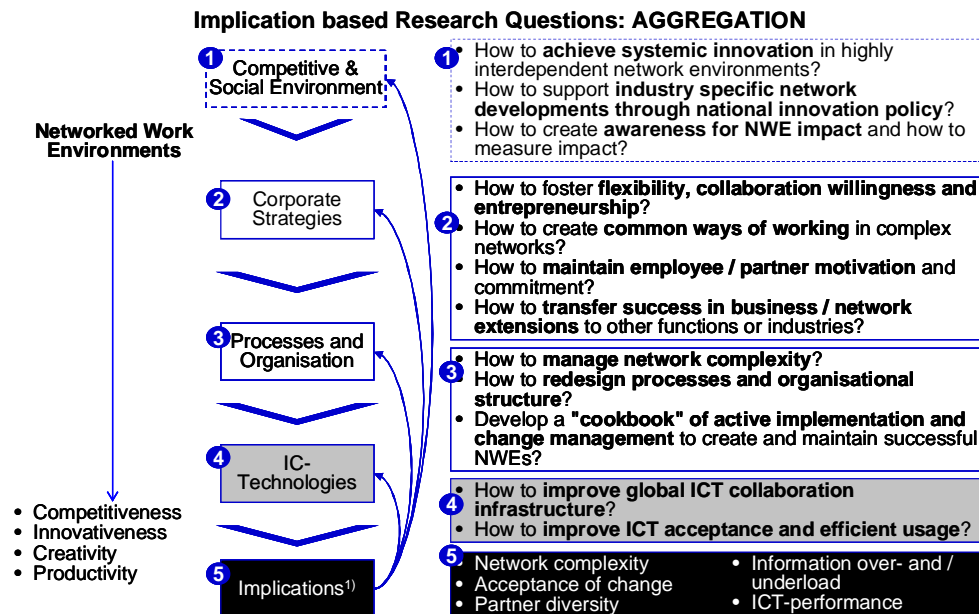
4. Technological Issues

- Insufficient communication tools
- Lack of financial investment in ICT infrastructure for virtual collaboration
- Lack of security
- Highly classified development material would require extensive sign off procedures which are usually dealt with in a physical way
- Lack of an internationally accepted encryption system for electronic sign offs
- Lack of broadband connectivity
- Weight and battery issues (resolved by process and modifications to the kit)
- Costs of technology
- Technology - it has not disappeared in the background yet

Potential research priorities related to value drivers

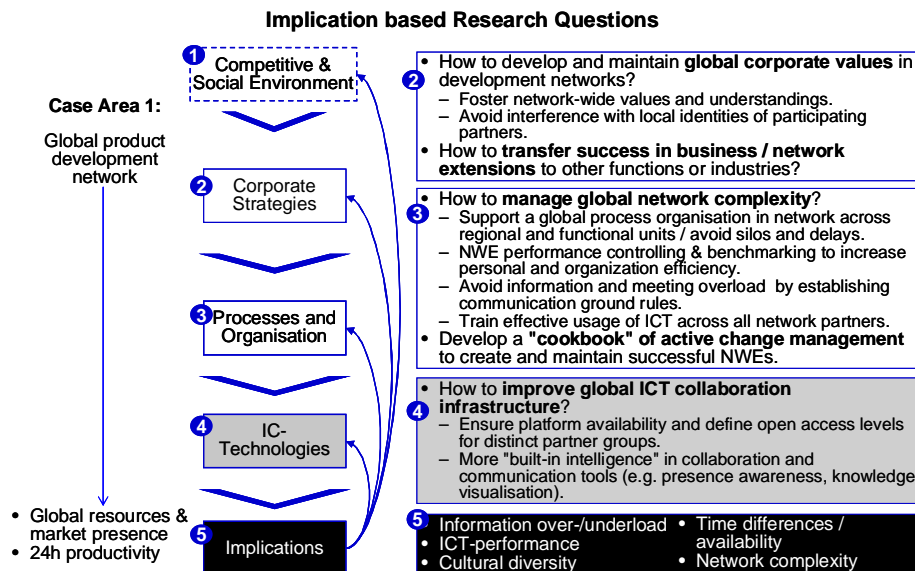
The proposed research questions resulting from the examination of the case studies are presented in the figures below. They also indicate the different levels within the NWE, on which research is suggested.

Figure 34: Implication based Research Questions: Aggregation



Global product development

Figure 35: Implication based Research: Questions: Global product development



Health services

Figure 36: Implication based Research Questions: Healthcare (1/2)

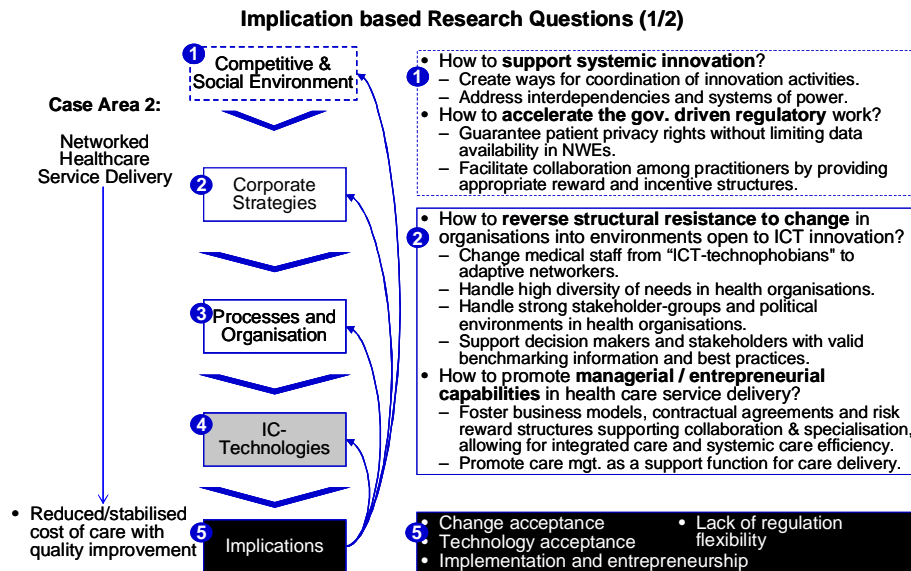
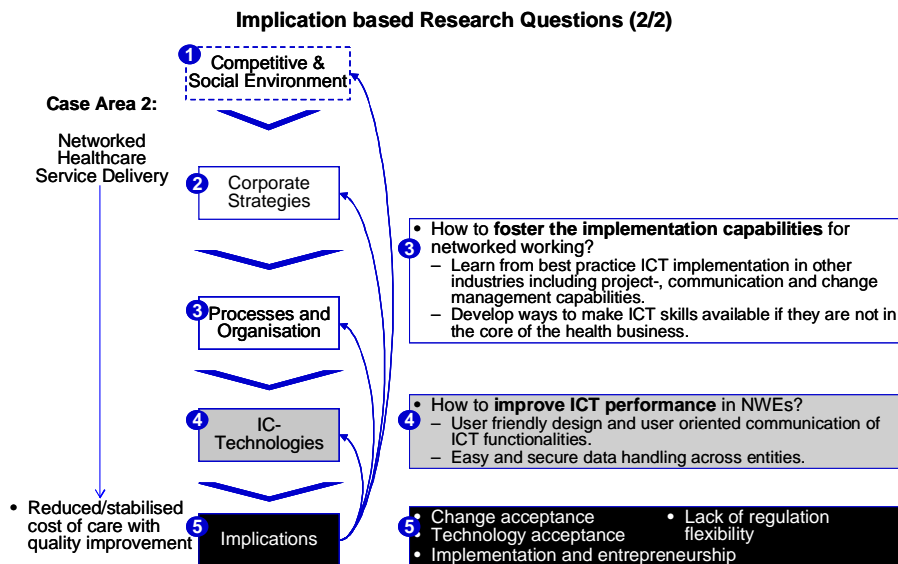
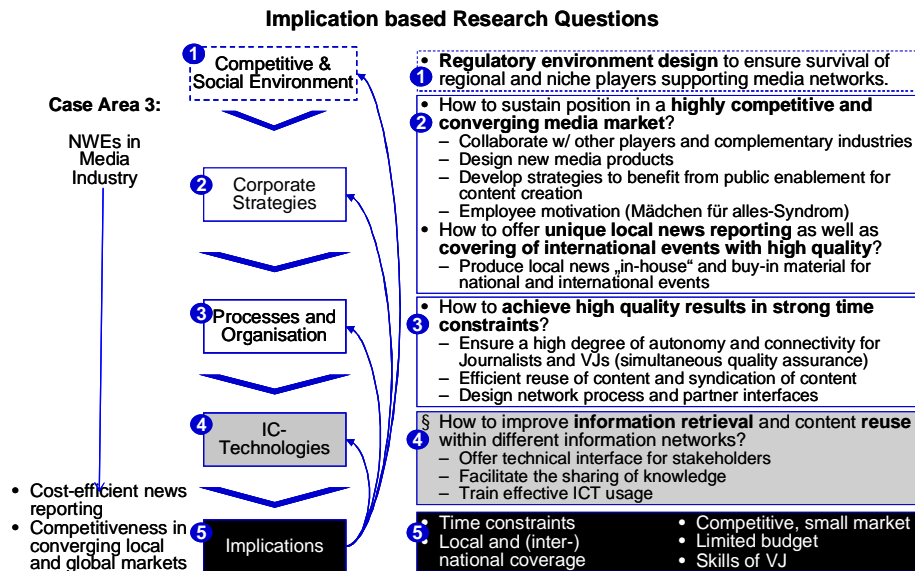


Figure 37: Implication based Research Questions: Healthcare (2/2)



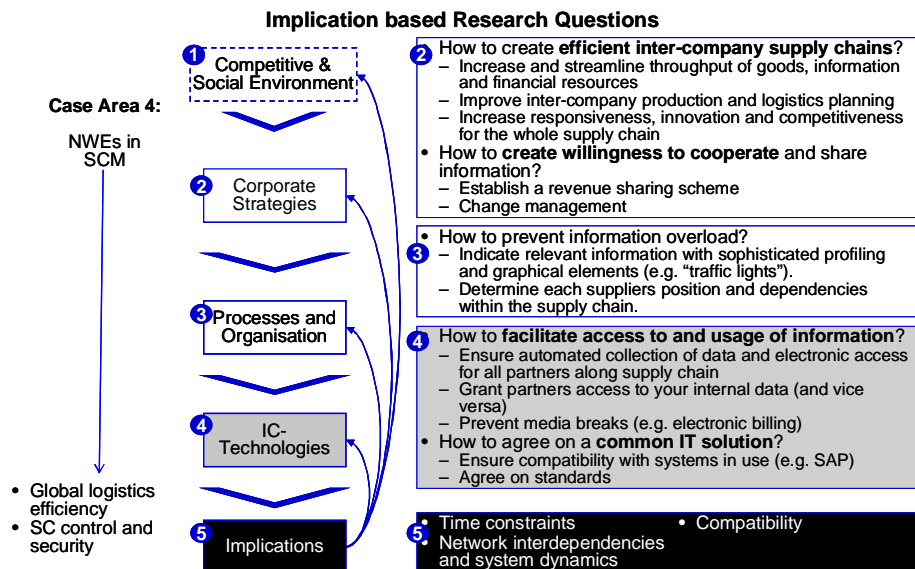
Media industry

Figure 38: Implication based Research Questions: Media industry



Supply chain management

Figure 39: Implication based Research Questions: Supply chain management



3.3 Indicator Needs Arising from the NWE Cases

The different case studies have shown that data collection within the different NWEs is done but not in an integrated manner. Many of the needed key performance indicators (KPIs) can be found in a variety of sources. However the collection of these data is patchy. Some of the KPIs aren't measured at all and if they are, they are not aggregated into an integrated NWE-view. The figure below indicates - at the example of the health and the media industries - how such KPI measurement is currently done.

The lack of an integrated NWE-view makes it difficult to compare NWEs. Such comparisons however are necessary, if benchmarking and ultimately improvements of NWEs are to be possible.

Findings from company internal NWE measurement:

- NWEs impacts are measured – however measurement is scattered and incomplete (e.g. separate levels, separate channels, no integration).
- An explicit “NWE-view” does not exist – but could be generated by tapping and complementing the various sources of information. In general companies measure total investments in ICT but do not relate it to outcomes and also detail it in different categories. A possible solution could be to develop a taxonomy of potential investments in NWEs and their impact. This could provide the basic to provide a more differentiated view on ICT investments in NWEs and relate them to their potential impact.
- NWEs are not easily to be compared to traditional ways of working in cases where they are integral parts of new business strategies and processes (problem of missing point of reference).
- Data collection, analysis and presentation needs standardisation and automation to reduced manual efforts and ensure easy access and derivation of insights.
- Communication about measurement should be user centric and avoid negative reactions on automation and efficiency indicators.

Figure 40: Exemplary structure of NWE Key Performance Indicators and sources

Exemplary structure of NWE KPIs¹⁾ and sources

		Health		Media	
		KPI	Pot. Source	KPI	Pot. Source
Efficiency	NW-internal	<ul style="list-style-type: none"> • Pat. release time • Mat. & pers. cost • Utilisation • ... 	<ul style="list-style-type: none"> • Hosp. perf. cont. • Hosp. perf. cont. • HR-controlling • ... 	<ul style="list-style-type: none"> • MA/minutes of reported news • MA/number of news reports 	<ul style="list-style-type: none"> • Performance controlling • Performance controlling
	NW-external	<ul style="list-style-type: none"> • Pat. travelling time • Treatment of remote patients 	<ul style="list-style-type: none"> • - ? • Municipal statistics 	<ul style="list-style-type: none"> • Content re-use • ... 	<ul style="list-style-type: none"> • NW-wide content syndication revenue
		KPI	Pot. Source	KPI	Pot. Source
Quality Improve-ment	NW-internal	<ul style="list-style-type: none"> • Diagnosis precision • Empl. motivation 	<ul style="list-style-type: none"> • Association quality survey • Empl. sat. survey 	<ul style="list-style-type: none"> • Content quality • Empl. motivation 	<ul style="list-style-type: none"> • Mkt. feedback (customer, awards) • Empl. sat. survey
	NW-external	<ul style="list-style-type: none"> • Patient satisfaction • Image • ... 	<ul style="list-style-type: none"> • Patient sat. survey • Market perception survey 	<ul style="list-style-type: none"> • Customer sat. • Image • Diversity of opinions / niche channels 	<ul style="list-style-type: none"> • NW-internal • Market survey • Antitrust surveys
		KPI	Pot. Source	KPI	Pot. Source

1) Key Performance Indicator. A metric used by a company to analyse the performance of existing businesses or processes in comparison to targets and past developments. In context of the network4value project a KPI is not equal to NWE-indicators dealt with in Task 3.

A rigid and viable cross company benchmarking framework could identify performance improvement potential and support decision making to design NWEs.

On a more general industry, country-wide or European level the split of indicators related to ICT on the company level might provide a foundation for a differentiated view on an aggregated level.

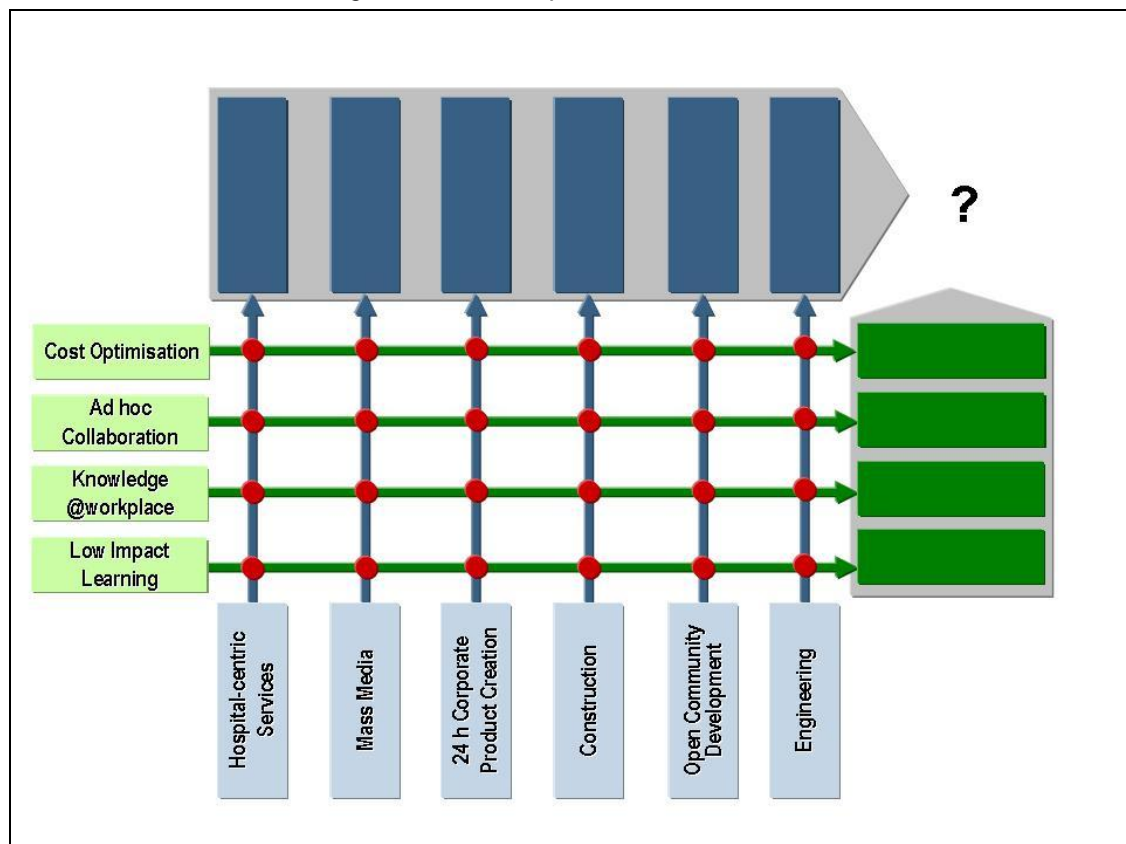
Chapter 4: Industry and Theme Specific Analysis

4.1 Thematic and Domain Specific Roadmapping

One of the objectives of the network4value study was to identify the current state of different networked environments (thematic and domain specific) and to then with the aid of experts (including workshops and interviews) formulate visions for the future of such networked (new) working environments. Roadmaps detailing the transition from the current to future (vision) state were to be developed and validated (within workshops, communities, etc.). Each R&D roadmap would contain a set of R&D topics that are positioned in the innovation life cycle with a tentative timeline for exploitation of the results (industrial take-up identified) as follows:

- Take-up - Adopt, deploy & demonstrate mainly existing technologies (0-2 years).
- Development - Clearly defined RTD to achieve exploitable results (3-5 years).
- Research - Prototyping is required to find the optimum way forward for further (6-10 years).
- Emerging - Exploring RTD needs and opportunities for potential solutions (11-20 years).

Figure 41: Roadmap themes and domains



Within network4value a series of different roadmaps were developed. Several of them are in line with the AMI@Work communities' portfolio. The developed roadmaps have been categorised as being:

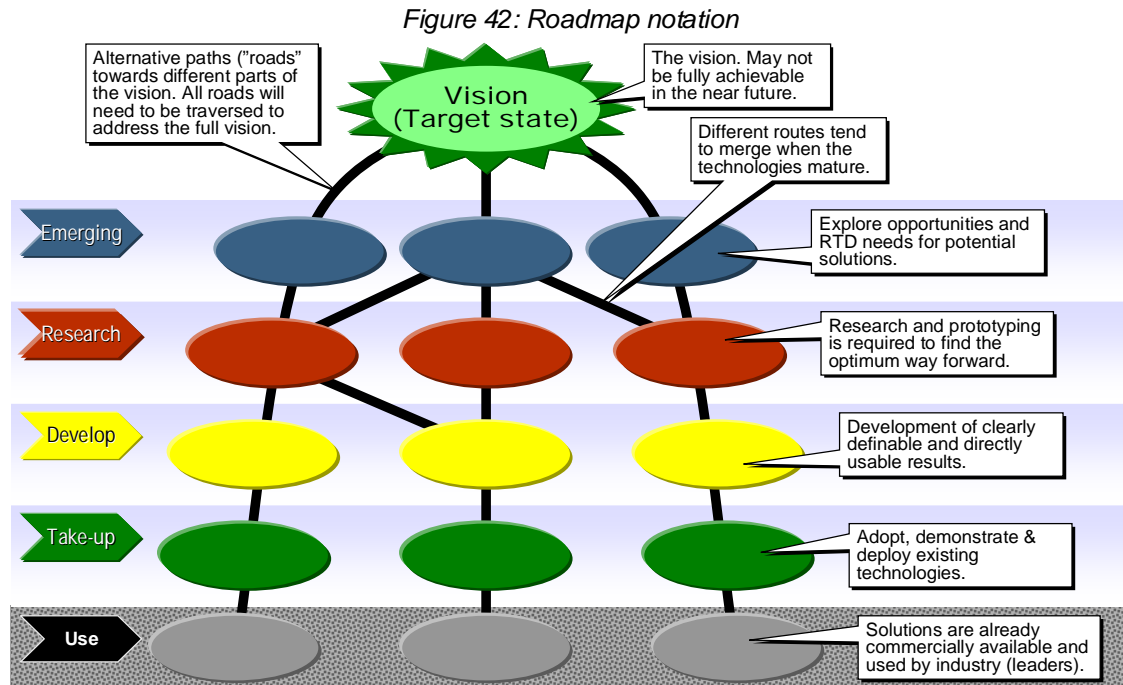
- Theme Specific - These roadmaps are seen as horizontal and span across different industrial domains and/or sectors. Theme specific, enabling roadmaps developed in network4value include:
 - Global eco-efficient workplaces
 - Ambient collaboration
 - Ambient knowledge sharing
 - Learning in the network economy
- Domain Specific – These roadmaps are seen as vertical and typically cover a specific domain and/or industry. The domains were partly selected due to their importance as vertical application areas for Europe. Partly they were selected because they can be seen to be some of the most interesting emerging collaborative technology examples and drivers for global change. These domain specific, validating roadmaps developed in network for value include:
 - 24/7 Innovation and open value creation
 - Open innovation
 - On demand micro-media
 - Global concurrent engineering
 - Mobile workplace innovation in construction
 - Pervasive health services

Approach

For each thematic area and domain considered, the current as-is state was identified followed by a vision statement describing the to-be situation once the vision was achieved. This was followed by a presentation of a hypothetical scenario illustrating how things would function if the vision was achieved.

Several different road-mapping techniques were considered based on a study of the methods used to develop R&D roadmaps by roadmap projects funded in the last call of framework 5³³. Since members of the network4value consortium participated in several of these projects (such as: SASKIA, NESKEY, INTELCITY, VOMAP, COCONET, ROCKET, ROADCON), it was possible to rely on their experience for identification of a simple, visual, and easy to understand road-mapping method. In the end, the approach adopted by ROADCON³⁴ was selected. This selection was based primarily on the simplicity of the approach, the experience of network4value partners in using it, and the fact that the approach had been tested in various workshops and by a support group of 293 organisations³⁵.

The approach is illustrated in Figure 42.



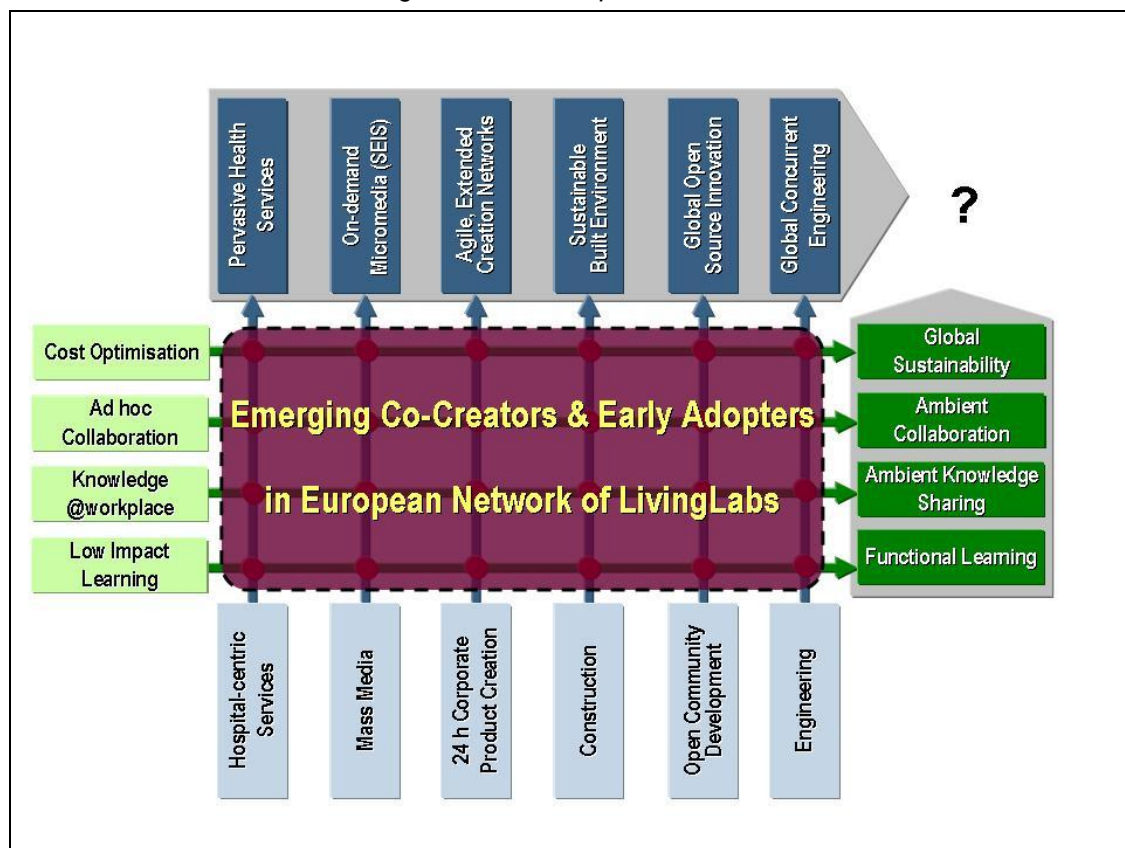
Following the development of the roadmap in line with the notation shown in Figure 37, each of the ovals (R&D activity) within the roadmap was described further. It should be noted:

- **Use** – is primarily specific to the industry, i.e. technologies that are currently being used by market leaders.
- **Take-up** – primarily consists of tools and technologies that are ready for deployment. This layer is mainly applicable to ICT developers who have technologies to offer that are ready for adoption, demonstration, and potential deployment.
- **Develop** – is primarily specific to ICT vendors. These include clearly defined requirements and specifications for tools that are to be developed.
- **Research** – is specific mainly for R&D performers such as the R&D departments of organisations, research institutes, universities, etc. In simple terms, these are those areas where EC funding for R&D projects should be allocated.
- **Emerging** – is similar to the EC project type known as FET (future and emerging technologies). These are typically R&D activities that may be taken up for exploration by different R&D performers. Note that while some may prove worthwhile and then qualify for further research, then development, then take-up, and finally use, others may give way to other exciting and/or emerging technologies.

In the above figure, the black lines are used to indicate possible routes that will together contribute towards achieving the vision (or to-be state for each roadmap). The lines interconnecting the bubbles are used to demonstrate that certain activities typically build-up upon previous activities (as an example the eWork guidelines that are being developed are a basis for the research undertaken in research on self-assessment tools).

Last but not least, it is worthy to mention that the majority of roadmaps are technology driven. While many are expected to be technically feasible, human and organisational barriers may act as an impediment to their complete realisation. Therefore, when implementing a roadmap or a part of it, due consideration of human and organisational factors is required. Within the research actions that follow each roadmap, a special section on "inhibiting factors" is included. This, amongst other factors, takes into account human, organisational, and other barriers to the successful achievement of the proposed research actions.

Figure 43: Roadmap vision states



The final step in the development of the roadmaps is the presentation of a set of research ideas/actions that can in part contribute to the realisation of the vision through delivery of a set of R&D activities (ovals in Figure 37). Table 10 provides the common template and directions for providing the R&D ideas/actions. Variations in both roadmap figures and related R&D tables have been made in order to accommodate the unique nature of versatile themes under study. The theme and domain specific roadmaps can be seen in Appendix I.

The content of the R&D idea/action tables in connection to each roadmap rise directly from the roadmap themes. Chapter 5, Recommendations for Action, however, views the visionary roadmaps on an aggregate level.

Table 10: R&D idea/action template

Title	<i>Short project title</i>
Keywords	<i>4-5 main keywords</i>
Problem/Issue (why)	<i>What is the main problem the project will try and resolve</i>
Objectives (what)	<i>Measurable and tangible objectives</i>
Approach (how)	<i>Approach to be used ... may be broken down in the form of WPs or tasks</i>
Focus	<i>Tech. & standards; ICT infra., Applications; Business Processes</i>
Phases	<i>Research; Development; Validation; Deployment; Dissemination</i>
Technologies	<i>Main technologies to be developed/extended</i>
Business process change	<i>List of perceived changes to/introduction of new business processes</i>
Impacts	<i>Main expected achievements/impacts at organisational/societal level</i>
Inhibiting factors	<i>What may be the potential inhibiting factors: technological/societal</i>
Participants (who)	<i>Types of participants: industry; ICT vendors; Research institutes/universities</i>
Duration	<i>What is the appropriate duration to achieve this project</i>
Resources	<i>Identify estimated resources</i>
Follow-up Actions	<i>List here follow-up actions in terms of technology developments, etc.</i>

4.2 Network4value Concise List of Policy Indicators

The table below lists suggested indicators for statistical coverage of NWE-related constructs / developments. There are four different types of indicators:

⊕ indicators which are already established in the European Statistical System, but have not yet been utilised for analysing NWE related developments;

- indicators which have already been piloted in cross-country, European surveys (for example in one-off academic or industry studies), but are not yet established in the European Statistical System, and may need refining for analysing NWE related developments;

⊗ indicators which are already in use in national contexts but not yet for cross-country studies but not yet for cross-country studies, and which may need to be refined for the analysis of NWE related developments;

- indicators which do not exist yet (i.e. for which no data exists yet) but which are deemed necessary for coverage of NWE-related developments.

Roadmap Core Indicators	Ambient Knowledge Sharing	Ambient Collaboration	Global Sustainability	24/7 Innovation and Global Value Creation	Global Open (Source) Development	On-demand Micro-media	Global Concurrent Engineering	Sustainable Built Environment	Pervasive Health Services	Learning	Global Logistics (RFID- enhanced)
Readiness Indicators											
Broadband access (firms)	Ⓔ	Ⓔ	Ⓔ	Ⓔ	Ⓔ	Ⓔ	Ⓔ	Ⓔ	Ⓔ	Ⓔ	-
Mobile broadband availability	•	•	-	-	-	•	-	•	•	•	•
Mobile broadband access	Ž	Ž	Ž	-	-	Ž	-	Ž	Ž	Ž	Ž
Work in team/ project structures	-	•	•	•	•	-	•	•	-	•	-
Collaboration at the workplace	•	•	•	•	•	•	•	•	•	•	•
Inter-firm collaboration	Ⓔ/•	Ⓔ/•	Ⓔ/•	Ⓔ/•	Ⓔ/•	Ⓔ/•	Ⓔ/•	Ⓔ/•	Ⓔ/•	Ⓔ/•	Ⓔ/•
Physical worker mobility	-	Ž	Ž	-	-	-	-	Ž	-	-	-
Digital skills	Ž	Ž	-	Ž	Ž	-	Ž	Ž	Ž	Ž	-
Collaboration & communication skills	Ž	Ž	-	Ž	Ž	-	Ž	Ž	Ž	Ž	-
Self-management skills	Ž	Ž	-	-	-	-	-	Ž	-	Ž	-
Participation in lifelong learning	Ⓔ	Ⓔ	Ⓔ	-	-	-	-	-	-	Ⓔ	-
Workplaces enabling experiential learning	•	•	•	•	-	•	-	•	-	Ⓔ	-
Attitudes towards entrepreneurship	-	•	-	-	-	•	-	-	-	•	-
Direct participation	•	•	•	•	-	-	-	•	•	•	•

Roadmap Core Indicators	Ambient Knowledge Sharing	Ambient Collaboration	Global Sustainability	24/7 Innovation and Global Value Creation	Global Open (Source) Development	On-demand Micro-media	Global Concurrent Engineering	Sustainable Built Environment	Pervasive Health Services	Learning	Global Logistics (RFID- enhanced)
Uptake & Intensity Indicators											
Task complexity	•	•	•	•	•	•	•	•	•	•	•
ICT use for team/ project work	-	•	•	•	•	-	•	•	-	•	-
Multi-location eWork (spread)	• /Ž	-	• /Ž	-	-	-	-	• /Ž	-	-	-
Virtual collaboration at the workplace	•	•	•	•	•	•	•	•	•	•	•
Cross-border virtual collaboration	-	•	•	•	•	•	•	•	•	-	•
Virtual communities membership	•	•	-	-	•	•	-	-	-	•	-
Electronic freelancing (eLancing)	-	• /•	• /•	-	• /•	• /•	-	• /•	-	-	-
NWE tools (uptake, patterns of use)	• /•	• /•	• /•	• /•	• /•	• /•	• /•	• /•	• /•	• /•	• /•
Physical workplaces/staff ratio	-	-	•	-	-	-	-	•	-	-	-
Social structures for team work	•	•	•	•	•	•	•	•	•	•	•

Roadmap Core Indicators	Ambient Knowledge Sharing	Ambient Collaboration	Global Sustainability	24/7 Innovation and Global Value Creation	Global Open (Source) Development	On-demand Micro-media	Global Concurrent Engineering	Sustainable Built Environment	Pervasive Health Services	Learning	Global Logistics (RFID-enhanced)
Impact Indicators: 1st Order											
Gross rates of return	€	€	-	€	€	€	€	€	€	€	€
Overall rate of innovative activity	€/•	€/•	-	€/•	€/•	€/•	€/•	€/•	-	€/•	-
Labour productivity	€	€	-	€	€	€	€	€	€	€	€
Pay levels / remuneration (per hour)	€	€	-	€	€	€	€	€	€	€	€
Capacity to change	•	•	•	•	•	•	•	•	•	•	•
Impact Indicators: 2nd Order											
Job satisfaction	€/•	€/•	-	€/•	€/•	-	-	€/•	€/•	€/•	-
Job-related health complaints	-	•	-	•	-	-	•	•	•	•	•
Job autonomy / job demands: Pro-active work organisation	• / Ž	• / Ž	• / Ž	• / Ž	• / Ž	• / Ž	• / Ž	• / Ž	• / Ž	• / Ž	• / Ž
Perceived stress	-	•	-	•	-	-	•	•	•	•	•
Individual labour market opportunities (perceived)	•	-	-	-	•	•	•	-	-	•	•
Subjective well-being	•	•	-	-	-	-	-	•	•	•	-

Roadmap Core Indicators	Ambient Knowledge Sharing	Ambient Collaboration	Global Sustainability	24/7 Innovation and Global Value Creation	Global Open (Source) Development	On-demand Micro-media	Global Concurrent Engineering	Sustainable Built Environment	Pervasive Health Services	Learning	Global Logistics (RFID- enhanced)
Impact Indicators: 3rd Order											
Levels of (un)employment	⊕	⊕	-	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕
Employment rate of older people / of women	-	⊕	-	-	-	-	-	⊕	⊕	⊕	-
Employment impact of parenthood	-	⊕	-	-	-	-	-	⊕	⊕	⊕	-
Skill utilisation (invisible under-employment)	⊕/•	-	-	⊕/•	-	-	-	-	⊕/•	⊕/•	⊕/•
Unmet demand for generic/specialist skills	Ž	Ž	-	Ž	-	-	Ž	-	-	Ž	Ž
Total factor productivity (growth)	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕
GDP growth	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕
Virtual collaboration in rural and peripheral regions	-	•	•	-	-	•	-	•	•	•	•
Total transport volumes per unit of GDP	-	⊕	⊕	-	-	-	-	⊕	-	-	⊕
Total miles travelled for work	-	•	•	•	-	-	•	•	•	-	•

Chapter 5: Recommendations for Action

5.1 Call for Action to Support the Establishment of the Open European Collaboration Space (OECS)

The content of this chapter originates from an aggregate analysis of the case studies, the evidence base and the visionary roadmaps on an aggregate level, and against the backdrop of the European policy framework on research and development, ICT and collaborative, new working environments.

The main prioritised, aggregate recommendations for action are viewed at a glance in separate text boxes. The tables below these elaborate on the recommendations for action: what these mean at the level of an individual, organisation, network or at national or global level. What needs to be done or what issues need to be tackled in order to further the reaching of the goals can involve research and development work, but it can also mean advocacy work or the wide-spread addressing of issues at many levels.

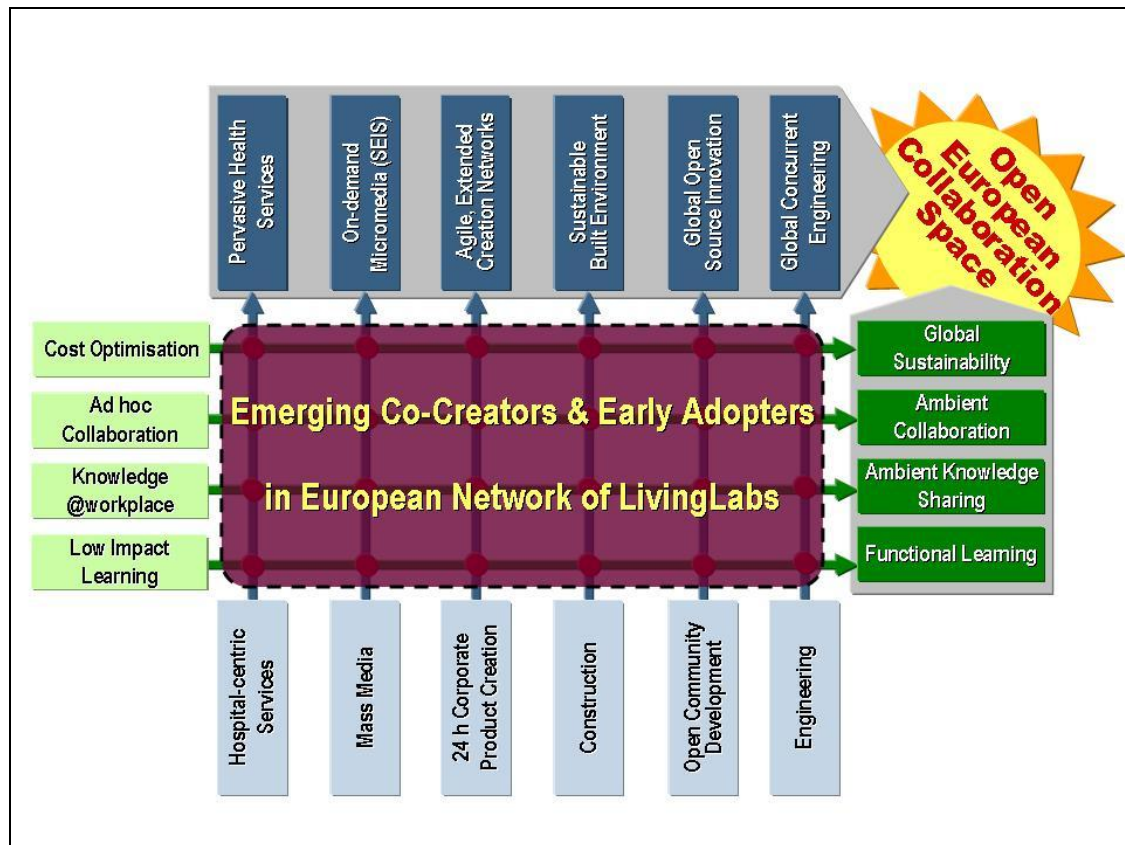
The visionary roadmaps point towards great challenges for Europe in its pursuit to achieve the Lisbon goals and to move forward in securing sustainable development through new types of collaborative structures. The vertical roadmaps represent a sample of areas which are of great importance to Europe. It is not all inclusive and the objective is to illustrate the interdisciplinary nature and interrelationships of the horizontal roadmaps to the success of those achievable goals of the vertical (validating) roadmaps.

The study report calls for unified European collaborative actions in order to achieve the Lisbon goals. These are to:

- f. Speed up innovation by improved utilisation of the European and Global network resources of user and citizen centric service and application creation.
- g. Participate in the orchestration of global collaborative innovation value networks for maintaining and taking leadership in selected areas of highest sustainable value for the European implementation and highest value out of global value capture.
- h. Exploit the strength of diverse European Public-Private-Civic-Partnerships for systemic innovation which creates sustainable value through collaborative good practice regional networks.
- i. Focus research activities on multidisciplinary phenomena-based research of emerging collaborative technologies, applications, products and services.
- j. Call member states to formulate and align national innovation strategies towards tackling global competition in the innovation economy. This would enable European level policy making and drive global regulatory needs for new global collaborative technology platforms and standards.

The outcome of all these actions is illustrated in the picture below aggregating the visionary roadmaps. The Open European Collaborative Space (OECS) can be achieved through multilevel actions and policies, but the most important contributing factor is the support for the collaboration of existing regional innovation initiatives. These initiatives should be networked to form a network of Living Labs (see the work of Corelabs from IST 5th call) and strengthened with the support to achieve common methodology. **These Living Labs enable true user-centric validation (vertical roadmaps) and co-creation. New forms of PPCP can take place in the creation of sustainable systemic innovation and larger markets for faster uptake and evolutionary growth.**

Figure 44: The visionary roadmaps and the Open European Collaboration Space.



The report will now further elaborate the actions that need to be taken and the development work that needs to be conducted in order to reach the overall objective of people and planet friendly prosperity, by the implementation of the OECS policies and actions.

- A. Rapid product creation by networking – Europe's competitive advantage
- B. Better utilisation of ICT through collaborative technologies to foster economic growth
- C. More ICT entrepreneurship – Collaborative micro-businesses
- D. Redefining the relationships of employer organisations and employees-Creative Commons thinking

- E. Extracting value in the global economy-Orchestration capability
- F. Maintaining and growing the proportion of active labour force-Wise regulation and immigration
- G. Deployment and utilisation of open collaboration and the digital convergence process
- H. Utilisation of economies of scale in public service provision-European legacy in diversity and public sector role turned to competitive advantage
- I. Advocating people- and planet-friendly growth and development focus on sustainable growth and development- Social transparency and eco-efficiency hold highest value ranks to emerge, providing potentials for global business development.

A) Rapid product creation – Europe's competitive advantage

Competing in the global economy sets increasing demands for productivity and creativity. There is a need to come to the market with new, improved products and services at an ever increasing pace. Global players and their local small extended partners need to develop their agility in order to stay in the global game. This is the corner stone for sustainable *job creation for Europe*.

THE GOAL operationalised at different levels	WHAT NEEDS TO BE DONE / DEVELOPED
<p>Individuals and organisations need to be more creative and innovative.</p>	<p>Fostering creativity: Both organisations and individuals need to find ways to establish working environments that foster creativity. Organisations will need to find ways to adopt organisation culture that is tolerant to differing viewpoints, the use of "trial and error" –method in problem solving, the deployment of experimental and seemingly irrational or illogical thinking in problem solving. There are risks associated to these and new ways need to be developed to manage the risks without costs to tolerance. Organisations also need to find ways to change their culture to being more tolerant for addressing contradictions and inconsistencies, as these too are of importance when creating something new. A key question is creating trusted networks of organisations where individual venturing and innovation can create new value.</p> <p>Effective innovation capture and new forms of collaborative structures (technologies, products, services, work processes and operational models). Solutions for capturing innovation need to be developed. These may be ICT solutions that aid in the illustration and communication of innovations or for example organisational changes that help to put the innovations into use. Managing/enabling change becomes more valuable than managing operational excellence. New forms of collaborative structures could be established with Public-Private partnerships in a pre-competitive market for venturous innovations financed by specifically targeted public procurement funding. This could offer possibilities for radical innovations in selected European core competitive areas(digital media or radio technologies).</p>
<p>Individuals need to be able to function appropriately in changing circumstances.</p>	<p>Self-leadership and goal setting: Functioning appropriately in an ever changing context may require better goal setting and self-leadership skills. Achieving goals in turn may require the utilisation of strategic thinking: where you are at present, where you want to go and what opportunities you have for reaching the goal. At best leadership can become collaborative through a shared vision. New organisation models may need to be developed to support collaborative, constant and dynamic participation and realignment. Relationship between self-</p>

	<p>managed learning and employability should be researched and ways for transferable competencies should be identified for the creation of vendor free skills certification which carry over from employer to employer and from country to country.</p>
<p>Individuals and organisations need to learn more rapidly.</p>	<p>Effective collaborative communication: Skills and software need to be developed to aid the visualisation and communication of complex knowledge.</p> <p>Learning to learn: The shortening life cycles of products translate into rapidly changing job profiles for employees and this creates the need to continuously and rapidly learn new things and out-learning the redundant. Learning skills should ideally be developed within the educational system, but there needs to be back-up systems in place where the goal has not been achieved. Best practises in learning to learn need to be deployed.</p> <p>Learning to facilitate learning: As it is not economically viable to increase training in the proportion corresponding with the pace of needing to learn, it becomes more and more apparent that knowledge workers need to take on tasks that aid and facilitate the learning of others. Peer-teaching practises need to be developed and deployed.</p> <p>Public-Private partnership models may need to be developed for sharing the costs of the above development work.</p>
<p>Organisations need to utilise knowledge in decision-making at all levels.</p>	<p>Open ambient access to Knowledge: Decision-making needs to be based on knowledge throughout the lowering organisations. This may require better, easy-to-use, more accessible knowledge management systems.</p> <p>Commitment: Knowledge based decision-making is not only about having access to knowledge but also about perception and attitudes. An individual should feel that he/she is an integral part of the organisation and it's functioning, and that his/her decisions have an impact. An organisation needs to embrace, utilize and provide leadership for distributed decision-making. This raises issues of participation, commitment, trust and responsibility for example – issues which require reciprocity in the relationships between work organisations and employees. All of these issues are complex and require the development and deployment of solution models.</p>
<p>Organisations need to utilize 24/7 global product creation and innovation.</p>	<p>Orchestration skills and capabilities: New ways of managing and orchestrating complex networks of organisations participating in product creation and innovation processes need to be developed and deployed. So far the 24/7 concept has mostly been intra-organisation focused by picking project team members from different time zones but the utilisation of different working times around the globe to speed up the completion of a single task or work process (similarly as a relay</p>

	<p>team works) within an extended enterprise (partner companies) still remains to be developed.</p> <p>New business models for product creation: New ways of organising product creation and innovation need to be researched, developed and deployed.</p>
Organisations need to have flexible product creation and business processes to suit rapid product evolution.	<p>Extended enterprise networks for product creation: The challenge is in managing a large extended enterprise network which usually consists of small local innovation companies, multinational horizontal players such as global logistics or manufacturing companies and innovative global vertical players. Involved organisations should maintain their independence to re-engineer their own business processes and to increase intra-organisational ability in concurrent engineering, flexible partner management and wise IPR policy strategies. The new global innovation economy puts special emphasis on mass-customisation capabilities for individual companies and their networks. More research and development work is needed in the managing and aligning extended enterprise networks for product creation.</p>
Networks of organisations need to collaborate in product creation and innovation.	<p>Network innovation: Innovation and new ideas know no borders and may originate at one organisation but be more applicable in another. From an aggregate point of view organisations need to develop ways to utilise innovation despite its origin (avoid “not invented here” – thinking). These networks constantly evolve and change. Research focus should be in increasing the understanding of how collaboration is achieved and what kind of different value structures could be established in such extended innovation ecosystems.</p>
Networks of organisations together with national, regional players need to work together to facilitate innovation.	<p>Public-Private-Civic Partnerships for innovation: The European networks of Living Labs are cross-regional and cross-national platforms for innovation-targeted R&D. The networks aim at bringing about economies of scale and efficiency in European innovation activities. This is likely to improve the market entry speed of new innovations and European competitiveness at a global scale. This is also expected to create new businesses, markets and industries and consequently contribute to European growth and job creation. A challenge for the public sector regulators and policymakers is finding ways to exploit such Living Lab networks and to aid in European value capture. When the public sector enables and supports the civic sector participation in innovation as well as value creation and capture, the outcome would inevitably be sustainable.</p>

B) Better utilisation of collaborative technologies to foster economic growth

The use of Collaborative Technologies (CT) is found to be the single most important factor contributing to increased productivity and economic growth. The impact of CT on economic growth is not only about investments in CT and the positive impact can only be achieved by making supportive changes in the business processes and the organisation of work. CT needs to, however, be utilised in a way that supports sustainable growth and results in the smallest possible occurrence of social expenses, falling from unemployment, exclusion, early retirement and increased health costs.

THE GOAL operationalised at different levels	WHAT NEEDS TO BE DONE / DEVELOPED
Individuals need to make better use of CT.	<p>Effective learning: People need effective pedagogical support for learning the use of CT. Improving the effectiveness of learning improves the rate of return for education related investments.</p> <p>User centric CT: CT solutions should be improved in terms of human-centricity and user friendliness. The special requirements of user groups – e.g. the aging population – need to be met and users need to be involved in the development of CT solutions (Living Labs). Truly interdisciplinary research needs to be conducted and better interdisciplinary research methodologies need to be developed. In addition to this, an on-the-job skills-certification system which supports open learning principles, needs to be developed and adopted widely.</p>
Organisations as well as their individuals need to utilize the CT related productivity improvements by changing the production and business processes as well as the organisation structure accordingly.	<p>New business models: New ways of organising production and business processes need to be developed and deployed in order to utilise and enable CT related productivity improvements.</p> <p>New organisation models: New organisation models that improve the utilisation of ICT and the increasing proportion of knowledge workers need to be developed and deployed.</p> <p>Effective deployment: CT needs to effectively be applied to basic organisation, production and business process functions (supplier, customer and resources management, logistics etc.).</p> <p>“Un-learning” outdated practices: Organisations and individuals need to replace some of the old practices with new ways of doing things. Organisations and individuals need to learn to analyse procedures for how well they suit the current situation.</p>
Networks of organisations need to collaborate	Effective collaboration: Networked organisations need to collaborate and engage in continuous development of CT utilisation in basic production and business process functions (supplier, customer and

effectively through interoperable CT.	resources management, logistics etc.). These organisations are both public and private. Larger Living Labs validation environments need to be established to further this cause.
National and regional partnerships spanning across the public and private sector need to be utilised to promote innovation and solve problems arising from CT use.	<p>Utilisation of Public-Private-CIVIC partnerships for CT innovation: Public-Private-Civic Partnership models need to be developed for harnessing ICT. Issues that need to be discussed, elaborated and developed are research methodologies, innovation process management, IPR's, open source practices, development of new leadership, governance and financial instruments</p> <p>Solving problems related to externalities of development: Unemployment and other social problems can result as an unwanted by-product of increased CT utilisation. Public-Private partnership models may also need to be developed for tackling the problems. Models for sharing responsibility and costs of development work may need to be developed and deployed. This calls for second generation Living Labs which cut across borders and regions on the basis of their vertical business interests.</p>
Global transparency needs to be pursued for sustainable growth.	Europe could promote social transparency and the open environment development which would support small European innovations to create good-practice examples and eventually business opportunities even for small language groups.

C) More ICT entrepreneurship – collaborative micro businesses

Enterprises utilizing ICT in the service sector account for a great proportion of ICT-related job creation. Innovation does not relate to size and in many occasions small units / teams / organisations have the capability for innovation but lack the capacity for market creation and large scale exploitation. Europe can foster large networks of innovative enterprises especially in the area of Public-Private service creation and even pave the way for market expansion on policies and regulation towards Single European Information and Innovation Space.

THE GOAL operationalised at different levels	WHAT NEEDS TO BE DONE / DEVELOPED
Individuals need to establish new, ICT-utilising enterprises in the service sector.	Spirit of entrepreneurship: Entrepreneurship is first and foremost a personality issue, which implies the adoption of educational practises that support the development of an entrepreneur mindset. The development of entrepreneurship skills and an entrepreneur mindset can and need to be supported by the educational system. Best practises need to be developed and deployed.
Organisations need to develop training.	Entrepreneurial training, development programmes and financing: Business organisations need to develop cross-border and cross-sectoral entrepreneurial training and development programs and provide core area venture financing facilities.
Networks of organisations need to be formed.	Microbusiness network: Globalisation has endowed small companies with lower entry requirements to participate in the global market developments especially in the areas of consumer goods, electronics, media and communication but most of all in the software and services sectors. Trusted networks of collaborative microbusinesses have proven to be the most rapidly growing businesses in these sectors. The challenge for Europe is to find ways to support this evolution and to establish its own microbusiness tradition. This is necessary in order to attract further investments and maintain sustainable growth in some areas of creative processes which are off shored to meet economic equilibrium.
National and regional policy frameworks need to support entrepreneurship.	Supportive regulatory framework: The regulatory framework needs to be analysed and developed towards a direction that lowers the entry barriers involved in establishing new businesses. Europe should leverage its size as the biggest and most attractive consumer market especially for services. The lack of job mobility hinders efficient creation of cross-border service innovation in areas where enabling collaborative technologies are available. Single-nation technology standards also hinder growth and achieving global market reach (e.g. 450 MHz frequency digital wireless broadband, private mobile radio standards, service operator policies, mobile digital TV standards).

D) Redefining the relationships of employer organisations and employees – commons principle

The traditional European perception of labour market dynamism is based on collective bargaining with employer and employee organisations. New emerging challenges have risen from the unification of the European labour market, liberalisation of the intra European labour mobility and from the emergence of a need to actively attract talent from non-European countries. Also the individual alliances and the loyalty-to-one-employer concept has undergone changes as new forms of employment and increased occurrence of self and micro employment have become more common. These could amount to strong job growth in Europe in the days to come.

THE GOAL operationalised at different levels	WHAT NEEDS TO BE DONE / DEVELOPED
A balanced new negotiating context needs to be established. This process involves the society at large .	<p>Participatory knowledge worker: A knowledge worker needs to be more aware of the work place requirements and development needs for him/her as an employee and not solely depend on the employer organisation support. This enables him/her to make good qualification / career decisions, keep his/her knowledge base up to date and be able to use his/her knowledge and understanding to participate in the further development of his/her industry. When this happens, the knowledge worker shifts from passive towards active and gains reasonable ownership, empowerment and responsibility. This requires an all-inclusive learning environment for life long learning enabled with vendor free skills certification framework.</p> <p>Socially responsible work organisation: The issue of social accountability may need to be discussed and debated at a wide, societal level. Balanced reciprocity in the relationships between work organisations and employees needs to be discovered.</p>

E) Extracting value in the global economy

Europe and European companies need to be networked in order to capture value in the global economy. More and more product and services creation processes, which rely on local, modular, mass-customisation capabilities, cut across continental borders in the pursuit of competitive advantage. This development may continue to hinder job creation in Europe. An opportunity for Europe lies in the orchestration capability needs of extended value networks. European corporations need to be agile in moving within the flows of high value creation capturing.

THE GOAL operationalised at different levels	WHAT NEEDS TO BE DONE / DEVELOPED
Individuals need to become innovators and co-creators.	New roles and ways of participating in innovation and creation: People will need to find individual ways to make an impact and to participate in the innovative and creative processes. This may need to be done from multiple roles. The internet, wikis, blogs and new types of ways to organise work (e.g. peer production) may need to be utilised for global, collaborative creativity in a way never seen before in the history of man.
Organisations need to be able to capture value in the changed global economy.	Orchestration capability: European companies need to strengthen their capabilities in the orchestration of global value networks. Best practises need to be developed and deployed. Systemic Innovation on a PPCP basis: The Public-Private-Citizen partnership model and the endorsement of Living Labs need to be utilised as a vehicle for innovation. More models and best practices need to be explored for complex value capture. The issue of sustainability needs to be better understanding in this context.
Networks of organisations need to work together to capture value.	Building networks for value capture: Business networks need to link up and become Pan European players. New forms and systems need to be developed to increase exports. These could be the utilisation of format business models in more industries, different branding and brand value patents.
Nations and regions need to support value capture.	Nations and regions for systemic innovation: public-private partnerships, Living Labs, European network of Living Labs

F) Maintaining and growing the proportion of active labour force

The consuming middle class in the growing economies of e.g. Asia is soon larger than its equivalent in Europe and USA combined. These economies are receiving a large proportion of global investments. This development has brought about a new division of global labour. Maintaining and even growing the proportion of the active labour force should be a key focus. Europe is challenged by its lowest proportion of labour force due to baby boomers retiring after 2010 and low birth rates after the 70's.

THE GOAL operationalised at different levels	WHAT NEEDS TO BE DONE / DEVELOPED
Individuals need to participate in income generating activities for longer.	New forms of income generation: In order to improve the employee rate new forms of labour participation need to be developed and deployed. One such form could be micro-entrepreneurship. In general the active participation to the labour force needs to be lengthened both at the early adulthood and active aging end.
Organisations need to be flexible employers.	New organisation models to support flexibility and versatility: Both organisations and individuals need to share the vision of finding and supporting new forms of labour participation. Organisations may need to explore and identify new roles for the active aging workforce, This may also require the deployment of new types of contractual arrangements which can be tailored to suit individual needs. Research and development work needs to be targeted at the new division of labour needed to accommodate this kind of development.
Nations and regions need to support labour force growth.	Labour force strengthening public actions: New forms of labour representation and new legislative and regulatory policies need to be established in order to support the development. European strategy for active and focused labour immigration to Europe. Also the European Service Directives need to be implemented.

G) Deployment and utilisation of open collaboration and the digital convergence process

Proactive European level policies are needed to exploit the global technology and business model convergence that is lead by digital convergence in the level of content creation and service delivery. Open software development, digital transmission (internet IP backbone) and HW electronics are key areas. Our children should be 'Born Digital' in their pursuit of innovation and education.

THE GOAL operationalised at different levels	WHAT NEEDS TO BE DONE / DEVELOPED
Organisations need to develop their business models.	<p>New business models: New ways of organising digital production and business processes need to be developed and deployed. Process interoperability is guaranteed with collaborative actions by global key players.</p> <p>New organisation models: New organisation models that improve the utilisation of ICT in digital product and service provision need to be developed and deployed. The concept of "born digital" needs to be utilised in terms of large scale re-use through open depositories.</p>
Nations and regions need to foster diversity.	European diversity: European diversity in digital content production can be utilised as the opportunities for diverse content is considerable during the age of the so called long tail phenomenon.

H) Utilisation of economies of scale in public service provision – European legacy in diversity and public sector role turned to competitive advantage

The proportion of labour force serving public sector in Europe is higher than 30%. In comparison, the proportion of labour force in public service in USA is less than 10 percent. If the European model is more sustainable in providing services for the citizens it should create economies of scale in public service production which could be achieved in very distributed and localized manner with the help of ICT.

THE GOAL operationalised at different levels	WHAT NEEDS TO BE DONE / DEVELOPED
Individuals need to become innovators and co-creators.	European co-creation: Europeans can increase the efficiency of its public service sector by utilising participatory and co-creation approaches to public service provision.
Organisations need to form partnerships in order to develop the society.	The Public-Private-Citizen Partnership (PPCP) model and the endorsement of Living Labs need to be utilised as a vehicle for innovation also in the area of public service provision. This includes civic activities, technology enhanced and aided social relationships with extended families and friends, education and healthcare to name a few of the possibilities.
Nations and regions need to provide good public services at a lower cost.	Localised/pervasive services: New forms of citizen centric entrepreneurial activities in the field of public service provision could be developed and deployed. The public sector can in many ways be seen as one of Europe's strengths; namely in the areas of health care, education, media and inclusion. Public procurement could be channelled for new strategic innovations in a pre-competitive market. Radical innovation could be enhanced such as service creation among open source city alliance partners.

I) Advocating people- and planet-friendly growth and development

As a result of the globalisation process, the world appears to have gotten smaller. Phenomena – challenges as well as opportunities – have become global. The mitigation of ecological, health (from HIV to H5N1) and socio-political problems (poverty, terrorism) calls for joint efforts.

THE GOAL operationalised at different levels	WHAT NEEDS TO BE DONE / DEVELOPED
Individuals need to make people and planet friendly choices.	Individuals need to make people and planet friendly choices. These need to be further investigated.
Organisations need find ways to be prosperous without causing damage to the planet or people.	Organisations need find ways to be prosperous without causing damage to the planet or people. This may include actions toward eco-efficiency (economic growth decoupled from logistics/production). Organisations also need to organise their processes in a way that does not interfere negatively with people-sustainability (e.g. keeping a positive work-life balance).
Nations and regions need to support the finding of constructive solutions for global sustainability challenges.	Nations and regions need to support the finding of constructive solutions for global sustainability challenges. Governance and democracy play an important part here.

5.2 Recommendations for Indicator Work

At EU level, the data sources which are used for mapping issues related to firstly use of ICT at and for work, and secondly working conditions and work organisation, are currently separated from each other. This makes it very difficult to analyse ICT-related changes in work organisation. In addition, collaboration using ICTs is a subject which has scarcely found any attention in existing surveys. This may be understandable given the elusiveness of the phenomenon, which makes it hard to measure using survey research. It does, however, seem very problematic in the face of evidence which suggests that collaboration across firms and other organisations is a prime determinant of competitiveness in the knowledge economy. It is clear that for Europe to develop its economic competitiveness while preserving current standards of wealth, social stability and equality, European companies have to make best use of virtual collaboration.

There is therefore a need to provide better, more suitable and relevant statistical indicators for informing policy making at the EU, national and regional level in Europe. Because of the costs of data collection for producing statistics, any attempt to provide new indicators must put much focus on finding the most cost-effective means to collect the required data. There is also the issue of a potential conflict between the interests of data users at the national and the EU level, which

means that the opportunities to obtain economies of scale by setting up European-wide data collection frameworks remain limited.

Against this background, the network4value project has come up with a number of recommendations how NWE related issues can be better covered by EU indicators, and which of the existing data collection instruments may be best placed to carry the suggested new and modified variables.

First of all, there is a case for developing the European Survey on Working Conditions (ESWC) into a fully-fledged element of the European Statistical System. Comparable, timely data on working conditions and NWE related issues must be a top priority in order to tailor the European Employment Strategy to the individual situation in each Member State.

The survey is currently under the responsibility of the European Foundation for the Improvement of Living and Working Conditions, and has been conducted every five years since 1990. It is not yet integrated in any way with the more established instruments of Eurostat and the National Statistical Institutes (such as the Community Labour Force Survey, the European Community Household Panel, the upcoming European Adult Education Survey). At the same time, the ESWC is partly a duplication of effort since similar surveys are being carried out at the national level by many of Europe's NSIs.

We suggest to put the ESWC on a more formal basis by giving Eurostat overall responsibility for survey execution, with the medium-term goal of replacing the existing national surveys on work organisation by a joint Community Survey on Working Conditions (following the example of similar frameworks such as the Community Surveys on ICT Usage in households and enterprises). This would also provide the basis to conduct the survey more frequently, such as once every two or three years. The upgraded survey should then fully cover issues related to collaboration through ICTs and traditional means.

It is important to note that the function of the Community Survey on Working Conditions would be less to "rank" countries by their success in implementing "modern" forms of work organisation, but rather to supply EU and national policy making with the required comparative data to gauge the room for common policy making as well as to identify the necessity for policies which are specifically tailored to the situation in a given country.

Secondly, the emphasis in data collection in the area of ICT utilisation at the workplace needs to shift away from "fashionable" phenomena such as home-based telework towards the really important elements of change, such as multi-location working and virtual collaboration using ICTs. It appears that the focus on modern-day utopias such as, for example, the "electronic cottage" is harming the decision-making ability of policy makers since it tends to mask underlying, much more relevant changes in the way work is organised across people, time and space. Collaboration in general, and virtual collaboration in particular, are hardly covered at all by statistical indicators at the national level, to say nothing of cross-country data. This situation needs to be remedied. The adequate instrument for such indicators, as far as they are to be collected from workers as observation/reporting units, would be the Community Survey on

Working Conditions. The Community Survey on ICT Usage in Households is not well suited for the purpose as it primarily targets the household as a user category of ICTs.

The third point to be made is that Europe lacks a data source for assessing the extent to which workers are equipped with the necessary generic (as well as specialist) skills for working in the knowledge economy. There is plentiful evidence which suggests that to be successful in working in an NWE-based job – or, more generally, in what has been termed the pro-active workplace – workers need to have advanced levels of communication, collaboration, team working and self-management skills, as well as up-to-date digital literacy. Because of the important role of the public sector – and EU funding – in providing further training and education opportunities to EU citizens, a data source for comparable indicators on generic skills should be developed. It appears that the European Adult Education Survey which is currently being prepared would provide a good vehicle for this purpose. It should be ensured that the decisions about which variables to include in the survey will not be taken by core education policy-makers alone.

Finally there is the need to ensure that all indicator data discussed in this document become available to policy-makers more timely than it is currently the case. Eurostat has shown in the case of the Community Surveys on ICT Usage that timely publication of data collected by Member States' NSIs (following a common data collection approach) can be achieved if the will is in place. The intention should be to achieve this timeliness for all Eurostat-managed data sources, including for instance the European Community Household Panel.

Chapter 6: Conclusions and Outlook regarding i2010

6.1 Introduction to the European Challenge

The foundations for global resource utilization were laid some 80 years ago when the global monetary policies were partly liberalized. The world became a dollar-based, trade and investment driven economy which is very much impacted by consumer and investment sentiments of the US economy. After monetary liberalisation the liberalization of trade followed. Production based investments spread to new areas, especially to populous areas – South East Asia and Middle East from 70's onwards – as they were endowed with increasing purchasing power common to rising economies. It was only during the 90's that the need for labour and talent mobility became a focus for research. Labour mobility was and still is very much regulated by nation-states and regions.

The traditional brain drain from developing countries – especially from Asia to Western countries – has slowed down and even reversed up to some extent. New growing economies have not only attracted investments but also highly skilled repatriates. As Europe restricted labour mobility it was not able to offer enough talented workers during the later 90's when there was a big shortage of technical talent. The talent shortage and the fact that investment mobility was not restricted lead to increasing investments in the growing economies of Asia, and to the outsourcing and off-shoring of production. New emergent multinational players originating from new economies got financed through the Western stock market boost. The world became much more connected and integrated.

The world became a single market for the ICT sector in the area of ICT consumer goods and infrastructures, soon followed by software development enabled by the internet on one hand, but even more so by the investments made by global proprietary mega corporations and even more profound opportunities in the areas of Open Source software development, open ICT architectures and Open depositories of digital content sources. This trend provided an opportunity for big players to become bigger but the process also made it possible for small, innovative players creating innovations and agile business concepts to attract available risk capital and achieve phenomenal growth. Global consumers had created opportunities for low-cost innovations to boom on the internet platform.

Europe did not seize the opportunity of this phenomena in exploitation of these innovations and only a few successful European players exploited these innovations. The new paradigm called for direct corporate actions to be integrated into global innovation value networks. A few areas such as mobile telephony provided advantages for European players. Initially European innovations such as the internet on fibre optics, Open Source software, IPV6 routing, just to mention a few, were exploited by the Americans and the value capture was handed over the Atlantic. Now we see another value capture of the global innovation economy taking place in the growing Asian economies where innovation is seen as a public utility and supported by public focused investments to provide broadband access as an utility for citizens as an enabling platform for new consumer and user centred innovations. This public utility provides fast scalable market for new service innovation and media entertainment.

Multinational companies originating from the western countries are finding these growing Asian economies not only to provide cost based advantages in production but also to provide increasingly integrated research and development processes which utilise the high talent resources of the Asian populous economies in global innovation and research. More and more product and services creation processes cut across continental borders and efficiently exploit the time resource of the earth's rotation (follow the sun product creation process). Speeding up innovation will continue to be the number one focus of global companies. Bringing new innovations to market on time and achieving competitive advantage relies on local, modular mass-customisation capability. Off shoring or outsourcing will soon be balanced and companies that are a part of global value creating innovation networks will prevail.

6.2 Implications Regarding i2010 Strategic Framework

The Commission proposed a new strategic framework, the i2010, a policy orientation towards a single European Information Space for inclusive European information space. This report aims to support these objectives and identify key issues how Europe should participate in the global innovation networks for sustainable growth and European value capture.

This report is focusing to the role of new European collaborative work place as means to support in achieving the Lisbon goals and bring content and research insights for the i2010 strategic framework. In this chapter we focus on five critical areas of i2010; job creation, inclusion, digital convergence, sustainability and competitiveness.

6.2.1 Job creation

The emerging global networked economy is both a challenge and an opportunity for Europe. The composition of the labour force differs greatly from other industrial nations. The proportion of the labour force serving in the public sector in Europe is higher than 30% while the equivalent figure for the USA is less than 10% and for Asia somewhere in between these.

If the European inclusive social model is more sustainable in providing services for citizens and in creating new jobs, it should create a competitive advantage through the economies of scale in the public service provision. Success can be achieved through the usage of collaborative ICT which needs to be utilised in a very distributed and localised manner. New forms of systemic innovation in Europe need to be utilised for solving societal challenges. Systemic innovation leading to new product service creation will create potential for export, job creation and attract investments into Europe. Other areas susceptible for PPCP-based (Public-Private-Civic partnerships) systemic innovation in Europe are related to media, well-being services, education and various e-business/e-government applications. In these areas global excellence is within reach if the challenge of cross-border public services development is somehow overcome.

The new global division of work brings greatest changes to areas of manufacturing, global logistics, virtual service enterprising and the software and media industries. Concerning industrial processes where labour costs are critical, the investments in these areas will continue to be channelled on the basis of cost savings and subsidies. Another contributory force is related to markets: if the local market grows rapidly and the regional consuming middle class creates strong demand, investments will follow. A third factor influencing investment decisions, however,

concerns innovation and high level competencies. European regions can attract investments on the basis of providing talent for innovative and competence critical tasks. If the flow of investments is not regulated but job mobility is, then the only area in which Europe can lead the development is in the area of collaborative innovation networks. These networks replace worker mobility with task mobility.

The biggest changes in relation to employment will take place in relation to low skilled order/delivery processes. This will happen through the utilisation of emerging sensory networks and single RFID tags. The reduction of labour force will be seen in areas of warehouse management and transport, retail shops and some field force maintenance work. The replacement jobs are created in higher skilled areas such as system integration, Embedded SW areas and high skilled service and maintenance jobs. This transition will require together with public partners to design new vocational on the job training, a vendor free life-long learning skills certification framework.

Maybe the biggest area for job creation is in the service sector. New emerging technologies will enable ever more efficient ways for micro service business development. Especially peer-to-peer technologies and emerging local innovative collaborative services will create new forms of economic wealth and job creation. Areas of such developments are in local media production where all content can be shared and developed as a common digital utility. New forms of peer production models are being created. Small innovation, when shared and networked, leads not only to operational efficiency but also rapid scalability and quick growth potential with minimum initial investment costs. The convergence of traditional telecommunications services, media sector and ICT Industry will bring new possibilities for innovative small entries. Other areas of such technology-enabled peer-to-peer service development could be deployed in service provision for the aging population aiming at extending their period of independent living. Additional application areas are those of pervasive health services and learning/training/education. Internet-based and mobile gaming is also a good opportunity for European small-scale investments and job creation.

6.2.2 Inclusion

The better utilisation of ICT at the work place should be understood as a utility for all citizens. In order to create sustainable growth with minimum social expenses falling from unemployment, exclusion, early retirement and increased health costs, all efforts should be made to exploit modern collaborative technologies and services for keeping these economically active. Maintaining and even increasing the portion of working population of active labour force should become a clear objective.

Collaborative networked services for areas on inclusion are different localised, context sensitive and pervasive services. Collaborative technology development harnessed to support people with physical disabilities offers a high value area for world class competency.

The clear competitive edge for Europe here is the development in public service innovation. This area should be assessed and researched from the perspective of export potential targeting in particular the aging Asian economies, whose social models resemble the European model more than that of the USA.

A great wealth of innovative Public-Private-Civic partnerships should be investigated and considered to be part of co called European network of Living Labs.

6.2.3 Digital Convergence

Proactive European level policies are needed to exploit the global technology and business model convergence that is lead by digital convergence in the level of content creation, service delivery, open software development, digital transmission (internet; IP backbone) and HW electronics. Our children should be 'Born Digital' in their pursuit for innovation and learning.

Europe should act as a leader in the question of interoperability and design of open architectures. Not only technology standards suffice for interoperability but also legislation, regulation and policy directives can guarantee cross border processes and services inside Europe and across continents.

Europe enjoys the greatest potential of reusable written digital or analogue (printed) content in multiple language formats. This mass of underutilised capital in the form of knowledge depositories has more value than perceive. We lack ways in creating market for exploiting these.

European diversity in digital contents could create new businesses of the so called 'long tail' phenomena of global consumer market. This is clearly already seen in the media sector where marginal, interesting contents, productions and services can be shared efficiently through the internet, which creates valuable markets for marginal groups. The European wealth of different cultures now has the global long tail phenomenon to be introduced and utilised.

6.2.4 Competitiveness and Sustainability

The better utilisation of ICT is the single most contributing factor for economic and productivity growth for Europe in the coming years. The Public-Private-Citizen partnership model and the endorsement of Living Labs need to be utilised as a vehicle for innovation. Models for more complex value capture need to be developed and deployed.

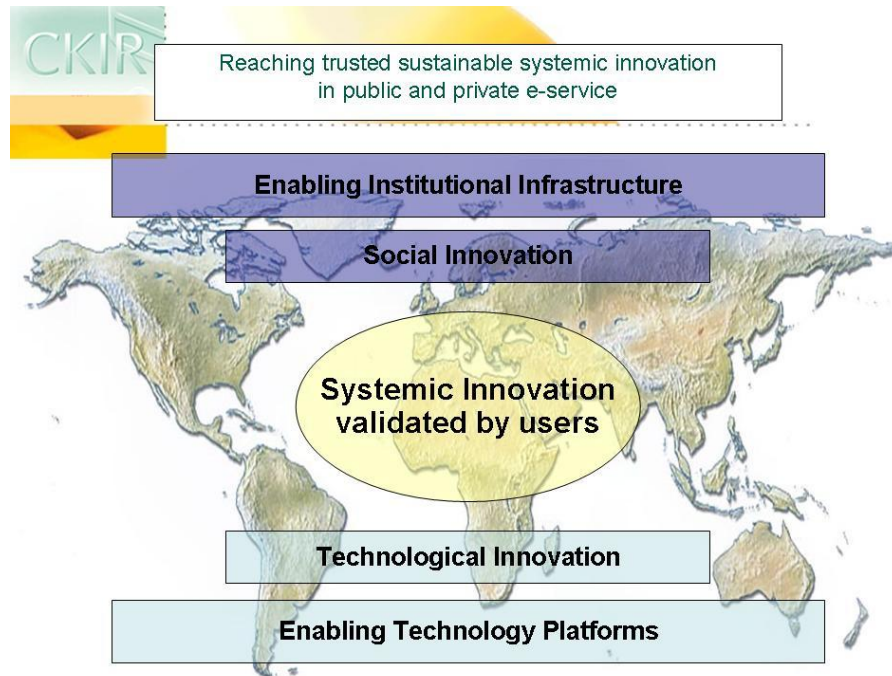
An enabling technology environment together with social innovations can be transformed to generate systemic innovation powered by active citizens. European communities of early adopters need to be supported as they are key factors in the wider adoption of new services. Users need to be integrated to the innovation process and through co-creation and co-production. True sustainability is born within the context of co-production and co-creation. These developments lead to increased efficiency in work and social processes, and lay a foundation for new service creation, which in turn will form a platform for new entrepreneurial activities.

As a result of the globalisation process, challenges as well as opportunities have become global. The mitigation of ecological, health and socio-political problems calls for joint efforts. One of the strong points of Europe is the technological and organisational knowledge base on ecological sustainability. This knowledge could be merchandised for new innovations in order to achieve potential for export and related job creation. High transparency of resource consumption (ecological footprint, socially sustainable development) can in part help to globally achieve good governance and strengthen democratisation.

Another area of potential European competitive advantage could be the full utilization of public procurement in the context of pre-competitive innovations. The absolute size of European public procurement could serve as a strategic instrument to channel resources towards more venturesome or radical technology innovation where higher risks are. Such innovations could take place in e.g. health care sector, education sector or media sector dependant to the scalability of new products or services throughout Europe (call for Single Open European Collaborative Space OECS),

An enabling institutional infrastructures needs to be established to support this development. This may first take a form of a national Living Labs as early adopter validation environment for emergent innovations and later more widely, an European network of Living Labs for more widely exploitation and mass market creation.

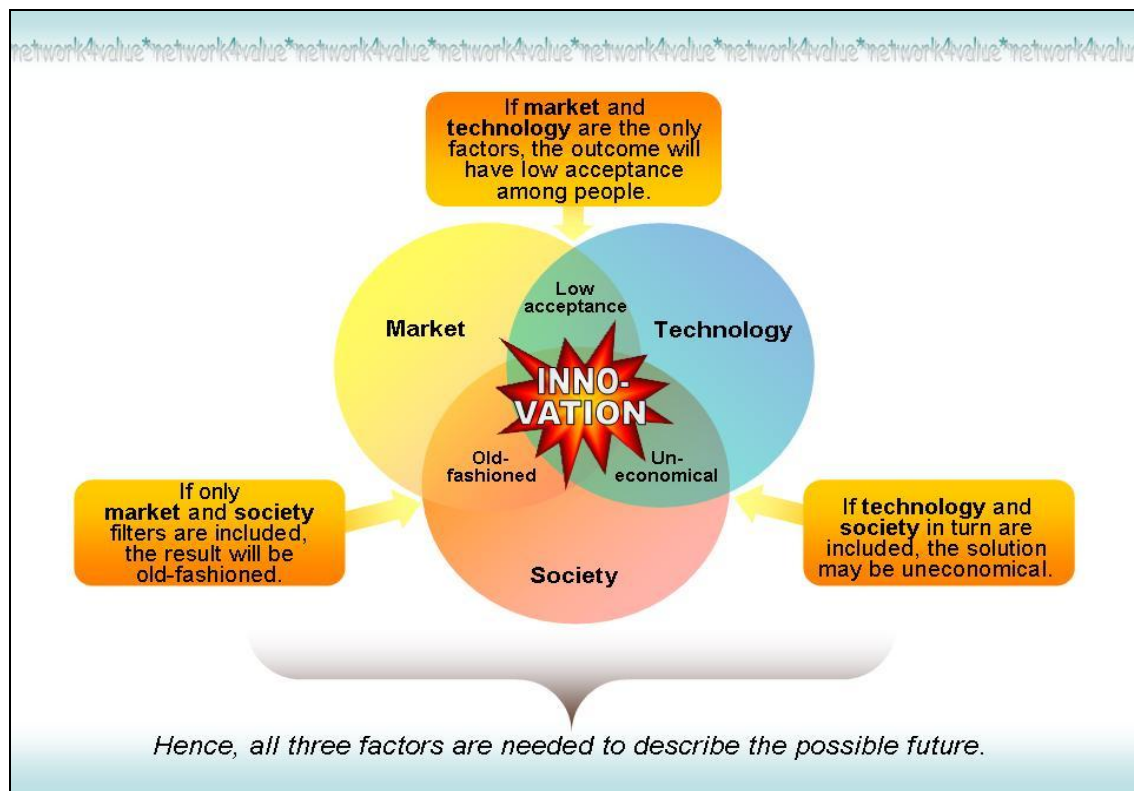
Figure 45: Reaching trusted sustainable systemic innovation in public and private eServices



6.3 Conclusions

True sustainable value is created only through involving users and local committed people in the creation and validation of new innovations. Europe has an opportunity to endorse such sustainability through involving the society and public sector to this innovation creation. However without the global market potential (market sustainability) and latest technology innovations together with true interoperability (technology sustainability) a true sustainable value is difficult to achieve for individuals.

Figure 46: Sustainable innovation realised with local committed people, with user focus



The network4value study therefore recommends a broad multidisciplinary policy and technology initiative to be established called the formation of an Open European Collaboration Space (OECS). OECS is a joint (with a PPCP) technology and service initiative to enable materialisation of the visionary roadmaps for sustainable value creation through emergent new collaborative structures both at corporate-, public- and home work space.

OECS has direct implications to policy and technology architectures on national and European levels. Policy implications would focus on supporting the implementation of the i2010 program and the creation of the Single European Information Space collaborative structures achieving economies of scale for European public services and pre-market innovations through strengthened public procurement on selected strategic areas.

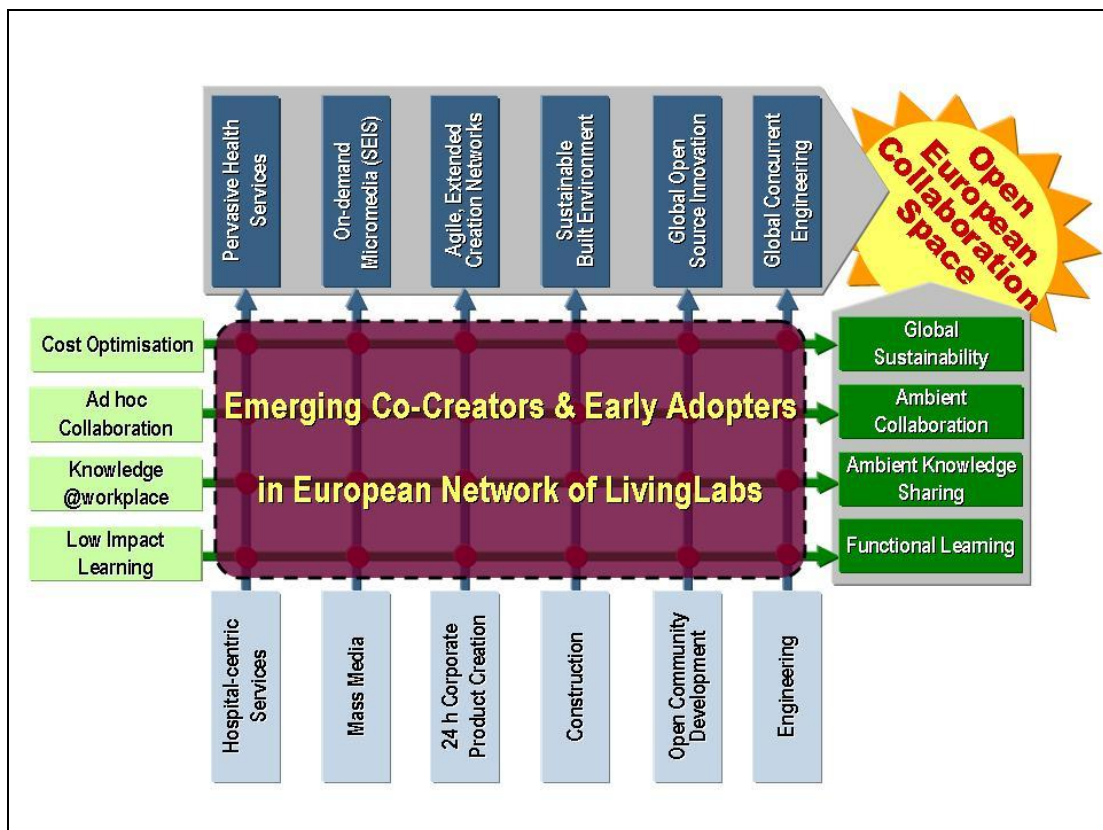
The Open European Collaborative Space will be materialised through networks of Living Labs for user-centric innovation and sustainability. Co-creators together with early adopters, attracting investments, quality of life and security, physical infrastructure, new social models for collaboration, networked localness and creativity. The OECS is:

- § An instrument for all organisations from all sectors to seamlessly “connect” and collaborate on-demand to provide value added service and product delivery.

The OECS will enable:

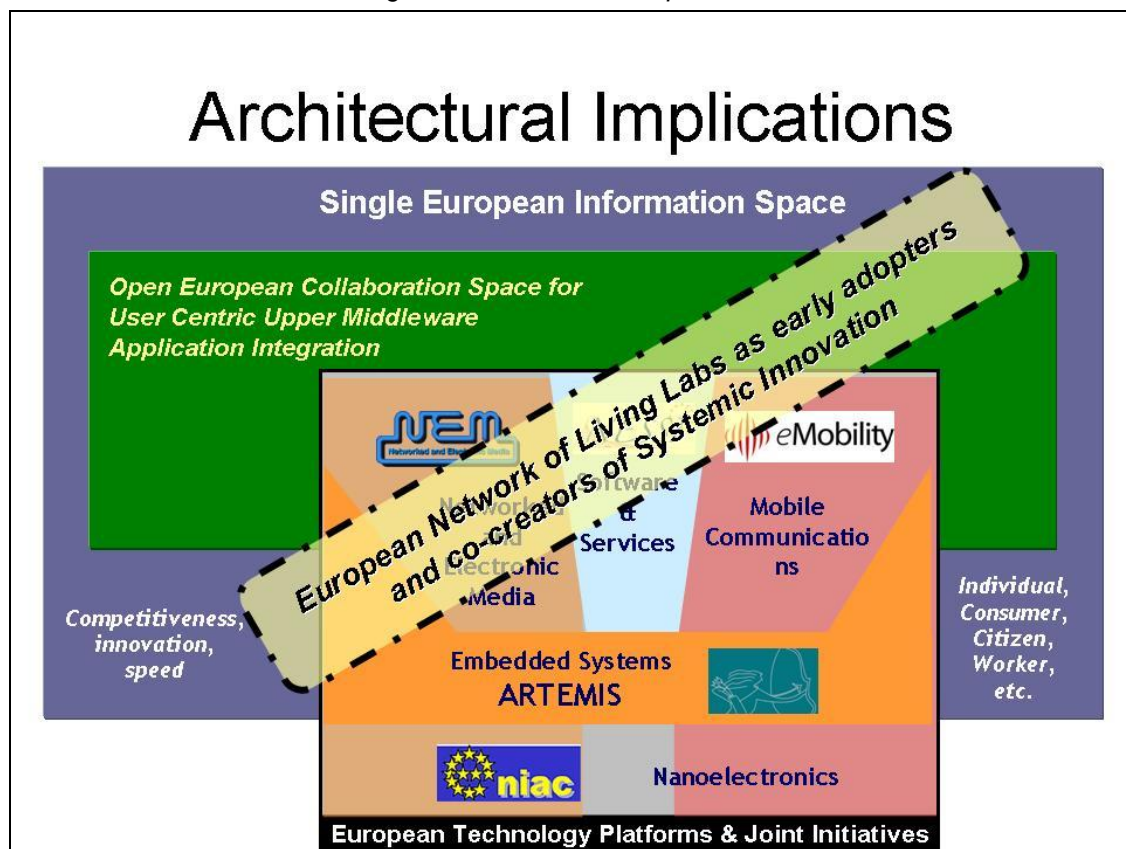
- § New opportunities to co-create and deliver new products and services and scalable early entry market
- § Open collaboration space provides a “space” to connect competencies and skills
- § Open collaboration space relies on “interfaces” to standards, and is not yet another standard
- § These interfaces can act as mechanisms for inter-connecting different technology platforms and enhance interoperability.

Figure 47: Open European Collaboration Space



The OECS is an integrator between the European Technology Platforms (ETPs) when it comes to application testing and validation in an open, user-centric environments (Networks of Living Labs). As best it can create environments for user centric prosumerism (producing+consuming), co-creation and co-production. Its relevance to technology architectures lies on the so-called upper middleware layers for application integration. It endorses open innovation platforms and calls for collaboration with various OS Communities (such as GNOME, Eclipse, Debian, MySQL, Laika etc..).

Figure 48: Architectural implications



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Appendix I: Theme and Domain Specific Roadmaps

Theme Specific Analysis (Validation) and Recommendations for R&D

The following theme specific roadmaps³⁶ were developed in network4value:

- Global eco-efficient workplaces
- Ambient collaboration
- Ambient knowledge sharing
- Learning in the network economy

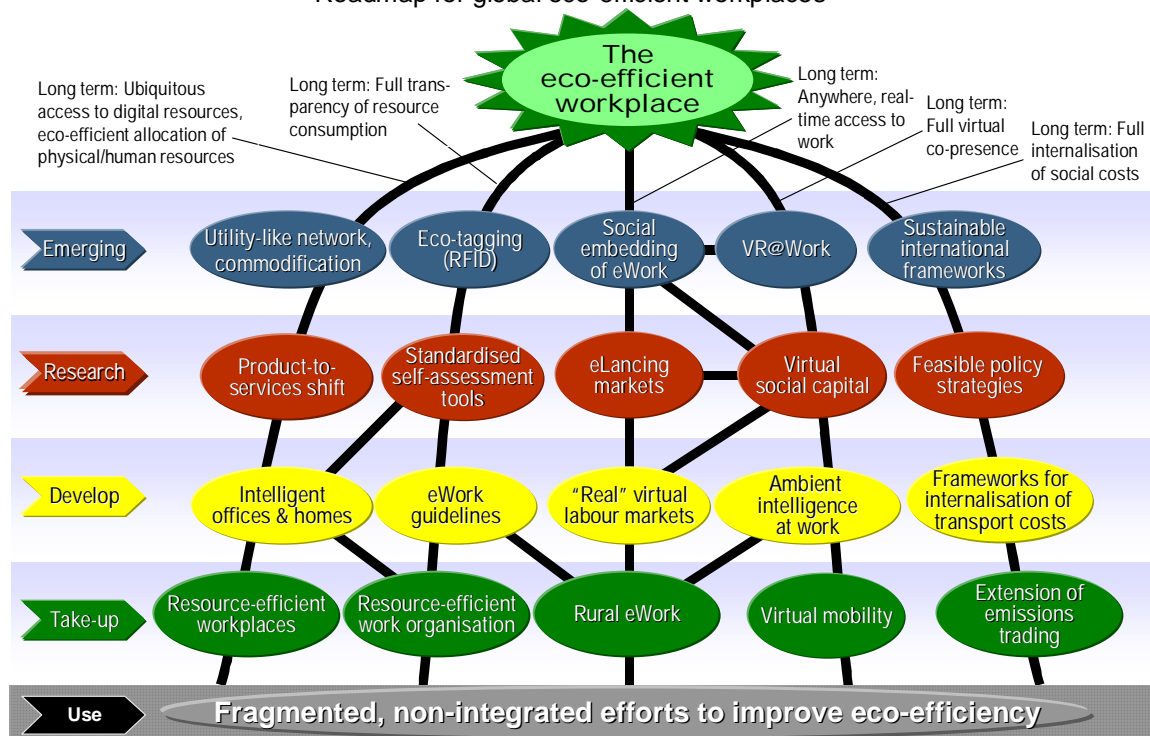
Global Eco-efficient Workplaces

Current state: Efforts to make work organisation more resource efficient are very fragmented and have not been sufficient to reverse the trend towards environmentally unsustainable patterns of production.

Vision: Eco-efficient allocation of physical and human resources, optimised substitution of physical transport and full participation of rural & remote regions in knowledge economy

Scenario: A global regulatory framework ensures that all environmental costs to society are internalised in the price system. Prices (for example for transport and real estate related energy use) therefore act as a powerful incentive to reduce resource consumption³⁷ throughout the production system, including the way work is organised across space and time. Firms benefit from high transparency of resource consumption (ecological footprint) of their activities due to availability of comprehensive real-time information. Inputs to work are immaterialised wherever possible. Ownership of physical equipment has been reduced substantially because access to digital resources is ubiquitous. Full virtual co-presence has finally enabled a large share of physical travel to be replaced by virtual collaboration. This means that knowledge workers can freely choose their place to live regardless of concerns that they might lack access to work. The exodus from rural and remote regions has been reversed and there are now a growing number of remote regions which fully participate at the forefront of the knowledge economy.

Roadmap for global eco-efficient workplaces



Key Elements:

Applications in use by organisations today, and overall current situation

- § Attempts to reduce resource consumption of work systems have until now been lead primarily by cost saving and competitiveness objectives. Because the price system does not properly reflect the real, especially long-term social costs of resource consumption, such efforts do not necessarily result in positive impacts on environmental sustainability. Promising evidence of increasing eco-efficiency in case studies is contrasted by overall developments which remain unsustainable with regard, in particular, to the coupling of economic growth and levels of physical transport³⁸.

Ready for take up

- § Resource-efficient workplaces: The significance of desk-bound computer equipment as a cost factor for companies has grown much over the last decades. As a result of EU regulation (Waste Electrical and Electronic Equipment Directive), equipment costs are increasingly reflecting the full costs of resource consumption related to office equipment. For these reasons, firms' efforts have focussed on keeping costs in check by managing all equipment-related expenses in a holistic way.
- § Resource efficient work organisation: Systems which remove the traditional, fixed assignment of physical workplaces (desks) to members of staff have been developed in recent years, and are being implemented in more and more firms. Such systems, variously dubbed "hot-desking", "hotelling", "desk sharing" etc., make extensive use of advanced ICTs. They can result in considerable savings in resources because of the fact that work desk utilisation rates (in hours per day) in traditional organisations tend to be extremely low. An other example of new work organisation practices which tend to increase resource efficiency is (electronic) outsourcing, since specialised providers often benefit from scale effects as a result of better utilisation of resources. Like any innovation in work organisation, the take-up of both hot-desking and e-outsourcing is held back by socio-cultural and organisational factors.
- § Rural eWork: ICT networks such as Internet via broadband have dramatically improved rural and remote areas' access to resources (including information and jobs) which are concentrated in urban agglomerations. Thus, ICTs have *enabled* workers and firms in remote areas to participate more than ever before in the regional, national and global economy. Instances of high-qualified knowledge workers based in home offices or telecottages in remote (but often scenic) regions such as the Highland & Islands region of Scotland demonstrate what is possible³⁹. Mobile broadband access will increase this potential. Due to these trends, the bottleneck for rural development today is not access to resources anymore, but lack of skilled labour and lack of access to knowledge networks (e.g. networking capital)⁴⁰.
- § Virtual mobility: Many activities which traditionally have required physical transport (of people and/or goods) can already be carried out via electronic networks. Such "virtual mobility" is substituting for physical mobility in ways which should be strongly beneficial to the environment. Virtual mobility is constrained by characteristics which are peculiar to the electronic media channel being used (cp. media richness theory). Another barrier, not to be dismissed, is that travel is often seen as something positive by stakeholders – including business travellers themselves⁴¹.
- § Extension of emission trading to incorporate larger shares of total fossil energy consumption: EU regulation successfully established a greenhouse gas emission trading scheme in 2005. Until now, the system only covers a minor (although significant) share of total energy consumption in the EU. Successive coverage of remaining parts of the primary and secondary, and also the service sector is required to progress towards full internalisation of social (environmental) costs in prices. Emission right trading for work-related transport would be of special relevance for the topic of this roadmap⁴².

Develop

- § Intelligent offices and homes: Ambient intelligence and ubiquitous computing will provide radically new ways for improving the resource efficiency of office-based work. The same applies to work which is carried out at home or at third (including mobile) locations. The basic principle at work is allocation of work-related resources (such as light, heating, computing power) to the individual or group in ways which are totally adapted to the individual needs of those concerned.
- § eWork guidelines: The European Commission has helped bring about a European framework agreement on telework. Until now, these guidelines exclude issues related to resource consumption but rather focus on social aspects. As has been demonstrated by recent research⁴³, home-based eWork can be organised in ways which are supportive of environmental sustainability, but it can just in well increase the ecological footprint per worker. This means that there is the need to provide advice to organisations which use eWork on how to set up and manage remote work⁴⁴. It goes without saying that such advice will only attract sufficient interest if supportive conditions are in place (such as a price system which reflects the environmental costs of resource consumption).
- § Real virtual labour markets: While online job exchanges have considerably grown in importance in recent years, virtualisation of labour markets has hardly progressed beyond the stage of initial demand/supply matching. Real virtual labour markets are systems which support not only matching, but also the contractual, work delivery and remuneration stages of the labour process.⁴⁵
- § Ambient intelligence at work: Applications of ambient intelligence will boost the efficiency and effectiveness of virtual collaboration by enriching electronic communication with contextual information, thereby tailoring online communication tools according to the current, individual needs of the user. For example, ambient intelligence at work will automatically supply users with the optimal media richness required for a given communication task.
- § Regulatory framework for internalisation of full costs for transport and real estate related resource consumption will be required for providing the market incentives which will align the working of the price system with the long-term objective of environmental sustainability.
- § **Research**
- § Product-to-services shift: The shift from product to services is potentially of huge importance for increasing the resource efficiency of work organisation. Owning the infrastructure on which work depends will become less and less attractive as soon as it will be possible – and also cost-efficient – to acquire just-in-time access to work tools and support services from specialised providers operating in cyberspace. Making the “age of access” happen will require a shift in values (i.e. ownership of physical assets becoming a liability rather than an asset) as well as the establishment of a well functioning platform which is to bind together large numbers of providers and clients in a seamless, virtual business eco-system.
- § Self-assessment tools: ICTs offer manifold possibilities for improving the supply of economic actors with information about their resource consumption and related contextual information⁴⁶. Awareness of the ecological footprint of current work organisation can be considered a first step for firms towards more eco-sustainability. Standardised, easily usable and highly case-sensitive self-assessment tools would help firms in achieving awareness.
- § eLancing markets: Full virtual labour markets could develop – in a number of areas – into spot markets for specialised labour. On these, suppliers of specialised labour could meet buyers just-in-time, thereby extending today's outsourcing relationships into global eLancing markets. Proponents of transaction cost theory suggest that eLancing markets will naturally develop as a result of decreases in the costs of transactions organised on the free market, which themselves are an outcome of the advent of electronic networks and the Internet. The experience until now, however, has shown that for eLancing markets to work, a system has

to be created which supports the establishment of much higher levels of trust in virtual communication than possible at the moment (see below).

- § Virtual social capital: Tools and systems that enable virtual collaboration will need to put more emphasis on strengthening of social capital in ICT-mediated interrelations. Exploitation of recent experience with online virtual communities, and integration of findings from radically new online consumer applications into the development of virtual collaboration work tools, promise to make vital contributions to this objective.
- § Feasible policy strategies: The establishment of effective, global regulatory frameworks for internalisation of (long-term) environmental costs in the pricing mechanism requires extensive research into policy strategies which support the required negotiation process between countries – differences between which are manifold, for example with regard to stage of economic development, wealth per head, resource consumption, exposure to the effects of climate change, and inter-country dependencies.
- § **Emerging**
- § Utility-like network and software commoditisation: The product-to-services shift in the area of working tools will be boosted by software becoming a “commodity-like industry due to the predominance of Semantic Oriented Architecture”⁴⁷. Plug & play access to software as a service will greatly reduce the need for ownership of physical equipment. The same applies for the utility-like network, i.e. computing power and connectivity becoming available ubiquitously – just as electricity and water today. The scale economies which can be achieved thus will increase resource efficiency considerably.
- § Eco-tagging using RFID technology: Today, firms which want to optimise their work organisation in order to reduce their ecological footprint suffer from lack of access to environmentally relevant information. Advances in environmental informatics will be of relevance in this respect. The extent of traceability afforded by RFID technology will offer radically new ways to supply firms with real-time information about material flows related to their work processes⁴⁸. This will provide the basis for optimising value chains for reducing the ecological footprints of the production process.
- § Social embedding of eWork (including eLancing and virtual labour markets): eWork has been held back by the challenge of reproducing social cues and social contexts in virtual environments. Increasingly, research looks into how eWork can be socially embedded in order to overcome traditional patterns of media choice.
- § Virtual Reality @ Work: Face-to-face interaction, and the demand for physical transport which it implies, will remain crucial as long as virtual meetings lack the wealth of social cues, the flexibility and the richness in contextual information that are characteristic for meetings in physical space. It will be neither feasible, nor desirable or cost-efficient to try to totally replace work-related physical interaction with virtual interaction in the foreseeable future. Still, more progress towards full virtual co-presence is required in order to shift a significant share of work-related travel from the physical to the virtual domain⁴⁹. The application of advances in virtual reality to typical settings of work-related interaction could potentially be of great impact in this regard.
- § Sustainable international regulatory frameworks: The emergence of sustainable international regulatory frameworks: The emergence of sustainable international regimes for internalisation of full costs of resource consumption would provide the necessary market incentive system to align the development of the capitalist production system with the long-term goal of environmental sustainability.

Research Ideas/Actions

Title	Reducing the total ecological footprint of collaborative knowledge work
Keywords	Substitution of travel by virtual collaboration, work-related travel, built environment for knowledge work, office space requirements
Problem/Issue	Whereas much progress has been made in decoupling economic progress from environmental burden in other areas, overall levels of physical transport are still increasing in line with, or even faster, than economic growth. Efforts are needed to exploit ICT's potential to support fully virtualised collaboration in knowledge work environments. Moreover, resource consumption for office space (and related equipment) dedicated to knowledge work needs to be reduced in order to relieve pressure from urban agglomerations.
Objectives	(a) Explore the overall ecological footprint of knowledge work in collaboration-intensive settings; (b) Identify ways in which ambient computing and virtual collaboration technologies can reduce resource consumption without vitiating economic sustainability (growth and innovation); (c) Assess means with which these technologies and practices can be implemented in real-world business settings.
Approach	(a) Identify suitable scientific approach to the measurements of overall resource consumption / ecological footprint of collaborative knowledge work; (b) Measurement in a number of case studies (which are sufficiently representative of overall collaborative knowledge work in Europe); (c) Comparison between different collaboration models according to degree of virtualisation, intensity of face-to-face interaction, office space concepts, and so forth; (d) Develop recommendations how to set up and manage collaborative working environments in order to minimise ecological footprint without negative effect on the effectiveness of collaboration.
Focus	Sustainable workplaces, sustainable office space, sustainable real estate, sustainable work-related mobility, sustainable virtual collaboration
Phases	See approach
Technologies	Product lifecycle concepts, ecological footprint, ecological backpack (Material Impact per Service unit – MIPS) and related concepts, CSCW, virtual collaboration technologies, ambient computing, VR
Business Process Changes	Business process redesign where necessary to reduce ecological footprint in ways which do not affect business performance and longer term economic sustainability
Impacts	Full awareness of overall resource consumption, broken down to the level of collaboration related business processes in order to guide targeted intervention in processes. Contribution to decoupling of economic growth in knowledge-intensive activities from total levels of transport.

Inhibiting Factors	Environmental costs are often not internalised in the price mechanism, which can mean that companies that reduce their ecological footprint are penalised by the market.
Participants	Research institutes together with a number of companies (case studies)
Duration	Immediate start, continuous work with annual breakthroughs
Resources	To be defined
Follow-up Actions	To be defined

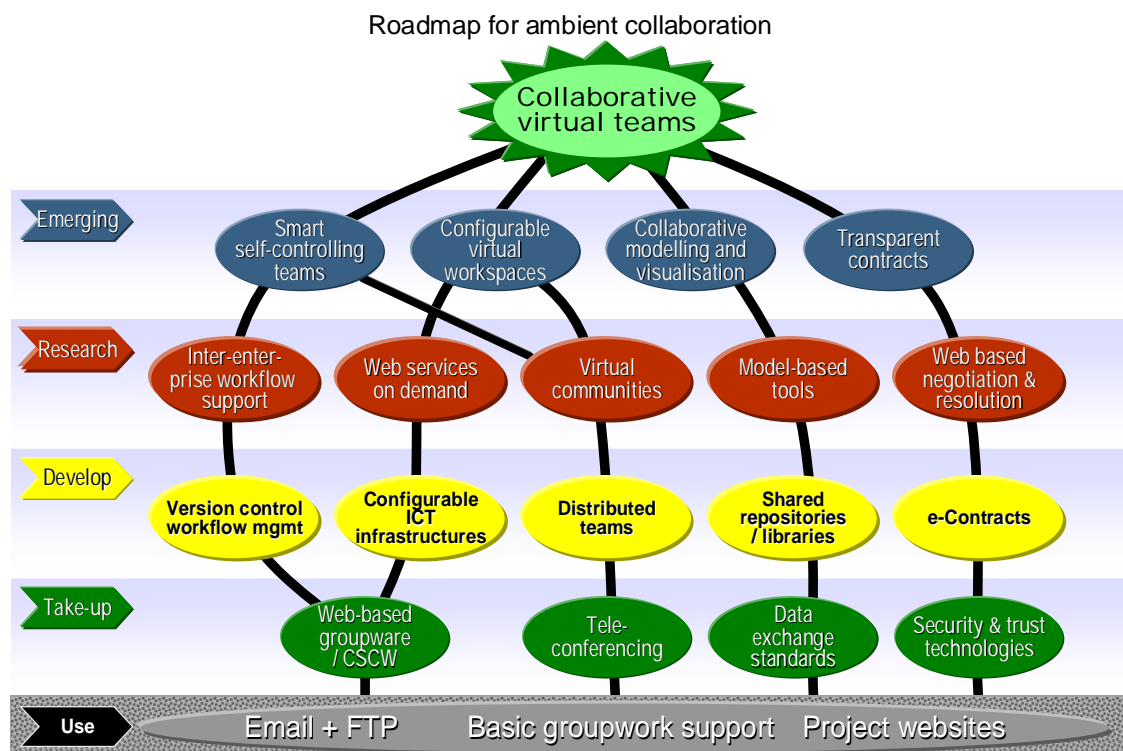
Ambient Collaboration

Current state: Teamwork between distributed experts in participating companies is supported by email and basic web-enabled document management systems ("project web sites"). Quite sophisticated tools/systems to support distributed teamwork are already commercially available. However, the business models of ICT vendors are targeted mainly for internal use by one company and its supply chain. Business models are missing for the provision of these tools and related services to temporary inter-enterprise teams.

Vision: Distributed team members collaborate across organizational, geographical and time boundaries as if they were co-located. There is a single global virtual workplace for all project and business applications including distributed production and service delivery.

Scenario:

A complex project (e.g. power plant) is to be started that needs the competence of different organisations from different corners of the globe. Organisations participating in a global network are pre-selected based on their competencies and contracts with these organisations pre-generated. Once organisations select to participate in the project, their relevant tools and services are "plugged-in" to a shared ICT environment that provides shared access to relevant applications and services that are configured on the fly when needed. Each organisation participates using its own operational environment while at the same time having (through interfaces) access to the shared repositories and services. Once the project is over, the shared environment is "de-configured".



Key Elements

Technologies in industrial use

- § Email and FTP: In its simplest form, sharing of data is possible today through email and shared FTP servers. The major problem here however is a lack of version control, ownership of partial models, etc. When for example, a user leaves an organisation, the information they have is lost!
- § Project websites: Basic collaboration in projects involving distributed organisations is supported today by "project web sites"/servers, for exchanging and storing files. These typically constitute a document server and basic project management functions. One of the main problems with such systems is that users need to learn the system. With persons working concurrently on several projects, it can be a challenge to consequently use a different system for each project (in many instances, the choice of the project website and services is dictated by the largest organisation participating in the project). Furthermore, data needs to be uploaded to and downloaded from the system. There is lack of support for asynchronous working.
- § Basic group work support: services like calendars, discussion forums, email distribution lists, partner contact information etc. Use of more sophisticated groupware is however limited by licensing conditions: the dominant business model of pricing systems based on the number of "seats" is not suitable for temporary short term projects with several and dynamic partners.
- § **Ready for take up**
- § Web-based groupware / CSCW: Tools for Web based group work support such as Computer Supported Collaborative Work, (CSCW), Customer Relationship Management (CRM), Document management, Product Data Management (PDM), Workflow Management (WfM) etc., are now available on the market and can be put to use by organisations.
- § Teleconferencing: A salient cost associated with many projects is the amount that is spent on phone bills and travelling. Today however, with audio and video using medium to high speed data connections a certain degree of teleconferencing is possible. Tools to support archiving of such teleconferences are also fast emerging.
- § Data exchange standards: Data exchange standards allow for the interoperability of different applications operating on a common data set. Where some applications are non-compliant with shared standards, interfaces can be developed to map data onto agreed and shared standards.
- § Security & trust technologies: Security and trust technologies such as public key infrastructure (PKI) and cryptography exist for digital signing and encryption of data. Tools to support audit trails for tracing electronic transactions, logging archiving, etc. are now emerging.

Develop

- § Version control and workflow management: Tools for change, version & workflow management need to be developed to work across the business applications of an organisation. While some workflow/version control exists at a document level, such is not necessarily the case at a data or model level.
- § Configurable ICT infrastructures: Business models for ICT infrastructure provision to temporary, distributed, cross-organisational project teams need to be developed. These ICT infrastructures should be easily configurable and support integration and/or interoperability across relevant business applications of an organisation.
- § Distributed teams: Social cohesion of distributed teams, supporting the emergence of communities of practice, perhaps through shared/distributed authoring using tools such as WIKI and the maintenance of emerging, specialized ontologies.

- § Shared repositories and product libraries: Tools such as product model servers and shared repositories need to be developed. These should allow an organisation's business application to operate on a shared product data model level with each individual application controlling its own data set within the model. This will allow for better product data management and minimise data redundancy, need for multiple inputs etc.
- § e-Contracts: Legal and contractual governance and agreements on practical procedures for ICT based collaboration e.g. model contracts. These should as an example allow for role based access control to different project databases, websites, intranet areas, etc. These roles could for example be: read-only, update, create, delete, etc.
- § **Research**
- § Inter-enterprise workflow support: Research in the area of tools for inter-enterprise workflow support for partially defined and ad-hoc processes are required. Work within inter-enterprise settings can at times be ad-hoc with a lack of a common set of processes. Nevertheless, the work of one organisation typically impacts that of another. Tools to support such workflow management across inter-enterprise processes in one-of-a-kind projects are required.
- § Web services on demand: There is a need for research in the area of "plug-and-serve" services on demand within inter-enterprise settings. Such services typically constitute those services that while may not be necessary at an organisational level, may be required at an inter-enterprise level for a specific project or task. Conceptually, these services and their interoperability could be seen as the nodes and their linkages in a typical computing/information Grid architecture.
- § Virtual communities: Virtual communities that are formed within one-of-a-kind inter-enterprise projects require sophisticated applications based on WebDAV (Web-based Distributed Authoring and Versioning) to support their distributed work. In addition to sophisticated tools supporting distributed teamwork across organisations, social aspects and cultural issues of work within such dynamic teams needs to be researched.
- § Model-based tools: There is a need for research in the area of model based tools for all engineering functions. This relies on the use of a shared product model that is served via a product model server. Each organisation (and/or engineering function) would have access to a partial model of the main model for data updating, manipulating etc.
- § Web based contract negotiation: Smart contract configuration from the editing of a contract till its negotiation and digital signing needs to be addressed. Tools that have the capability to select appropriate clauses based on different parameters are required to produce the "relevant" contract. These semantic / executable contracts should then be interpreted by ICT tools for monitoring and guidance for contract fulfilment by the participant organisations.
- § **Emerging**
- § Smart self-controlling teams: Business models considering the social and cultural aspects of self-managing teams are required. These teams could be created on demand, and would need different types of tools to support their ad-hoc team work. Conceptually, this may be seen as similar to the Open Space technology paradigm where individuals and/or organisations meet, set an agenda on the fly and then work together to address a specific issue. Developed tools should where possible automate linkages between team members (e.g. recognise patterns of activity in different teams and suggest cooperation across teams, monitor resource usage, etc.).
- § Configurable virtual workspaces: Workspace requirements will typically vary from project to project based on the project type/focus and the participants. Collaborative workspaces of the future should be configurable on demand and on the fly based on the specific needs and requirements at the time. They should include configurable web services, different groupware modules supporting virtual teams, access to share databases and repositories, etc. The set up time as opposed to being months, weeks, or days, should be negligible (e.g. few hours for basic configuration, and then minutes thereafter for self-configuration in line with project and

participant requirements). Smart agents or bots should be used seek, collate and present information from different sources.

- § Collaborative modelling and visualisation: In the future, there is a need to look into collaborative modelling and visualisation of data in inter-enterprise settings. While in the present, this is only partially possible (and still under research) in the form of modelling based on a common data set, tools and techniques to support concurrent collaborative modelling and visualisation are missing. These tools should support manipulation of shared models using e.g. GRID-based communications and make use of advanced visualization to develop and communicate abstract (non-physical) information and concepts.
- § Transparent contracting: There is a need for mechanisms and tools to validate and cross check ICT transactions against ICT contracts and against the minimum levels of security and trust throughout the project life cycle. These mechanisms should also include “model checkers” to cross check product data models on model servers. Furthermore, Transaction monitors should be used to monitor the flow of electronic information and documentation to ensure that they meet a pre-defined level of legal validity (e.g. within an ICT contract) security (e.g. digitally signed) and trust.

Research Ideas/Actions

Title	Inter-enterprise co-creation of products and services
Keywords	Distributed engineering, inter-enterprise collaboration, modular products
Problem/Issue	Unique one of a kind product/service development requires competency sharing of organisations from different countries. A common interoperability architecture/framework is required to enable data sharing and exchange.
Objectives	<ul style="list-style-type: none"> - Develop a common ICT architecture where different organisations can plug-in relevant parts of their applications/repositories. - Common access to a shared product model where each participant organisation owns part of the model (i.e. that part or set of variable that the organisation is responsible for. - Development of tools and mechanisms for product/service assembly (note that it is expected that products and services are modular, developed by different organisations in different countries, and assembled in line with the requirements of a customer.
Approach	<ul style="list-style-type: none"> – Requirements specification from organisations detailing their existing applications and needs from a common inter-enterprise services application. - Resulting architectures/applications are tested in a mock-up scenario
Focus	<input checked="" type="checkbox"/> Technology & Standards <input checked="" type="checkbox"/> ICT Infrastructures <input checked="" type="checkbox"/> Applications <input type="checkbox"/> Business Processes
Phases	<input checked="" type="checkbox"/> Research <input checked="" type="checkbox"/> Development <input checked="" type="checkbox"/> Validation <input type="checkbox"/> Deployment <input type="checkbox"/> Dissemination
Technologies	ICT reference architecture, inter-enterprise interoperability interface, product and service module assembly.
Business Process Changes	New ways of collaborative work, product co-creation mechanisms, etc.
Impacts	New unique one-of-a-kind products and services in response to customer demands. Products and services can be assembled on demand offering value to customer.
Inhibiting Factors	Cultural issues in terms of working across countries and therefore cultures. From a technical perspective, there may be problems in enabling interoperability across heterogeneous legacy systems of different organisations.
Participants	Component manufacturers, inter-enterprise collaboration software providers, global companies (with offices in multiple countries), research institutes with expertise in inter-enterprise collaboration mechanisms (including social and cultural aspects).
Duration	24-30 months
Resources	300-400 person-months
Follow-up Actions	Concept and solution demonstration for real-life product/service.

Title	Managing contracts in one-of-a-kind inter-enterprise setting
Keywords	Virtual organisations, contracts-on-demand, security and trust technologies
Problem/Issue	Business models and application architectures need to take into account new opportunities offered by various security and trust technologies. Currently, there is a lack of proper legislation to support electronic exchange and handling of data. This problem is further aggravated when seen in a global context.
Objectives	<ul style="list-style-type: none"> - Identification of contracts and legislations that support/cover paper-based document exchange within inter-enterprise setting - Identification of contracts (and legislations) that support ICT-based data exchange in inter-enterprise settings - Identification of available security and trust technologies to ensure validity and integrity of electronically exchanged data/documents. - Propose a set of norms, model contracts, and clauses of legislation providing legal cover to electronic data exchange in one-of-a-kind inter-enterprise settings.
Approach	<ul style="list-style-type: none"> - Study of existing legislations in different countries (both for paper based information exchange and electronic data exchange). - Where possible provide mapping of existing legislations for paper-based information exchange to those for electronic data exchange - Study existing contracts covering electronic data exchange, identify loop holes, valid clauses, etc. - Discuss sets of model contract and draft legislations with organisations that operate in inter-enterprise settings spanning different geographical (hence legal) zones.
Focus	<input checked="" type="checkbox"/> Technology & Standards <input type="checkbox"/> ICT Infrastructures <input type="checkbox"/> Applications <input checked="" type="checkbox"/> Business Processes
Phases	<input checked="" type="checkbox"/> Research <input checked="" type="checkbox"/> Development <input type="checkbox"/> Validation <input type="checkbox"/> Deployment <input checked="" type="checkbox"/> Dissemination
Technologies	Security and trust technologies, transaction tracking and audit trails, e-Contracts
Business Process Changes	New methods of "automated" trust in electronic data exchange, new forms and processes for legal support.
Impacts	<ul style="list-style-type: none"> - Elimination of legal barriers to ICT-based inter-enterprise collaboration - Contracts on demand (generated based on project data exchange requirements) - Legal cover not only for documents, but for objects, data sets, single datum, etc.
Inhibiting Factors	<ul style="list-style-type: none"> - Existing legislations and lack of legislations - Resistance to change from current legal practitioners
Participants	Security and trust technology experts, repository/ database solution providers, lawyers, etc.
Duration	18-24 months
Resources	200-250 person-months
Follow-up Actions	Development of an e-Contract generator, testing of developed contracts within past and new projects.

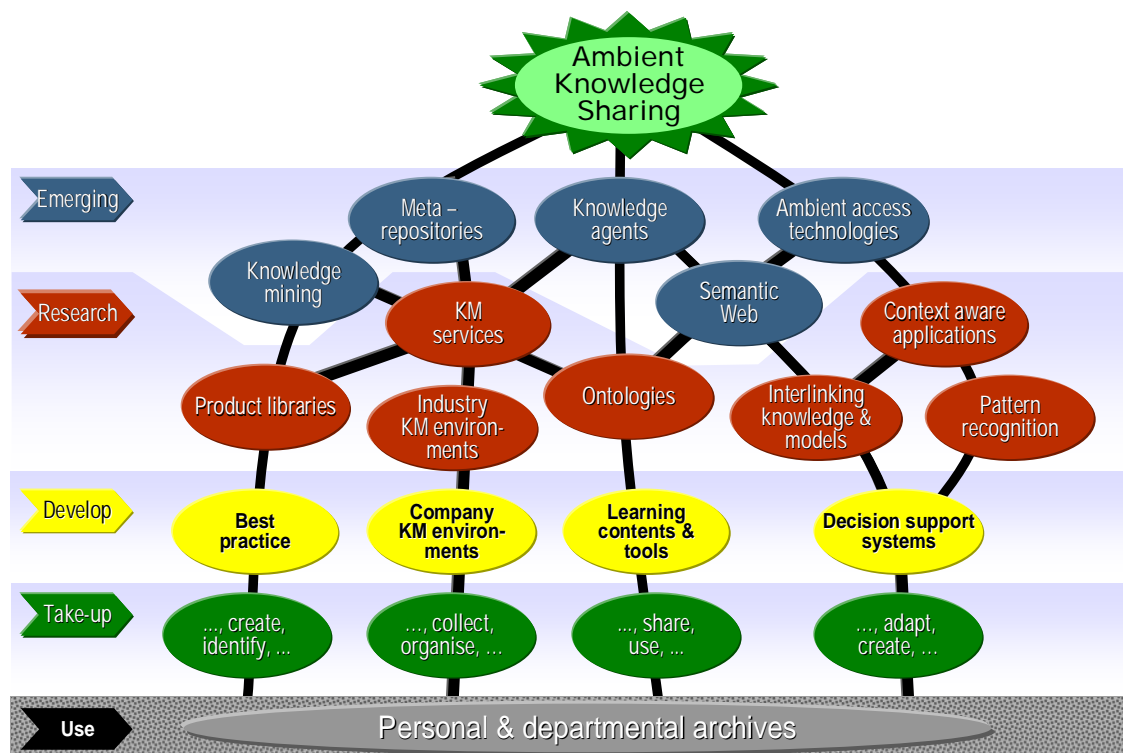
Ambient Knowledge Sharing

Current state: Experience and previous solutions are available in personal and departmental archives but new solutions are regularly re-invented in every project.

Vision: Sharing previous experiences, best practice and knowledge within and, increasingly, between organisations. The aim is to have (transparently) immediate access to the right information, at the right time, in the right format, and from the right sources (both internal to an organisation and external).

Scenario: An individual faces a problem (e.g. leakage through the roof of a concrete basement due to excessive rainfall). His/her KM environment will be able to search across multiple data repositories, mine the relevant information (e.g. from potential similar problems or occurrences) and return the potential solution(s) and relevant contact people. At the same time, it will have the capability through a combination of ontologies (or a meta-ontology) to exploit relevant content for identification through the semantic web and retrieval of the same into end-user applications using intelligent knowledge agents. The retrieved content may come from a different domain (e.g. the aerospace sector) and relate to a different problem whose solution may yet be relevant and adaptable to the problem in context.

Roadmap for ambient knowledge sharing



Key Elements:**Technologies in industrial use**

- § Most information is stored in scattered archives, mainly paper-based, but in some cases digital. Content is not annotated, and is extremely difficult to find. Experiences from projects are not captured or retained efficiently and in most cases reside in the minds of those involved in the project. There is little, if any sharing or propagation of knowledge.

Ready for take up

- § Standard KM processes: The following form a closed loop of basic processes for a knowledge management initiative. They are to be enabled through strategy and leadership; culture; measurement; and technology.
- ▶ Identify: Methods and tools for the identification of relevant experiences and practices that may form re-usable knowledge.
 - ▶ Collect: Methods and tools for the collection of knowledge from various sources and archives (personal, organisational, inter-organisational)
 - ▶ Organise: Methods and tools for knowledge systematisation and consolidation. Once knowledge has been collected, there is a need to structure it in a meaningful form for ease of extraction and use.
 - ▶ Share: Methods and tools for knowledge dissemination/propagation, search and retrieval.
 - ▶ Adapt: Knowledge is not necessarily always applicable in the form it is in. On most occurrences, it needs to be customised or adapted to organisational peculiarities. For this, it is necessary to have in place, o Organisational guidelines for business processes, task descriptions and the organisation of information
 - ▶ Use: Methods and tools for knowledge re-use. These help in the retrieval, adaptation and re-use of past experiences and practices.
 - ▶ Create: Methods and tools to re-create knowledge (new knowledge created on the basis of existing knowledge, or use of existing knowledge).

Develop

- § Best Practice: Methods and tools for the identification, capture, consolidation, and dissemination of best practices. These should contain tools that enable the search and retrieval of past experiences, good (to-do) and bad (not-to-do).
- § Company KM environments: Organisation specific KM environments that provide access to projects, experts, best practices, relevant documents (internal and external), support teamwork, etc.
- § Learning contents & tools: Tools that support and enable continuous learning online. They could contain basic tutorials, or wizards to guide through execution of a certain task.
- § Decision support systems: Tools that support decision making. The focus should be on support for real-time decision support as compared to decision support during planning phases only.

Research

- § Product libraries: Intelligent digital catalogues of building products. They should contain substantial product information (much more than simple geometry) in parametric form. As an example, they could contain guidelines for the construction (how to build or how to use) of the product.
- § Industry KM environments: KM environments at an industry level are needed to enable individuals to retrieve shared best practices and experiences. These should ideally be transparent to the users and be accessible by different applications and search services.

Furthermore, they should provide relevant groupware functionality at an industry (e.g. network of experts) level.

- § Ontologies: Identification of key concepts and their inter-relationships. Ontologies should not be too generic or too large. Rather, lifecycle phases, or topic specific (e.g. facilities management) should be developed in detail. A meta-ontology should be built on top of these to allow for interoperability and mapping between these ontologies when and where needed.
- § KM services: These services should facilitate inter-enterprise knowledge management through provision of simple services such as searching, and sophisticated services such as e-Tendering. These services may be subscribed to on a per need basis.
- § Interlinking knowledge & models: The ability to automatically link relevant knowledge entities (experts, documents, products) to a product model once it has been instantiated.
- § Pattern recognition: Mechanisms and tools to identify for example usage patterns in the execution of a particular task using some application. These patterns may then be used by application wizards to help users in the execution of such tasks (e.g. provision of the first ten steps) without the user having to navigate through complex menus.
- § Context aware applications: Applications that are context sensitive and can recognise what the user is aiming to do. They should thence be able to provide according guidance, menus, and make available the relevant information.

Emerging

- § Knowledge mining: Tools for the retrieval of knowledge, business logic, and rules from different information sources and applications. This should be automated, with the captured business logic and rules made reusable in the form of application components.
- § Meta repositories: These will provide definitions of, and relationships, and mappings between different information repositories, knowledge sources and ontologies. As an example, through their support, when a search is made for a particular item (e.g. a standard), then only one instance of that standard will be retrieved with a note that the same is also available in XYZ locations. In simple terms, instead of hundreds of links/pointers to the same information, only one direct link to the source of information will be provided.
- § Semantic Web: This will enable a paradigm shift in the way individuals and mainly applications solicit information from the Internet. As opposed to human interpretable and computer un-interpretable web content, annotations and intelligence will be added to content to all for ease of retrieval and interpretation by different applications.
- § Knowledge agents: Intelligent knowledge agents will act as a transient entity between individuals and/or applications and knowledge sources. They will (if necessary through automation) be able to modify and adjust queries so as to retrieve the required information from the relevant sources. As an example, knowing that the calling user/application is from the construction domain, when a search on "knowledge management" is done, the agent would search for "knowledge management + construction industry". Furthermore, the results may be ranked and categorised (automatically) based on the typical preferences of the user/application. Many more such applications of knowledge agents can be envisaged.
- § Ambient access technologies: Ubiquitous, personalized and context-dependent access to knowledge is necessary and will be provided through ambient access technologies. These technologies will be based on an integrated use of ontologies, semantic web, context aware applications, knowledge processes, personal usage patterns, mobility, etc

Research Ideas/Actions

Title	Knowledge Asset Validation
Keywords	Documents, good/bad practices, quality, experts, validation, time-stamp
Problem/Issue	Organisational repositories continue to build with new good/bad practices without a follow-up, re-validation, of existing "knowledge assets". This leads at times to use of incorrect practices, contact with past experts, and at times, ignorance of valid "old" practices.
Objectives	<ul style="list-style-type: none"> - Classification of different knowledge assets (documents, people, data sets, etc.) - Check points for validation of accuracy and up-to-date status of knowledge assets - Development of solution for identifying and forwarding items for validation
Approach	<ul style="list-style-type: none"> - Each knowledge asset within an organisation is tagged with a "validated on" and "validated by" - Requirements analysis is used to identify most used knowledge assets - Each knowledge asset within an organisation is periodically checked to ensure that it's content is up-to-date and still valid/relevant - Certain knowledge items are triggered for checking and validation
Focus	<input type="checkbox"/> Technology & Standards <input type="checkbox"/> ICT Infrastructures <input checked="" type="checkbox"/> Applications <input checked="" type="checkbox"/> Business Processes
Phases	<input type="checkbox"/> Research <input checked="" type="checkbox"/> Development <input type="checkbox"/> Validation <input checked="" type="checkbox"/> Deployment <input type="checkbox"/> Dissemination
Technologies	Smart tagging, object trust levels, groupware tools
Business Process Changes	More trust over use of knowledge assets, key experts as knowledge asset validators, etc.
Impacts	Considerable reductions in solution re-invention, increase in levels of trust of knowledge assets, more connectivity between knowledge experts.
Inhibiting Factors	<ul style="list-style-type: none"> - Availability of knowledge assets under one repository. - Resistance to share experiences - Lack of feedback on use of knowledge assets
Participants	Industry, ICT vendors with expertise in object tagging technologies, knowledge management experts (especially in the area of human-machine-human knowledge transactions).
Duration	18-24 months
Resources	120-150 person-months
Follow-up Actions	Knowledge asset tagging and validation at an inter-enterprise, cross-domain level

Title	Cross-domain knowledge capture and sharing
Keywords	Industrial best practices, meta-ontologies, semantic web
Problem/Issue	A problem within one industry may already have an adaptable solution in another industry. However, there is no mechanism to access such knowledge across industrial domains.
Objectives	<ul style="list-style-type: none"> - Provide a search mechanism that can search across industries for the solution to a problem. This search mechanisms needs to first know how to translate a question from one industry into that of another, - Development of meta-ontologies that operate across the semantic web. These meta-ontologies act as a mechanism for mapping the concepts of one industry onto that of another. - Mechanisms for publishing/sharing cross-domain knowledge
Approach	<ul style="list-style-type: none"> - Development of a simple add-in to office applications for classifying (automation where possible, based on context) knowledge. - Use of meta-ontologies to map knowledge from one industrial domain to the next - Intelligent search mechanism to take query from one sector and to retrieve relevant knowledge from other industrial sectors.
Focus	<input type="checkbox"/> Technology & Standards <input checked="" type="checkbox"/> ICT Infrastructures <input checked="" type="checkbox"/> Applications <input checked="" type="checkbox"/> Business Processes
Phases	<input checked="" type="checkbox"/> Research <input checked="" type="checkbox"/> Development <input checked="" type="checkbox"/> Validation <input type="checkbox"/> Deployment <input type="checkbox"/> Dissemination
Technologies	List the main technologies that are to be developed/used (max. 5 main technologies)
Business Process Changes	Knowledge classification from within typical office applications
Impacts	- Ability to identify solutions from other industries for problems from one industry.
Inhibiting Factors	<ul style="list-style-type: none"> - Reluctance to share knowledge and experience - Lack of proper domain specific ontologies
Participants	<ul style="list-style-type: none"> - Participants from different industrial domains (preferable networks of organisations) - Ontology, taxonomy, semantic web experts - Meta-clustering search engine providers
Duration	24 months
Resources	150-200 person-months
Follow-up Actions	Addition of more industrial clusters, etc.

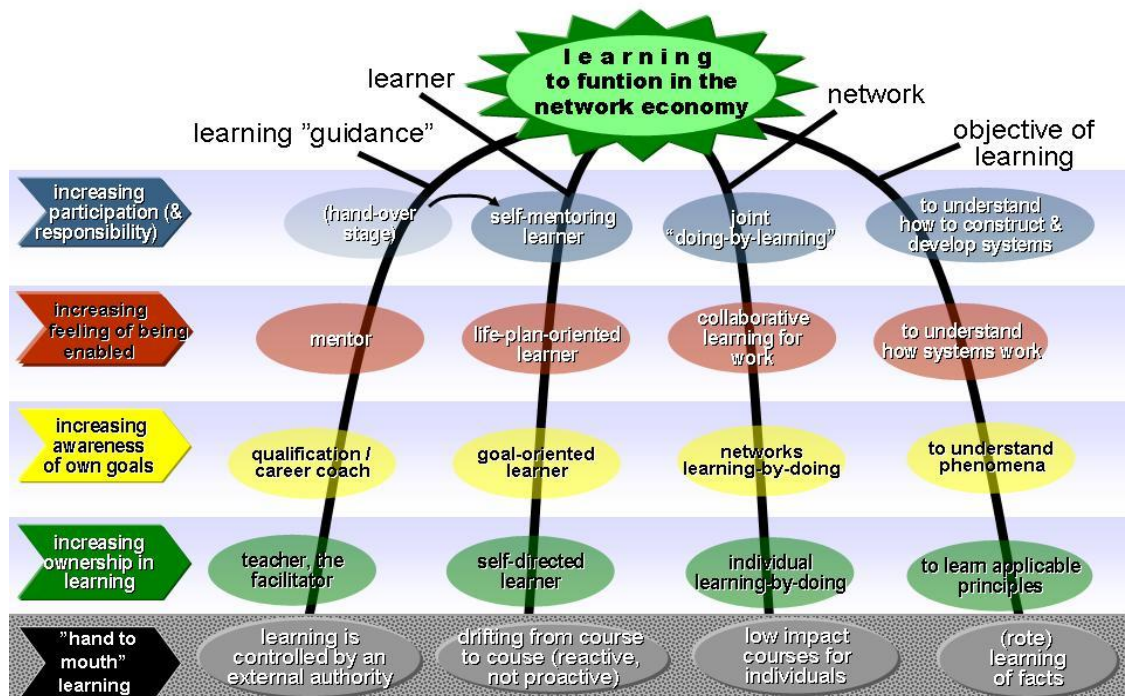
Learning in the Network Economy

Current state: Job profiles changed much less frequently in the previous century. An example: the city of Helsinki got a tram system in 1891. This saw the emergence of a new occupation, the “ticket ladies”. By the end of 1980’s the last ticket ladies’ tasks had been taken over by tram drivers. The job profile had until then remained the same for almost 100 years. Today in fast developing industries the life span of a job profile can be measured in months as they can change almost as fast as product life cycles. From an employee point of view this can mean that he/she may have a highly demanded job profile now but be on the cold list and in the need of retraining only 12 months down the road. The global economy sets increasing demands for productivity, which in turn results in the need for more and more agility among the major global players. This translates into a high demand of flexibility on the human resources part.

Vision: A knowledge worker knows the industry as well as his/her career aspirations so well that he/she is able to keep his/her knowledge base and qualifications up to date. This enables the knowledge worker to participate in the construction of both the industry and his/her personal career. Things no longer just happen to him/her, but he/she has an active role and joint ownership in the developments.

Roadmap for Learning in the Network Economy

learning in the network economy



Scenario: The organisations participating in the economy are agile. Organisations are flexibly established and terminated according to people’s needs (market). Their roles, tasks and networks evolve frequently and fluently. An individual is independent yet connected to many other

individuals and organisations through collaboration. He/she has more than one organisation for which he/she works. Individuals also collaborate amongst themselves by versatile subcontracting. Establishing temporally overlapping contracts is fluent and the duration of contracts vary (long contracts for maintenance-type tasks; short contracts for maximum expertise requiring tasks). The qualification needs applicable for work tasks in one company change rapidly, but the demand for the same qualification may well exist in second-mover organisations. Knowledge workers therefore move rapidly increasing the rate of return on their acquired qualifications. What is now called the *job market* could rather be called *the task market*.

Current state:

- a) Someone other than the learner decides what needs to be learned (someone higher up in the organisation hierarchy). This tradition begins at elementary school, continues throughout formal education and continues in the working life. In the work organisation this authority figure usually represents the employer. The learner him/herself may have a very feeble understanding of why he/she needs to take a certain course. The teacher at best will try to induce motivation in the beginning of the course as a self-originating motivation is not there.
- b) The learner faces externally set *learning demands* that are put in place by the authority figure. The learner responds to the demands without being aware of a long-term plan or larger context.
- c) The learning is often organised as separate courses that the learner goes off to complete in another environment away from the work setting. Although the teaching is targeted at a group the actual learning often takes place after the course while reviewing the learning material in solitude. Tests are almost always taken individually.
- d) People often learn disconnected, odd facts that remain detached from their experience and knowledge base (cognitive structures). A fact is often applicable to one particular situation but as the circumstances change or the context becomes more complex the applicability becomes poor.

Development paths

a) Learning “guidance”: State-of-the-art teacher training emphasises the need to change the role of the teacher. The driving force behind this is the emergence of the information society, where people must have more skills to manage their own knowledge base and what they do with knowledge. The teacher is seen as a facilitator who contributes to and improves the learning process of the learner. The teacher still mainly sets the boundaries within which the learner can choose the learning objectives according to his/her interest or need.

Someone who aids and facilitates learning needs to be available at the same pace that the knowledge worker faces new challenges. This learning coach or mentor does not need to be a designated teacher, whose tasks are only related to teaching. As the renewal of knowledge is rapid it would not make much sense for a person to solely be a teacher. This kind of teacher would very soon part from the practical application of knowledge, which would continue to widen the gap between theory and practise.

As more and more learning needs to take place the solution is not to increase the number of teachers. Instead, most if not all of the knowledge workers need to take on tasks that aid and facilitate the learning of others. One of the basic skills of the future knowledge worker needs to be pedagogical.

In the transition time – moving from class-room teaching to active, participatory and enabling learning – organisations need to assign qualification analyst, coach and mentor –type tasks to key knowledge workers who possess some pedagogical skills and the necessary personal

maturity required by the tasks. These people need to set an example (for model learning) and embed the role into organisations and working life.

b) Learner: Especially professionals working in adult education (andragogy) have encouraged learners to become more self-directed. Tests have been developed to assess learners' self-directedness. Self-directedness has quite often meant in practise measuring how eager the person is to learn (motivation), how confident they are that they will reach the learning goals and how well the person is able to monitor oneself in reaching the learning objectives.

This kind of approach can still leave issues of goal-setting and meaningfulness beyond the scope of the learner. Self-directedness needs to be taken to the next level to cover the decision-making regarding *what* one will learn i.e. the learning objectives. Objectives in turn relate to strategic thinking: where you are at present, where you want to go and what opportunities you have for reaching the goal. If the learner is setting his/her own goals, the issue of an external teacher needing to induce learning motivation, becomes a trivial line of thought. The motivation would rise naturally from a self-set vision and the *meaning* of the vision to the learner.

c) Network: There has been a long period of time during which people have become aware of the high costs and low applicability of most courses completed away from work. New delivery methods, e.g. eLearning solutions, have brought learning closer to where one applies the knowledge in the work environment. This being the case it has become easier for people to sequence learning and working. One can learn at the same time while attempting to do something in a new way that requires learning. This is one example of "learning-by-doing".

As the work processes are more and more distributed and production is modular or even fragmented, it is not enough if an individual learns something. Whole networks of collaborating people need to learn whatever the process under way requires in order for it to be efficient and innovative. In "learning-by-doing" the main objective was to learn, and doing something was the practical solution to increase learning. In the working context the main objective is conducting work in the best possible way, and the practical solution to develop the quality of work is by learning – hence the change into "doing-by-learning".

d) The objective of learning: The information age and what appears to be a quickening of the overall development pace has increased peoples' awareness of how short-lived odd facts can be (e.g. genetics). This has in the best of cases lead to a preference to teach (or help people learn) principles rather than facts. Also, in the best of courses pedagogues are implementing positive "hidden curricula" for teaching people *how to learn* and therefore update their knowledge base.

Course instructors with a good pedagogical understanding are building courses around phenomena rather than serving the learner detached pieces of knowledge rising from different domains of knowledge. This coheres with the way people naturally think and analyse concrete real-life issues. This problem-based-learning approach needs to be taken further towards understanding larger scale phenomena – i.e. systems.

Understanding systems is a mid-term goal as it answers the how-questions. In order for people to be able to do something differently, or better yet to make a difference, one needs to be able to ask why-questions. If the answers found for why-questions are not satisfactory, functional learning needs to be applicable to developing the existing systems and for constructing new ones. There are too many macro level examples in our society where people have become so estranged from the original purpose of a system that people begin to think of the system as a goal in itself. This can unnecessarily take up resources and create a gap between what the society and market has to offer and what people really need. Having better skills for understanding

systems and for developing them serves to close these gaps, not to mention increasing an active participation in constructing the future.

Research Ideas/Actions

Possible titles	<ul style="list-style-type: none"> -Developing mentoring practises among knowledge workers -Developing ambient learning environments -Increasing tacit knowledge transfer to explicit in the area of systemic thinking -Developing learning teams for core and context competencies and optimising their balance regarding proportions of explicit and tacit knowledge -Increasing knowledge transfer -Learning towards conceptual and systemic thinking -Developing skills and software to aid visualisation of complex knowledge
Keywords	knowledge worker, knowledge worker mentoring, functional learning, qualifications, ambient knowledge sharing learning, cognition, skills, visualisation, systemic thinking, tacit knowledge, explicit knowledge, extended enterprises, core competencies, context competencies
Problem/Issue	<p>As more and more learning needs to take place the economical and effective solution is not to increase the number of teachers and formal education courses. Instead, most knowledge workers need to take on tasks that aid and facilitate the learning of others.</p> <p>The diversity of knowledge worker teams needs to be enhanced and enriched and collaborative individual and team learning environments need to be strengthened.</p>
Objectives	<ul style="list-style-type: none"> -Developing pedagogical skills of future knowledge workers and developing of functional learning pedagogy -Deployment of functional learning pedagogy into NWEs especially in fast moving industries such as IT, communication, media -Exploiting and building on European demographic trends in enabling systemic innovations for knowledge worker teams (according to andragogical research an older person is better equipped to understand systems and entities, and to therefore apply systemic thinking, further increasing the possibility of systemic innovation) -Increasing tacit knowledge transfer to explicit, especially in the area of systemic thinking -To develop skills in visualisation of complicated knowledge -To develop a link between industry based visionary thinking to learning and qualification self-management
Approach	<p>Research on</p> <ul style="list-style-type: none"> -Mentoring, development work in finding best practises and their applicability for wider deployment into knowledge work; corresponding validation work -Cognition -Empirical learning environments -Multimodal learning interfaces; rich contextual environments & controlled contextual environments

	-Extended enterprises -Phenomena-based research, which can be conducted in Living Lab environments
Focus	<input type="checkbox"/> Technology & Standards <input type="checkbox"/> ICT Infrastructures <input checked="" type="checkbox"/> Applications <input checked="" type="checkbox"/> Business Processes <input checked="" type="checkbox"/> Human cognition and learning processes
Phases	<input checked="" type="checkbox"/> Research <input checked="" type="checkbox"/> Development <input checked="" type="checkbox"/> Validation <input checked="" type="checkbox"/> Deployment <input checked="" type="checkbox"/> Dissemination
Possible associated technologies	Learning enhancing technologies: Living Lab research design; wearable computing; personal area networks (PAN); location and context awareness technologies; wireless technologies; sensory technologies
Business Process Changes	Borderless, collaborative learning in business networks; self-managed, frictionless mobility of knowledge workers in business networks and the extended enterprise.
Impacts	-Knowledge workers: Improved self-management of career/life -Industry: Fast moving industries are able to evolve and maintain competitive advantages -Society: Less friction in the evolvement of work organisations helping them to achieve competitive advantages; > improved economical and social sustainability
Inhibiting Factors	-Societal: traditional, fixed views of employer-employee relations which distort how knowledge work is viewed within the context of network economy -Individual: the theme is close to personal development issues, i.e. inhibiting factors close to personal development apply

Industry Specific Analysis (Validation) and Recommendations for R&D

The following Domain specific roadmaps⁵⁰ were developed in network4value:

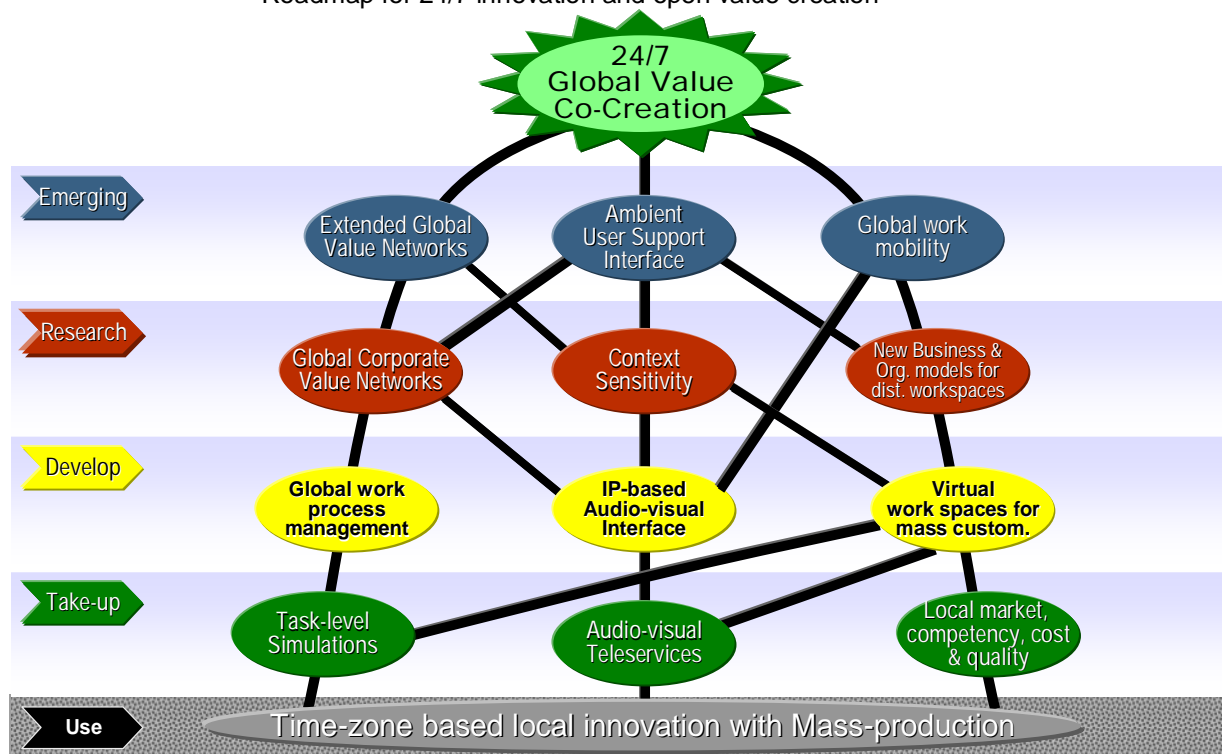
- 24/7 Innovation and open value creation
- Open innovation
- On-demand micro-media
- Global concurrent engineering
- Mobile workplace innovation in construction
- Pervasive health services

24/7 Innovation and Open Value Creation

Current state: Today, innovation is often governed by time zone limitations as a consequence of isolated, non-inter-connected innovation and competence centres. Support for collaboration in multi-cultural networks, personalisation, and sophisticated project management is limited. Off-shoring and outsourcing are driven by cost driven market and skill availability. Furthermore, products are typically mass-produced in massive facilities.

Vision: There is continuous co-creation and innovation of products and services using the “follow-the-sun approach”. Value is created through a combination of distributed competencies through 24 hour global resource utilisation to support continuous innovation. Products and value-adding services are mass-customised. Europe takes the lead in the orchestration of creation and value capture by facilitating systemic innovation (e.g. by way of complex Living Lab co-design systems).

Roadmap for 24/7 innovation and open value creation



Global value networks created with the purpose of utilization 24 hours innovation potential is also called the 'Now-Economy or the ON-Line-Enterprising'. Two main enablers have contributed to early evolution of successful cases where 24 hrs 'follow the sun' collaborative processes made possible. First the development of global work processes and development of collaborative technologies to enable virtuality, concurrency and extending/handing over tasks over time zones.

The second resource is the availability of open shareware tools, products and SW resource. Some of these are developed for proprietary needs of closed enterprise families but much more interesting are Open source platform developments.

There are clear signs of the efficiency of Open architectures and open source innovation platforms where participation also is at least partly all inclusive and the business ecosystem attracts innovation and entrepreneurial value for new entrants or even innovative individuals.

The three partly overlapping scenarios are presented above for proprietary (corporate specific) platforms for global creativity and innovation 24/7.

- scenario of the competence centric model focusing on resource utilization and local market needs.
- scenario for creation true rotating innovation networks to speed up innovation to market and unifying global processes for transferring creative contents on task levels to next teams. Also concurrent engineering and co-located models support rotating innovation process.
- scenario for providing and focusing on enabling both processes since in reality neither scenario would be implemented purely.

What are the company value and challenge?

Investment strategy for investing into new regions for highly skilled product creation is traditionally determined by three elements:

Market lead investment

Here growing markets attract investment for local R&D and eventually integrated production. Here advantage is for increasing mass-customizability since the development takes special market and local user specifics for modular creation process

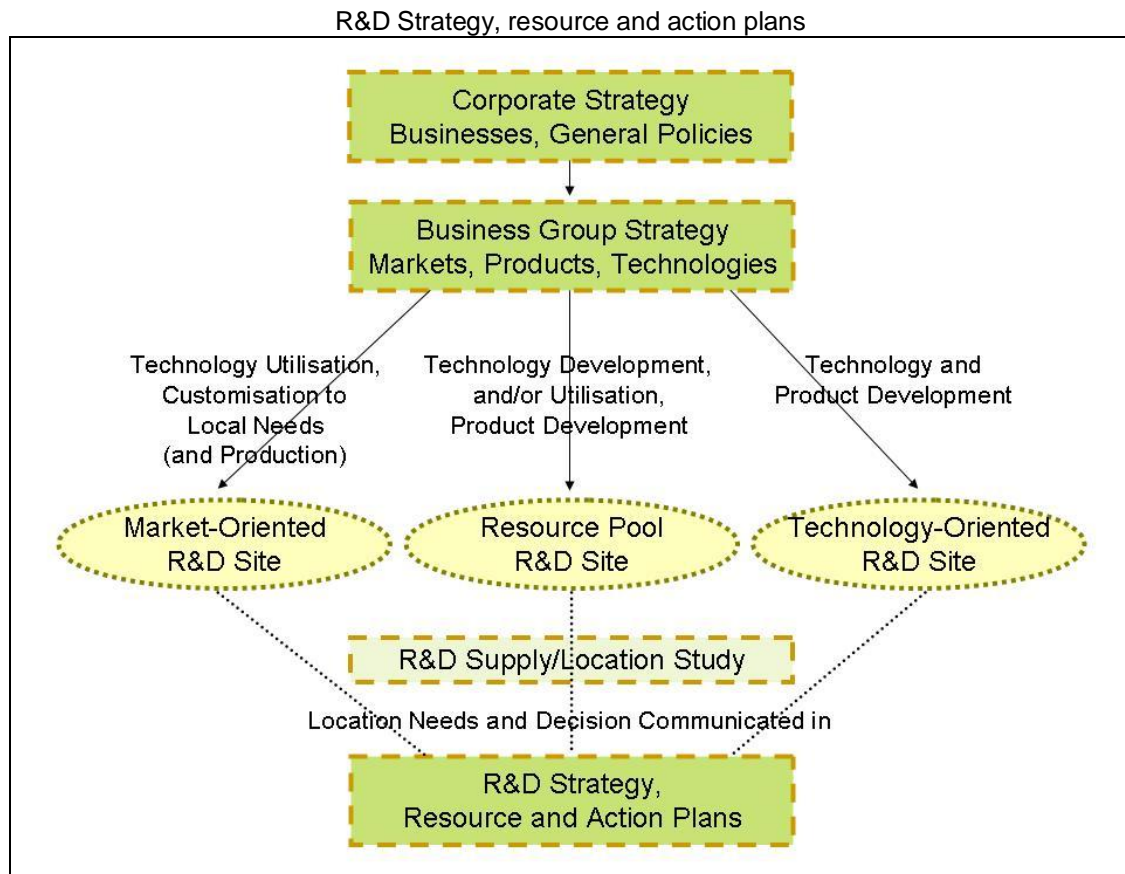
Talent availability lead investment

In some cases where competencies and talent is not been attracted to immigrate these pools tend to attract investments. Work follows more the worker in the future rather than worker the work, especially in highly skilled areas.

Technology availability, transportation and manufacturing cost lead investment

Sometimes Investments are mergers and entries to proprietary technologies or new regional standards or globally prevailing new technology centres. These could be the must-be locations. Also eventually R&D units create value with the close proximity of manufacturing whereas global logistics and transportation cost becomes a criteria. Manufacturability being also a research and development issue.

None of these are solely criteria for investments but in every instance they are weighted and compared for decision. In less high margin industry with lower skill needs the labour cost becomes also a parameter in decision making. This is truer in manufacturing than in R&D. However also cost based off shoring of R&D takes place, but in many cases they are also reasons due to skills availability and government policies and programs to attract high end investments.

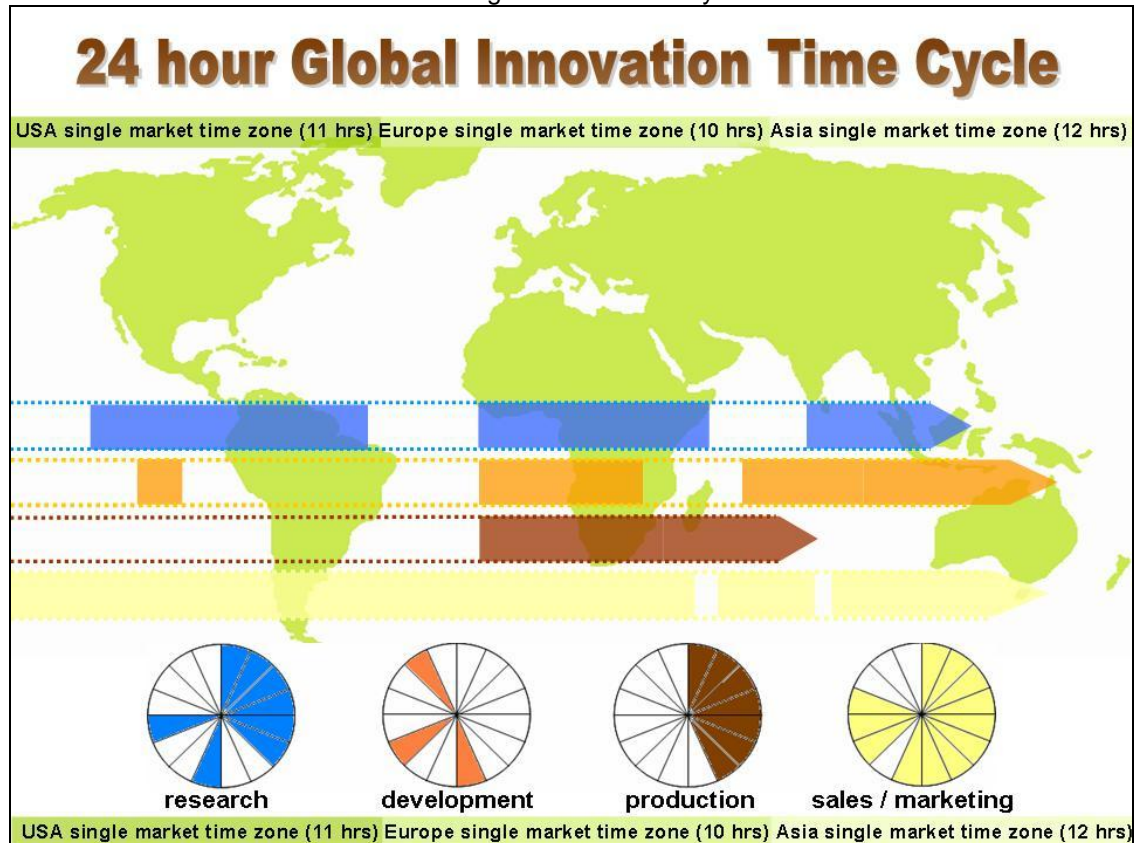


During the past years many companies have created their presence at the global growing markets around the 24 hrs economy and question has become more on how to improve global product creation and business processes through out of its network in a synergetic manner. Concurrently corporations have implemented outsourcing policies also on local sites. This has taken place through different core-context type of business analysis. Context for a company has become core for a partner, spin-off or subcontractor. Forms of local extended enterprises were created. Soon global networks of these extended enterprises became a necessity for all partners' existence. Networks of extended enterprises became competitors and partly overlapping extended enterprises started creating co-opetition, where competitors collaborated in some area and fiercely competed in another area. The battle of partnerships which constantly evolves became a competitive advantage and managing these partnerships became a core competency.

These innovative value networks can also be divided by different functions as seen in the picture below. It became a mixture of 16/5, 24/7, 8/5, 16/7 cocktails of business process global undertakings.

Global competition between corporations became a competition or corporate agility to adapt to the business environment changes which could be very different by different functions.

24 hour global innovation cycle

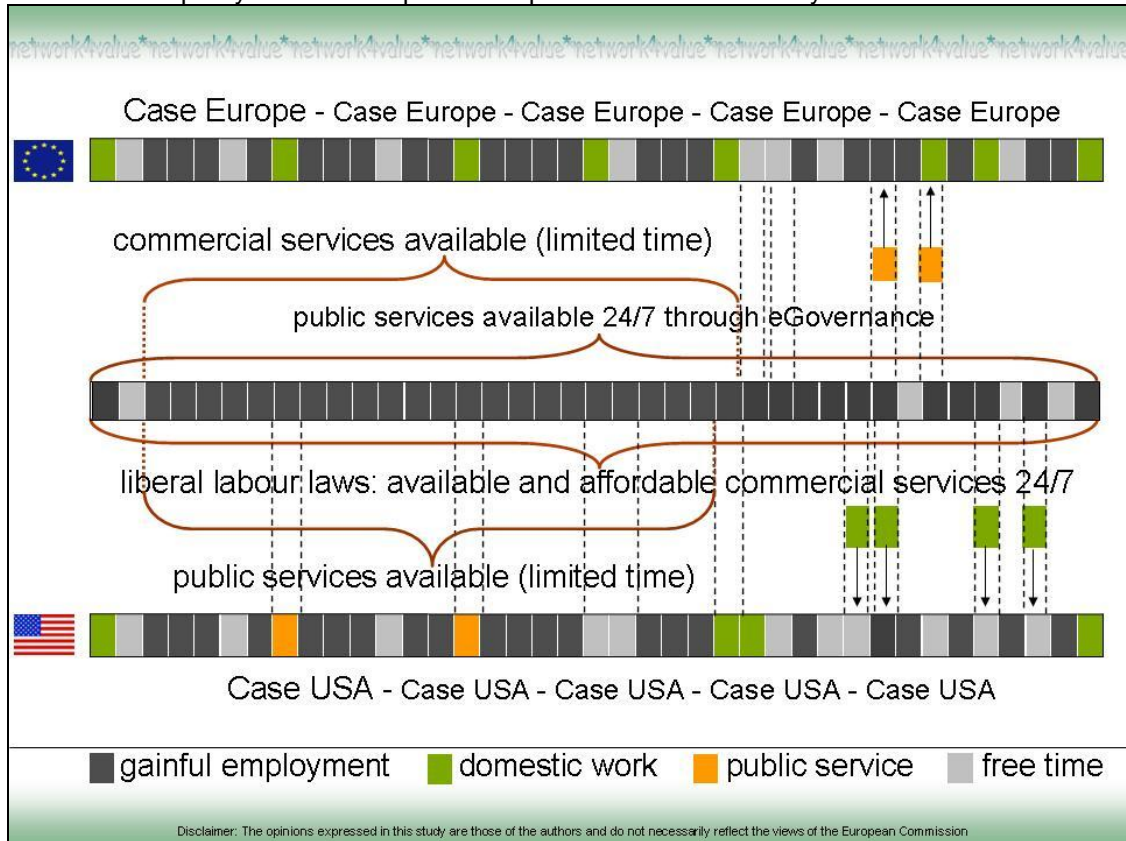


The new emergent paradigm of exploiting the 24/7 now-innovation economy is a reality for global companies, big players and small players, even local players without having conscious strategy on it. This can be called as globalisation impact on local economy.

What is there for Europe? How can Europe lead the way in exploitation of such networks of constant global innovations and capture the value in providing orchestration capabilities of such networks and not only for private corporations but for areas of public sector participation of global innovation.

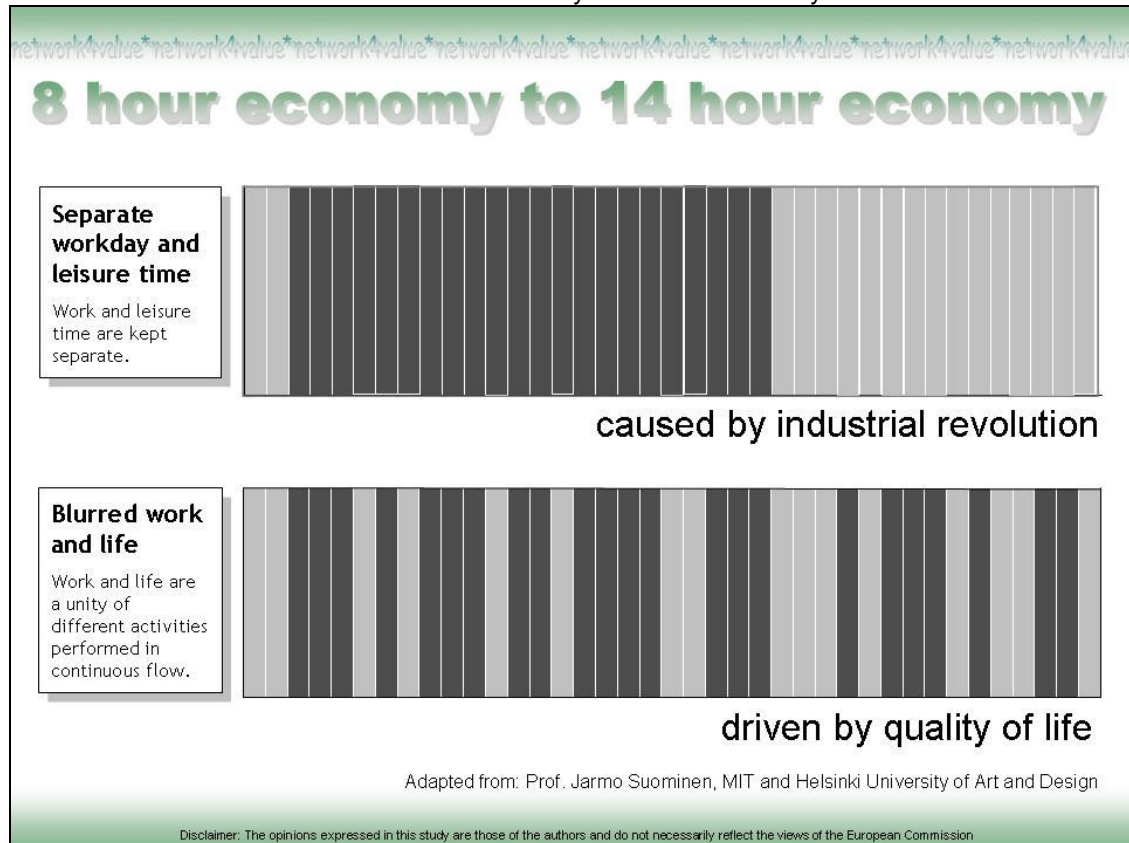
A good illustration is on the labour regulation which sets boundaries in physical participation to the 24 hrs economy. Asia and Americas enjoy wider spectrum of active labour participation (E11 hrs, AM12 hrs and AS 13 hrs) and when taking work time regulation the difference becomes even greater. When looking the picture from annual working time the difference is even greater. This of course tells about the quality of Living differences and choices that European nations have taken, however much can be done without sacrificing the social model of European labour markets.

Labour policy in relation to public and private service availability in the 24/7 context



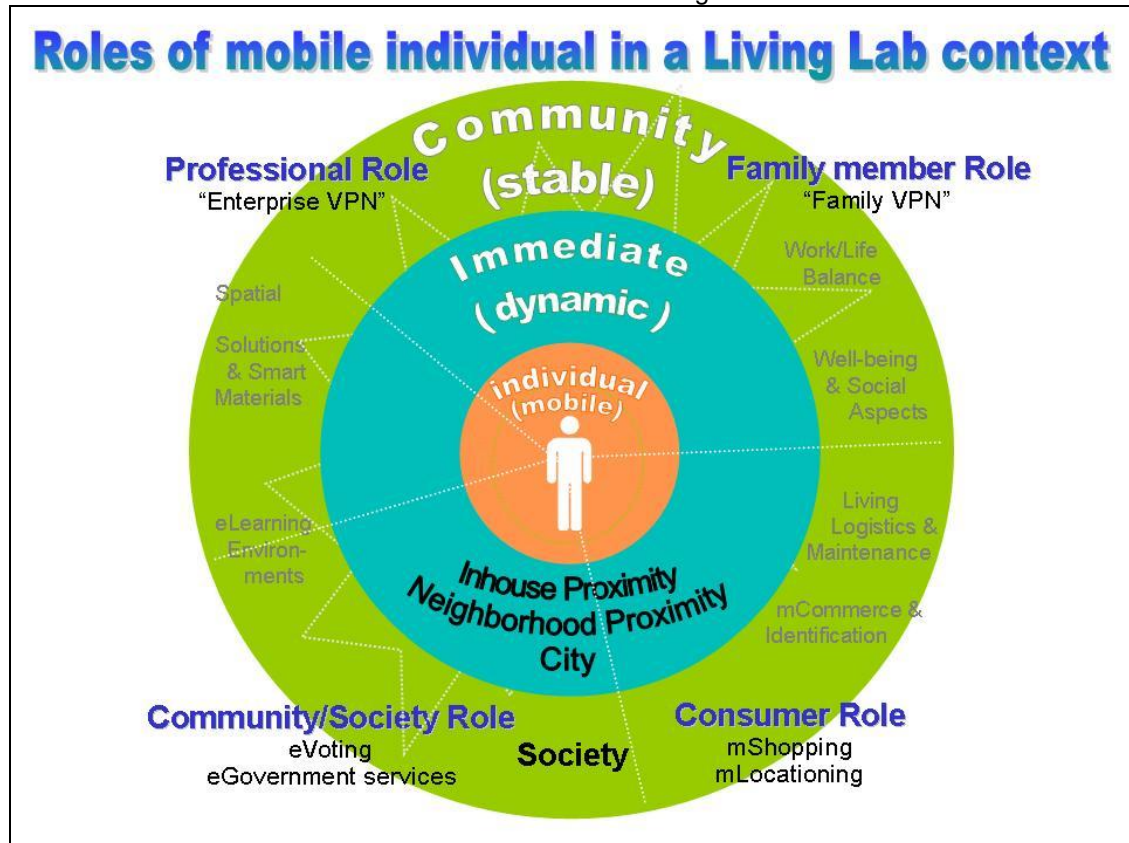
The globalization and emerging knowledge economy is also blurring the division of daily activities of a modern knowledge worker. The challenges are here the need to adjust work processes according to such agility needs of extended day, not to impact negatively to work-life balance of individuals. Much research is needed in this area.

From 8 hours economy to 14 hour economy



When user /worker/citizen becomes focus of research and individual sustainable productivity is introduced the work specific environment as research space becomes invalid and insufficient. A better starting point is to look the multiple roles of individuals and the daily life management of users provide much better base for measuring the work process efficiency also from the societal and individual perspectives. This leads also to the introduction to Living Lab research methodologies, where research has to take place in the living context. Here contextual control is low and need for high touch observation is high. Developing such environments cannot be left for corporate and research needs broad collaborative efforts. Below is a picture of such schema of individual roles and digital services that can be designed and researched in a Living Lab setting.

Roles of mobile individual in a Living Lab context



Title	24/7 global innovation
Keywords	product creation, concurrent engineering, task mobility, worker mobility, now-economy, extended enterprising
Problem/Issue	Innovation and product creation is increasingly exploiting 24 hrs cycle for speeding up time to market. Multiple sites around the world can concurrently engineer and develop and design new products in rotating daily cycles of global time. This is underutilized resource due to many reasons and research should focus on enabling collaborative technologies to enable better orchestration capability for European players in the exploitation of global innovation capability. Open innovation vs. proprietary innovation, comparative studies.
Objectives	Analyse current state and best practices Objective 1: to commission a study on collaborative ways for global product creation Objective 2: to identify research topics to be funded in the 7 th framework program
Approach	Study should focus on best industry benchmarks on SW development, Service development and Hard ware related manufacturing and product integration. Empirical as close to Living Lab type of arrangements.
Focus	<input type="checkbox"/> Technology & Standards <input type="checkbox"/> ICT Infrastructures <input checked="" type="checkbox"/> Applications <input checked="" type="checkbox"/> Business Processes
Phases	<input checked="" type="checkbox"/> Research <input checked="" type="checkbox"/> Development <input checked="" type="checkbox"/> Validation <input checked="" type="checkbox"/> Deployment <input type="checkbox"/> Dissemination
Technologies	Work and business process related collaborative technologies, real time enterprising and multimedia interfacing, simulation, demonstrations
Business Process Changes	List here the perceived changes or introduction of new business processes or methods of work.
Impacts	Direct impact to European competitiveness through better global orchestration capability Participants: Share best practice, conduct R&D on live process, personal competencies Industry: Industry alliance building and extending enterprising Society: Attract foreign investment, retain talent work-force, new base for innovative emergent business area.
Inhibiting Factors	IPRs, Trust, Openness Technological: Interoperability of process and technologies, security policies Societal: Challenging for support in policy, conceptually difficult, Work-life balance challenge
Participants	Industry: Mandatory is to have globally operating companies involved, also local >SME companies in the extended enterprise as partners and subcontractors ICT Vendors: Design new collaborative technologies, products and services Research Institutes & Universities: Multidisciplinary research; Org Science, business value, work process

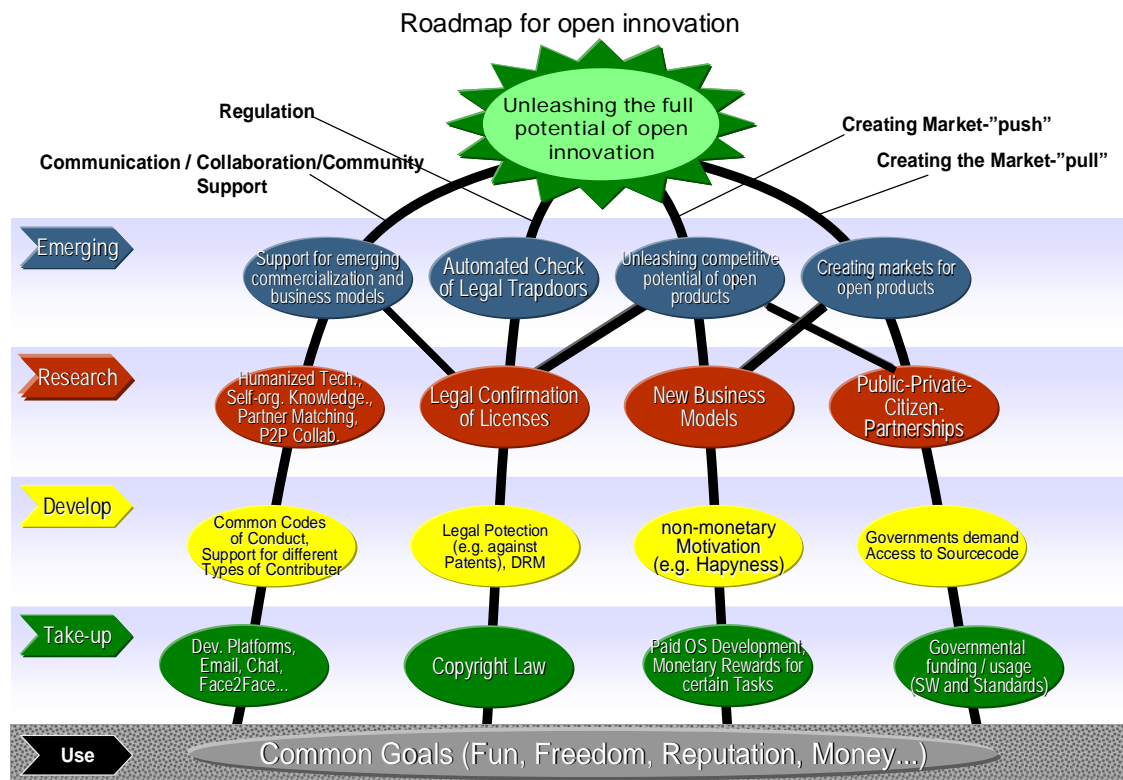
	efficiency, human inter-phasing, collaborative technology designs and research, Public sector: enabling environments for collaboration specially in services(Living Labs).
Duration	Studies as soon as possible and first empirical research started in 7 th FP first call. bringing volume towards end of 7 th FP.
Resources	Co-sponsoring from industry, multiple instruments like eureka and e-Ten
Follow-up Actions	Close collaboration from IST Units on study design and mentoring/review process

Open Innovation

Current state: The huge potential of open collaborative innovation is visible in various areas such as Open Source software development or the Wikipedia project. It has proven to be a very successful way of including stakeholders in the innovation and design process of products and services. However, this potential is not fully exploited within companies yet. One successful example is the Nokia Develop Forum.

Vision: Leveraging the full potential of open collaborative product creation. Giving organisational institutions and all other interested stakeholders the tools to work together without boundaries. This will also enable companies to leverage the potential within communities to build and strengthen brands.

Scenario: A hardware company is developing handheld computer devices. Since they are a start-up company its resources are very limited and they decide to use an Open Source operating system. They set up a community portal where everybody is allowed to send software patches to make sure the operating system runs flawlessly on the new devices. The community grows and soon hundreds of software products for the device exist, driving the hardware sales and creating a positive company image as "The User's Hardware Company".



Key Elements

Currently in Use / State of the Art

- § Most collaborative open development projects have not much more than a common goal. These goals may range from monetary interests to plain fun. However, many projects have to deal with a variety of hassles. Technology does not support their effort as flawlessly as it could, organisational boundaries limit them, legal uncertainties hold them back and very often there not be a market for their product.

Take up point

- § Open innovation processes, as they can be seen today, can rely on certain technological and legal standards as well as common practices:
- ▶ Collaboration: There is a huge variety of tools available to facilitate collaboration. Ranging from project platforms to exchange file and version control systems to email and chat applications.
 - ▶ Regulation: There is no real regulation available which was specifically developed to regulate open innovation. There are however existing laws on intellectual property.
 - ▶ Creating Market-"push": Already companies are trying to stimulate open development by paying independent to develop products for them in an open matter. One way of doing this is to set rewards for certain tasks.
 - ▶ Creating the Market-"pull": Already the government can be a big player when it comes to creating a market for products resulting from open innovation. The may e.g. use open source products.

Develop

- § Several developments in the area of open innovation are visible today already and will most likely define the landscape in the near future:
- ▶ Collaboration: Apart from more sophisticated software tools it is also the organisational innovations that will drive open development. Clearly formulated codes of conduct and things such as an elaborate management of different types of contributors will further ease collaborative innovation.
 - ▶ Regulation: It remains to be seen how individual developers within a community, but also the communities themselves will be protected against large commercial companies or the misuse of their products. There are several possible developments visible today: new licenses (e.g. the GPL Version 3 which will most likely include sections about software patents) and the contrary trend to that which follows the route of Digital Rights Management (DRM) software.
 - ▶ Creating Market-"push": More and more non-monetary motivational factors are being researched and results and implications find their way into everyday projects.
 - ▶ Creating the Market-"pull": A big boost for open development and Open Source development in particular is generated if governmental bodies not only ask for high quality products, but also demand insight into source codes.

Research

- § Research into collaborative, open development is far from finished. In a variety of areas vital enquiries are being made and new ideas are developed. :
- ▶ Collaboration: Tools to support collaboration will become more and more human centric and adapted to human needs. The knowledge generated within a project will be organised automatically, matching partners within a project can be automated and collaboration can (if wanted) be done on a purely peer2peer basis with no central hub controlled by a single person or organisation.

- ▶ Regulation: Many legal uncertainties will be reduced through communication efforts. (Software) Licenses which were developed by non-legal experts can easily be confirmed by independent bodies.
- ▶ Creating Market-"push": New business models are being developed.
- ▶ Creating the Market-"pull": New forms of public-private and public-private-citizen partnerships will be developed. Governmental bodies will act as partners within communities.

Emerging

- § The new and emerging developments and trends can of course only be guessed but we have reason to believe that a number of things will take place or should actively be pursued by governments and/or the European Union.
- ▶ Collaboration: (Software) Tools and processes that support the emerging (highly complex and fluid) business models need to be developed.
 - ▶ Regulation: Since many communities neither have the expertise nor the money to check for all legal trapdoors the need to be assisted and/or tools for that matter need to be developed.
 - ▶ Creating market-"push" and market-"pull": The goal must be to create a sustainable market for open products to unleash the full potential of collaborative open innovation.

Research Ideas/Actions

Title	Governmental Participation in Open Development Communities
Keywords	Government, Open Content
Problem/Issue	The governments have vast amounts of content that could potentially be more valuable if access to them were easier
Objectives	Facilitate easy access to information Standardisation Legal harmonization
Approach	Legal Boundaries Standards
Focus	<input type="checkbox"/> Technology & Standards <input type="checkbox"/> ICT Infrastructures <input type="checkbox"/> Applications <input type="checkbox"/> Business Processes
Phases	<input type="checkbox"/> Research <input type="checkbox"/> Development <input type="checkbox"/> Validation <input type="checkbox"/> Deployment <input type="checkbox"/> Dissemination
Technologies	
Business Process Changes	New forms of Government-Private-Citizen collaboration
Impacts	Increasing the value of existing content
Inhibiting Factors	Political resistance
Participants	To be defined
Duration	To be defined
Resources	To be defined
Follow-up Actions	To be defined

Title	Business Models for Open Development (Non-Monetary Rewards)
Keywords	Motivation, Non-Monetary, Recognition
Problem/Issue	Free work is hardly ever recognised outside their respective communities (exception: programming of Open Source projects may be accounted for the employers)
Objectives	New forms of rewards Cross-community recognition
Approach	Development of potential scenarios for reward models Potential testing of scenarios in Living Labs
Focus	<input type="checkbox"/> Technology & Standards <input type="checkbox"/> ICT Infrastructures <input type="checkbox"/> Applications <input type="checkbox"/> Business Processes
Phases	<input type="checkbox"/> Research <input type="checkbox"/> Development <input type="checkbox"/> Validation <input type="checkbox"/> Deployment <input type="checkbox"/> Dissemination
Technologies	
Business Process Changes	New forms of collaborations and rewarding systems between organisations and private citizens
Impacts	New reward systems would impact the motivation.
Inhibiting Factors	Potential resistance from unions. (they might see it as a negative trend which reduces the income of workers)
Participants	To be defined
Duration	To be defined
Resources	To be defined
Follow-up Actions	To be defined

Title	Interdisciplinary Research on Collaborative Open Innovation
Keywords	Technology, Social Sciences, Living Labs
Problem/Issue	Improvements in Open Innovation demand for an integrated approach. Technological tools need to be addressed but also a variety of topics from the area of social sciences such as psychology, business models, etc.
Objectives	Integrated improvements of technological tools and processes
Approach	
Focus	<input type="checkbox"/> Technology & Standards <input type="checkbox"/> ICT Infrastructures <input type="checkbox"/> Applications <input type="checkbox"/> Business Processes
Phases	<input type="checkbox"/> Research <input type="checkbox"/> Development <input type="checkbox"/> Validation <input type="checkbox"/> Deployment <input type="checkbox"/> Dissemination
Technologies	
Business Process Changes	Collaboration between partners of different scientific disciplines.
Impacts	Improvement of understanding of collaborative open innovation with a reduction of duplications of research. Fresh perspectives on well known topics.
Inhibiting Factors	Potential misunderstandings between researchers from different scientific disciplines. (e.g. different perspectives, research goals, approaches)
Participants	To be defined
Duration	To be defined
Resources	To be defined
Follow-up Actions	To be defined

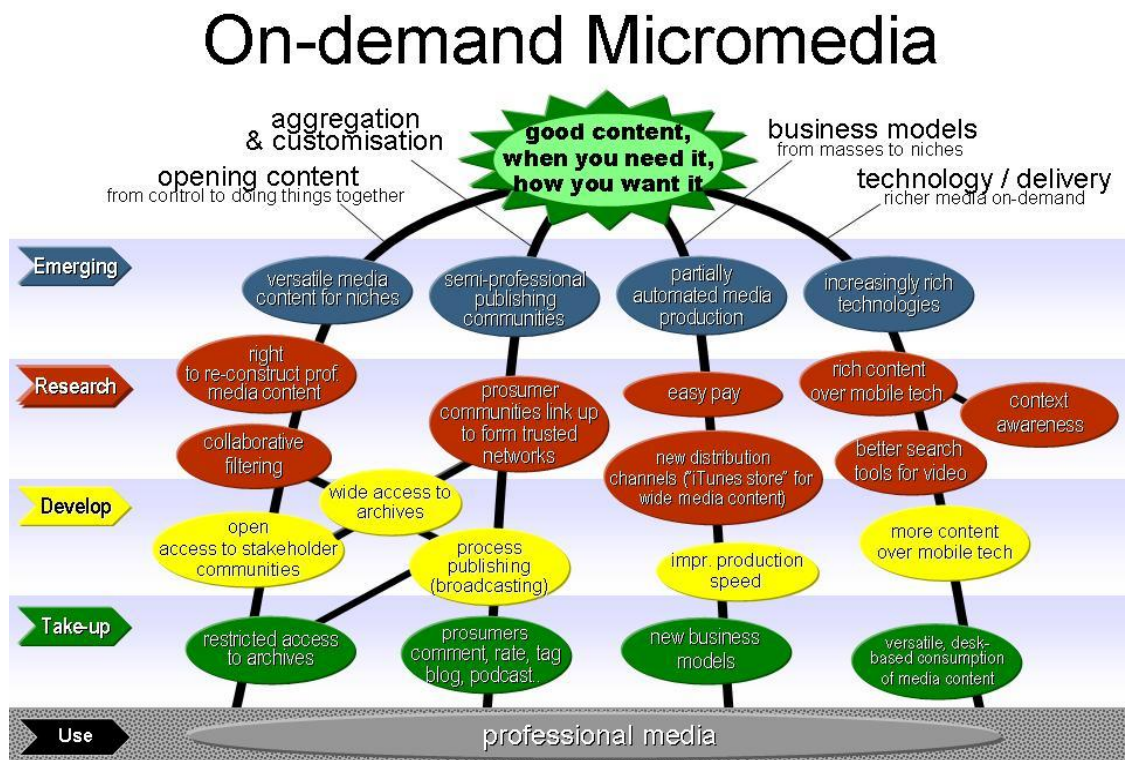
On-demand Micromedia

Current state: The era of mass media has passed but a substantial proportion of media content is still produced in traditional media houses. Media content is mostly delivered in bundles aggregated in a production-based rather than a user-focused way. E.g. articles are bundled into newspapers, TV programmes into TV channels and songs into albums. A user pays for the entirety but often actually only wants a proportion. Content is to a large extent engineered to suit “an average taste”. The technological advances together with unmet consumer demand have lead to the flourishing of illegal distribution channels (peer-to-peer, piracy products etc).

Vision: A consumer or user of media content wants to have access to good content, when he/she wants it and in which ever format he/she wants it – nothing less. “Good content” is not the same for everyone. Each subjective taste or information need is accommodated by the versatility of the vast content pool. Technological development is making it possible to deliver increasingly richer content regardless of user location or device. Content production is a part of life for most people, especially knowledge workers. Content production is reasonably profitable due to the adoption of new business models, technologies and distribution channels.

Scenario: The line between professional and amateur media is faint and most people produce media content for a niche. The media content pool is vast and versatile. Media content is produced (modular production) and consumed in smaller units.

Roadmap for on-demand micro-media



Key Elements

Opening content: Traditional media houses have large content archives that are utilised relatively little. Some front runners are already granting restricted access to archives. The next step would be for the media houses to give open access to stakeholder communities. Access could be taken further to a participatory direction and let stakeholders re-organise media archives with e.g. collaborative filtering techniques into easy-to-use media content libraries. Finally, allowing the re-construction of archive content into subsequent content would exponentially increase the quantity of media content and at the same time accommodate the versatility of views represented in the media content. There are already some front runners, for example the BBC with its Creative Archives project, who are giving restricted access to archives and allowing the re-use and re-construction of content. The vast majority are not, however, taking advantage of the technological development allowing such transformation.

Aggregation and Customisation: A growing number of people are already involved in the media production in some way: commenting, rating or tagging articles, debating on them in discussion forums and producing their own blogs or podcasts. The next step could be some kind of "process publishing". The term is used to highlight the idea of continuous collaborative evolvement of the published product. The process publication would be a cross between a traditional publication, a website and a debate. This could resemble the Wikipedia in terms of collaborative media production but be more advanced in terms of how the media user can follow the evolution path of the content and therefore also be able to evaluate the soundness and make of the knowledge base. Also the concept of an encyclopedia is not suitable to all types of themes. As a growing proportion of people are specialist knowledge workers and showing interest and know-how in media production, it is quite likely that new business models can be developed to allow the emergence of semi-professional media prosumers.

Business Models: Some new media business models are already being taken-up in IP-based, Web 2.0 –type services: semi-free / 2-phase business models, pay-for-play, pay-for-extras, pay-for-visibility and subscription or transaction based business models, to name some of the most prominent ones. Within the movie and TV industries there are more pay-per-view –type of business models and some cases of same time releasing (a DVD is released at the same time as the movie premiers in the box office). The previously mentioned involve distribution channel innovations. One of the main principles is that the consumer/user can purchase smaller units of media. More advanced business model development can be anticipated in the production of media – e.g. utilizing prosumers, stakeholder communities, semi-professional media producers and new technologies even leading to partially automated media production (by way of turning user pattern recording into knowledge).

Technology / Delivery: The technological development is expected to allow the faster delivery of richer media content regardless of time or place. Also, technological development in the area of context awareness can be expected to automate the fine tuning of the media experience. Technological development is also likely to lead to the availability of cheaper, easy-to-use capturing, modifying, enhancing (including 3D) and editing equipment and software.

Research Ideas/Actions

Title	RTD idea title of maximum 8 words (max. 50 characters)
Keywords	prosumerism, collaboration, micromedia, Web 2.0 business models
Problem/Issue	The business models and the value capturing originate from the era of mass media. Media houses are losing profits due to the flourishing of illegal distribution channels (peer-to-peer, piracy products etc) made possible by technological advances together with unmet consumer demand. Old ways of organising production are not suitable for the era of micromedia and the industry needs to find new fundamentally different ways to create and capture value.
Objectives	Objective 1: develop new business models and new ways to capture and create value in the era of micromedia Objective 2: develop new ways to organise production Objective 3: develop ways to utilize prosumers Objective 4: develop ways to serve niches Objective 5: develop applications that allow the utilization of new business models and new ways of organising production
Approach	To be defined
Focus	<input type="checkbox"/> Technology & Standards <input checked="" type="checkbox"/> ICT Infrastructures <input checked="" type="checkbox"/> Applications <input checked="" type="checkbox"/> Business Processes
Phases	<input type="checkbox"/> Research <input checked="" type="checkbox"/> Development <input type="checkbox"/> Validation <input checked="" type="checkbox"/> Deployment <input checked="" type="checkbox"/> Dissemination
Technologies	
Business Process Changes	See previous page
Impacts	Large scale impact on media industry, knowledge workers and society as a whole (e.g. due to increased quantity and versatility of media content)
Inhibiting Factors	IPR issues, legislation, traditions
Participants	To be defined
Duration	To be defined
Resources	To be defined
Follow-up Actions	To be defined

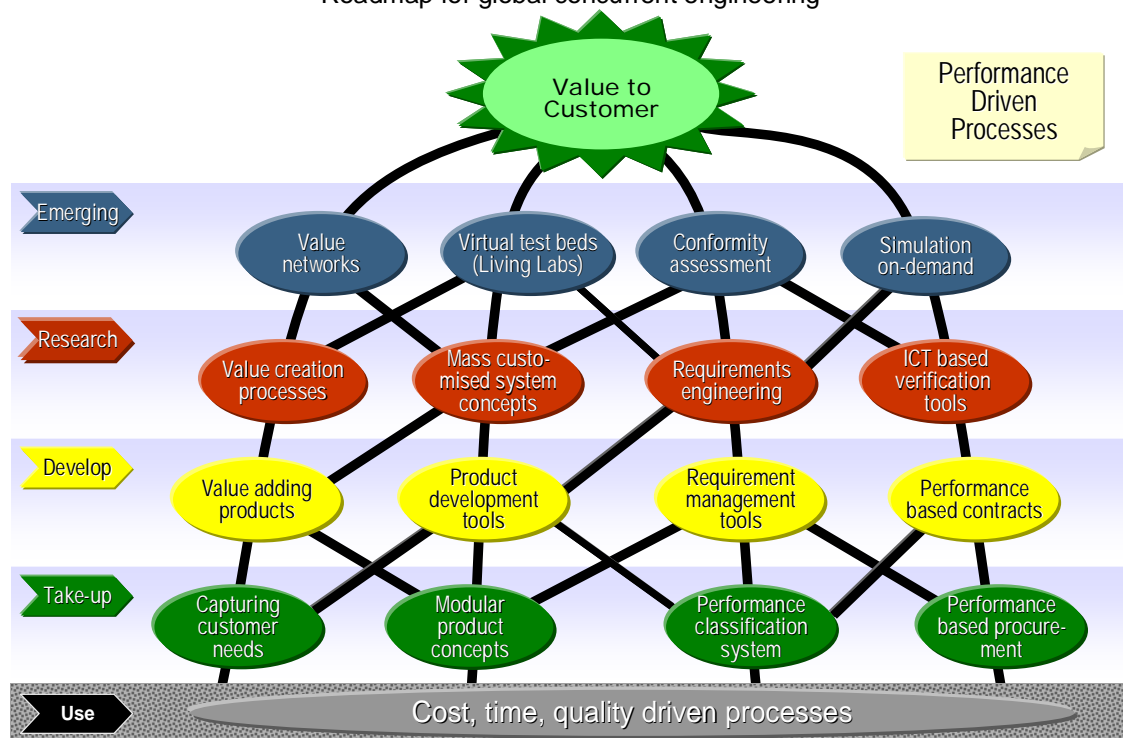
Global Concurrent Engineering

Current state: Engineering is driven by production needs and optimised product quality, manufacturing costs and delivery time.

Vision: Engineering is driven by user needs and optimised service quality, whole life costs, delivery time and sustainability. A performance driven approach is used to provide value to the customer.

Scenario: Shift of focus is needed; engineering service providers have to see themselves as regularly recurring chain of the client's business processes. The companies should be able to provide value for the customer in its entirety; helping client to define the needs, creating the performance brief based on those needs, designing the product, constructing it, maintaining it, operating it and finally, demolishing it. Performance approach forces the clients to think what is really needed to support their business processes. Performance based requirements give designers and suppliers possibilities to fully exploit their knowledge accomplishing creative and flexible solutions. When requirements are performance based, the variety of procurement methods is larger. Feedback from other parts of the process enables learning and better buildings in the future.

Roadmap for global concurrent engineering



Key Elements

State of the art / Technologies & practices already in industrial use

- § Cost driven business process: Tendency to select the solutions that have the lowest investment costs drives the decision making in engineering at the moment.
- § Quality management: The quality of the services, materials, and product assembly procedures and processes is checked regularly. Partly this is done by the product/component providers themselves.

Ready for take up

- § Capturing customer needs: Capturing clients' needs and targets at the very beginning of the project is essential for a successful end result. It is also important to bridge the gap between client terminology and the domain terminology. Several tools for this purpose are available that provide a mapping / translation between the two different terminologies.
- § Modular product concepts: Shorter delivery times are needed so that the product structures can adapt to the more rapidly changing business environment. Also more reliable and well-performing solutions are necessary. Modular product concept enables variety of end results from a limited number of modules that are effective to realise and easy to maintain.
- § Performance classification system: As stated earlier, it is vital that the end users and the practitioners of the domain have means to understand each other. Common classification (e.g. performance-based) is one key in enabling this.
- § Performance based procurement modes: As presented above in the scenario section, performance based requirements give designers and suppliers possibilities to fully exploit their knowledge accomplishing creative and flexible solutions. When requirements are performance based, the variety of procurement methods is larger.

Develop

- § Value adding products: Typically the partners in business networks (like supply chains) are required to participate in reducing waste from the process and provide services or goods that add to the productivity of the network. It can be clearly seen that this same target will be set for products and their components. The industry has to be able to provide products and services that improve the value of the business of the end users.
- § Product development tools: As stated earlier the life cycles of the products are shortening dramatically. The development phase of the new materials, systems and services has to be shorter and provide better solutions. This requires new product development methodologies and tools.
- § Requirement management tools: Too often the original requirements are lost due to the deficient requirements management. It is important to capture the client requirements at the beginning of the project, but it is equally important to manage the changes, and maintain transparent decision making during the performance driven process.
- § Performance based contracts: New contract types that are driven by performance need to be developed. These are expected to provide more business value to the client in that product is judged by its performance (and consequent business value addition capability) and furthermore, the designers, product manufacturers, etc. are assessed based on their "performance".

Research

- § Value creation process: In addition to the value adding products, the whole delivery process of these products has to add value to the end user.

- § Mass customised system concepts: The clients can order unique products that suit their needs and style thanks to modular products that can be easily mass-customised. Despite selecting from a limited number of choices, widely different end results can be created.
- § Requirements engineering: The requirement engineering supports the mass-customised product and system concepts. By clearly defining their targets with developed requirements engineering methods and tools, clients can transparently see how their requirements are transformed to the best-in-class-solutions.
- § ICT based verification tools: The verification of the performance requirements has to be regular. In all phases of the performance driven process, the technical solutions are (automatically) verified against the set performance requirements ensuring the there are no defects in the final product.

Emerging

- § Value networks: The current, unstable and changing supply chains turn into value networks, that provide excellent services and products for demanding clients effectively and value adding. This is possible through competency sharing to co-create unique products and services that offer value to the customer. The search for performance and productivity is a common goal for the partners of the value network. The win-win –situation finally exists.
- § Living Labs: It is difficult for a human being to create an understanding of the final product based on two dimensional drawings or even simple product mock-ups. In the future it will be possible to experience the product/service much before it is realised. Technologies like virtual reality, remote sensing, augmented reality, and mainly product/services experiencing in living labs will be mainstream.
- § Conformity assessment: The ICT tools that are used to capture the clients' requirements and to transform them into the technical solutions have in-built verification and conformity systems operating in the background giving feedback when some requirement is threatened.
- § Simulation on-demand: When and where required, designers, clients, product manufacturers, etc. can simulate product or product component development in full. This is available on multiple technological environments including the mobile one (e.g. and airplane can be seen with the augmented reality glasses in-situ at an airport terminal even before the plane is even built).

Research Ideas/Actions

Title	Products and service mass-customisation
Keywords	Modular products and services, product/service configurator
Problem/Issue	The customer has limited choices of acquiring the product/service of their choice. What is immediately available is that which is "off-the-shelf". There is limited if any opportunities for product/service configuration per customer needs and requirements.
Objectives	<ul style="list-style-type: none"> - Development of modular products and services (plug-and-fit product components, and self-configuring services) - Development of a product/service configurator where a customer can configure the product/service of their choice and then receive it through co-involvement of (if required) multiple organisations
Approach	<ul style="list-style-type: none"> - Select a particular configurable product type that is well-suited for mass-customisation in terms of the product itself and surrounding services (e.g. automotive sector). - User (customer) requirements or requests on configurable components/services - Identification of configurable components (and services) - Development of an online product configurator
Focus	<input type="checkbox"/> Technology & Standards <input checked="" type="checkbox"/> ICT Infrastructures <input checked="" type="checkbox"/> Applications <input checked="" type="checkbox"/> Business Processes
Phases	<input checked="" type="checkbox"/> Research <input checked="" type="checkbox"/> Development <input type="checkbox"/> Validation <input type="checkbox"/> Deployment <input type="checkbox"/> Dissemination
Technologies	- Product catalogues, mass customisation, object models, web-services
Business Process Changes	<ul style="list-style-type: none"> - New view to product and process provision - Closeness to needs of customer - Modular product/service development concepts
Impacts	<ul style="list-style-type: none"> - Value to customer (customer gets what they want) - Product interoperability (different modular products can work together)
Inhibiting Factors	<ul style="list-style-type: none"> - Lack of product/service configuration options - Lack of willingness by customer to pay extra cost of customisation
Participants	<ul style="list-style-type: none"> - Car manufacturers and their product suppliers - ICT vendor specialising in providing product configurators (product libraries) - User community
Duration	30-36 months
Resources	300-350 person-months
Follow-up Actions	<ul style="list-style-type: none"> - Concept deployment and validation in living lab environments. - Concept extension to other industries and product lines

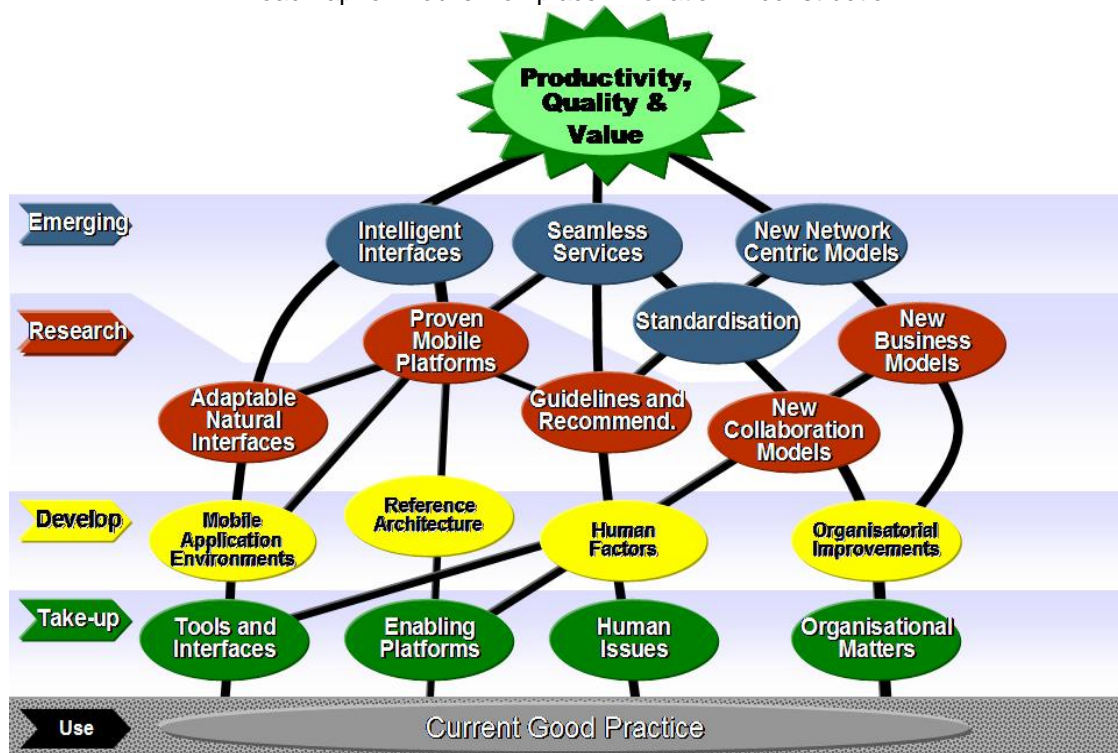
Mobile Workplace Innovation in Construction

Current state: The mainstream construction practice still follows the traditional working procedures, business models and services. The primary client in the process is production. Cost based competition leads to sub optimization of individual tasks instead of creating value to customers. Technologies and tools are not used in a way as they could due to many reasons.

Vision: New innovative ways of collaboration lead to networked value adding services. Product life responsibility, requiring overall optimization, creates value to end users and owners, who become the primary clients in the process.

Scenario: The productivity in the value network increases substantially. The whole life performance of the end product improves and is well managed. The organisational and human barriers have been overcome. The tools and interfaces meet user requirements and can be plugged in to integrated platforms.

Roadmap for mobile workplace innovation in construction



Key Elements:**Technologies in industrial use**

- § Most construction information relates with how building products are manufactured and installed, to a lesser extent how the spaces and building systems will be used, modified and maintained over their life time. Information about the original customer needs is often deficient, non-traceable or missing in the process, and mostly documented in a form of the selected technical solutions.
- § Use of ICT tools to produce building design and building specifications is common practice. In some cases of model based design the same information once produced is enriched during the process, e.g. *design > manufacturing*, or *design > construction*. At present, the seamless information flow and management is interrupted especially between the *construction > operation > maintenance* and *capturing user requirements > design* processes.

Ready for take up

- § The technologies and tools exist to be exploited for improving the building processes, building products and stakeholder organisations to achieve higher productivity, better quality and to create value. At present, new tools and technologies are mostly used in an old way, like the old ones were used in the old processes – not as the new ones could be in the new, re-engineered processes. There are important human barriers within the supply side and even in the demand side that need to be understood to achieve the transition process where the incentives for change become transparent. The human issues and organisational matters need to be considered when exploiting the tools and interfaces and enabling platforms.

Develop

- § Mobile application environments and reference architectures provide important prerequisite to improve the process. It is important to develop and evaluate new applications to demonstrate the feasibility and to understand the business benefits and deployment challenges. The creation of usable and feasible mobile multi-modal applications for product life cycle will largely depend on the availability of flexible integrated service framework. Such a service framework should allow companies to choose from service modules and modular building blocks when creating new services specific to their businesses. Using standardized and generic interfaces, the service logic will be independent of the underlying network technology. The integrated service framework should transparently responsible for the deployment and distribution of service modules on different physical machines so that scalability of a service design is supported with appropriate security and quality of service. The technological challenge in this theme is to define sufficiently generic resource abstraction interfaces for network resources, engineering applications, user interfaces including mobile devices in a technology that is standardized, modular, secure and scalable.
 - ▶ Business Architecture Views – should address the concerns of the users of the system, and describe the flows of business information between people and business processes
 - ▶ Data Architecture Views – should address the issued of information management within Co-Spaces Software Framework.
 - ▶ Applications Architecture Views – should address the issues related to the integration of supporting applications.
 - ▶ Technology Architecture Views – should address the underlying technology components used in developing the collaborative work environment.
- § As the business changes, it becomes essential for the management of each organisation to carefully review not only the business and social benefits but also the transition arrangements for the implementation. The business model for the entire collaborative enterprise will need to be revisited at the level of the virtual organisation and at the lower levels of each of the

participating organisations, ensuring that all of them can commit to their part in the new collaborative workspaces and not end up with a few of them seeing no individual benefit in them and hazarding the corporate vision. The market business model may well be changing as well and this is likely to influence the organisation's business model(s). These assessments must identify the changes required that need to be endorsed by all of the parties concerned. In some cases, it may not be possible to secure commitment from all of the parties, e.g. one could imagine resistance on building sites to any change in practice; however, with a sympathetic approach to those involved, the advantages of changing practices can be sold to them by demonstration in carefully-designed pilots, some of which may even involve the operatives themselves 'inventing' suitable solutions that bring benefits at both the personal and business levels. These considerations also relate to the pace of introduction of change, whether it should be introduced progressively or discontinuously, e.g. in a big bang, each needing to depend upon the circumstances and the human factors involved and also taking training into account as an essential component of the change.

- ▶ Identify business benefits as a company and as virtual enterprises
- ▶ Explore flexible work arrangements for supporting mobile working
- ▶ Identify security/privacy/authentication policies which need to be adopted
- ▶ Identify training and skills required by workers in adopting mobile technologies.

- § The human issues and human factors form major challenges to be met to accept new technologies in construction. If we are to develop jobs, workspaces and tools for mobile collaborative engineering in the future, which provide opportunities for creativity, productivity, satisfaction, quality, flexibility and high quality design and production, then we must understand more about the people who will work in these jobs and also the people for whom they are designing. This requires a thorough understanding of ergonomics/human factors. Such understanding must be context sensitive and take a holistic approach to understanding complex interacting systems and improving peoples' wellbeing and performance.

Research

- § R&D work should be targeted at developing adaptable natural interfaces and reference architecture to create proven mobile platforms as collaborative engineering environments. This kind of demonstrators should be thoroughly evaluated and validated on live projects to ensure human and organisational acceptance of the technology. Based on the validation results, guidelines and recommendations should be developed for companies to offer roadmaps for deploying such integrated service framework within their organisation.
- § The research needs to be further extended to explore new business models and new collaboration modes between workers and stakeholders. These business models should describe and characterize the configurations of some emerging collaboration modes in sub-contracting, partnership, co-operation, etc. The characterization of each mode should cover collaboration procedures and practices, information exchange rules, collaborations tools, security and trust issues, deployment methods, management and support issues.
- § The human barriers need to be understood to create collaboration models which could be supported by mobile and other technologies. These models should overcome the current limitations of old practices and should build on the opportunities brought by most promising results of industrial sociology and ergonomics research projects related to collaboration and interaction between teams of various stakeholders. These models should describe and characterize the configurations of some emerging collaboration modes in sub-contracting, partnership, co-operation, etc. Team-centric collaboration models and worker-centric collaboration models need to be explored as generic models for implementing mobile collaborative workspaces within distributed manufacturing organisations.

Emerging

- § The collaboration models and the new business models should merge to develop agreed network-centric models by engineering organisations. The business models and collaboration models identified under the human factors theme should be brought together to identify new types of successful network-centric models which could be defined in terms of technology, collaboration policies, IPR, security etc to provide seamless services.
- § The maturity of these proven mobile distributed collaborative engineering environments and the underlying reference architecture will lead to standardisation efforts to create a universally agreed service framework for the engineering sector. The focus should be in making the interfaces more intelligent. R&D efforts should be targeted at developing intelligent agents that can serve mobile workers to be more productive. These software agents should act on behalf of the user for actions such as finding and filtering information, ensuring procedures are followed, detecting changes or anomalies, automating workspace tasks, establishing ad-hoc workflows, retaining process and decision-making knowledge, and should provide a fundamental building block for a new generation of mobile workspace innovations especially well-suited for ambient intelligence environments.

Research Ideas/Actions

Title	Management of Human Factors in Construction@Work
Keywords	Human factors, mobile application environments, nomadic working
Problem/Issue	Main barrier for the acceptance of mobile technologies in engineering
Objectives	Understanding of jobs, workspaces and tools for mobile collaborative engineering
Approach	Validation through Living Lab research
Focus	Holistic, complex interacting systems improving peoples' wellbeing and performance
Phases	New collaboration models; New network-centric models
Technologies	Adaptable natural interfaces, self-configuring workspaces
Business Process Changes	New collaboration models, new business models
Impacts	Increased productivity and improved quality of life
Inhibiting Factors	Lack of understanding business benefits, lack of training, high deployment costs
Participants	Industry together with research institutes
Duration	From 1 to 3 years on
Resources	To be defined
Follow-up Actions	To be defined

Title	Organisational Innovations in Construction@Work
Keywords	Flexible work, security/privacy/authentication policies, training and skills
Problem/Issue	Lack of flexible work arrangements for workers to use mobile technologies
Objectives	Creating business and social benefits for the mobile work transition arrangements
Approach	Validation through Living Lab research
Focus	Flexible working styles, ad hoc collaboration, flexible contracting
Phases	New business models; Virtual enterprise models
Technologies	Mobile engineering technologies
Business Process Changes	New collaboration models, new business models
Impacts	Increased productivity and improved quality of life
Inhibiting Factors	Lack of security and control for supporting seamless access to information, tools and people
Participants	Industry together with research institutes
Duration	From 1 to 3 years on
Resources	To be defined
Follow-up Actions	To be defined

Title	Integrated service platform for Construction@Work
Keywords	Service framework, multi-model applications, product life cycle
Problem/Issue	Lack of integrated platforms providing seamless access to information, tools and people
Objectives	Creating business and social benefits for the mobile work transition arrangements
Approach	Validation through Living Lab research
Focus	Flexible working styles, ad hoc collaboration, flexible contracting
Phases	Business architecture; Data architecture; Application architecture; Technology architecture
Technologies	Mobile platform technologies, intelligent software suites
Business Process Changes	New network-centric models, seamless services
Impacts	Increased productivity and improved quality of life
Inhibiting Factors	Lack of standards creating interoperable platforms, resistance to change
Participants	Industry together with research institutes
Duration	From 1 to 3 years on
Resources	To be defined
Follow-up Actions	To be defined

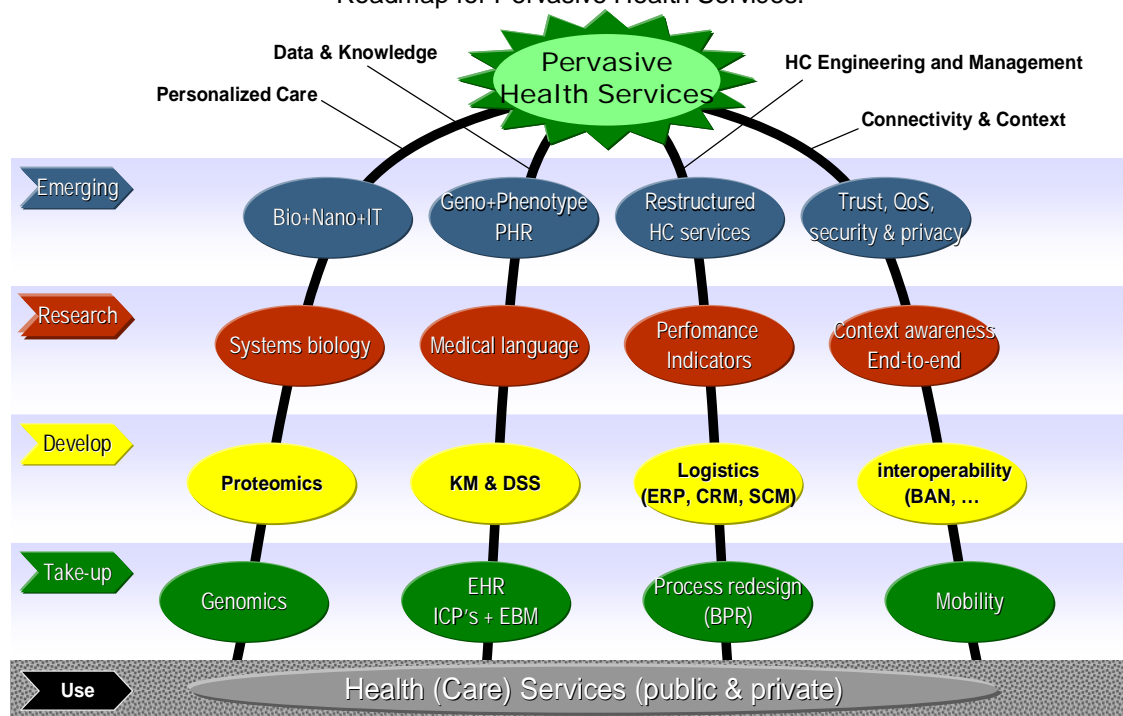
Title	Tools and interfaces for Construction@Work
Keywords	Flexible work, security/privacy/authentication policies, training and skills
Problem/Issue	Lack of flexible work arrangements for workers to use mobile technologies
Objectives	Creating business and social benefits for the mobile work transition arrangements
Approach	Validation through Living Lab research
Focus	Flexible working styles, ad hoc collaboration, flexible contracting
Phases	Business architecture; Data architecture; Application architecture; Technology architecture
Technologies	Mobile platform technologies, intelligent software suites
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Pervasive Health Services

Current state: Health care systems have been created over a long (100 years) evolutionary period and can be characterised as organisation centric. Although huge progress has been made in S&T and medicine the health care services are even today organised according to the old paradigms. Attempts to make them citizen-centric in order to better leverage the capabilities of modern medicine have been met with resistance to change and overall rigidity of the established health care systems and policies governing it.

Vision: There is a widely shared understanding that well-being, health and illness form a continuum. Health problems need to be handled as an integrated whole. Pervasive Health Services allow a person to manage one's health, well-being and illnesses with support of information and expert services when needed independent of location. Technology is a central element in making this happen (acquisition, access, knowledge, integration, collaboration, services).

Roadmap for Pervasive Health Services.



(interconnections between the four threads are not shown in order not to overcrowd the picture)

Scenario: An individual has been diagnosed for a potential health problem. There is no cure but there is an effective therapy that will keep the health problem in control. The longer version: The individual has felt that his health is not optimal. Normal diagnostic tests did not reveal anything. Therefore he has been carrying on him a body sensor network that allows critical vital signs and metabolic parameters to be monitored over a longer period of time at work, at leisure and sports, at home, and during sleep. The data is fed from the sensors to the BAN that in turn connects with secure WLAN, mobile networks etc. according to need in order to transmit the data to a secure server. The data from a two week monitoring period when combined with his genetic profile

(genotype) and previous health history (PHR) by a decision support system that the physician is using resulted in a diagnosis.

There is no cure to this health problem. But there is an effective therapy to keep the problem in control. To administer this therapy an implantable medication device is needed that releases the right amount of the medication. To determine the right amount the device includes sensors and control algorithms (closed loop control). It also communicates over a short range. This allows its performance and sensing data to be stored in a central secure server. This device integrates nano-, bio- and ICT technologies.

Key Elements

The roadmap builds on four interlinked paths: Data & knowledge, Connectivity and context, Personalised care and Health care engineering and management.

Currently in use

- § Health services are today mostly organisation centric with rather high barriers between provider organisations. ICT is used quite extensively but without marked interoperability inside or between providers.

Ready for take up

- § Major investments are being made to create interoperable electronic patient record systems in several countries (e.g. Australia, Canada, Denmark, England, Finland, France, Germany, The Netherlands, USA, and Wales). The selected technologies and standards differ somewhat. Work has also progressed quite far in the creation of Integrated Care Pathways (ICP's) based on clinical evidence being collected and analysed on a global basis.
- § Technologies supporting the mobility of care providers are becoming usable for different tasks starting from general practitioners and home nursing services and extending to consultation services for second opinion and support for clinical teams of experts.
- § New more citizen and patient centric services are emerging based on the application of "business process re-engineering" principles. Cost containment efforts of health expenditure are leading to refocusing to wellness management and proactive health services that are aimed at preventing the emergence of especially chronic degenerative diseases.
- § The Human genome has been revealed and new genome based diagnostic and therapeutic methods have been developed as a 1st step towards personalised health services.

Develop

- § The EPR data and be combined with the ICP's to create systems that support decision making in medicine. The DSS modules span from simple "if –then" rules to highly complex adaptive algorithms. DSS must be real time and presented in a format that the users (esp. physicians) finds attractive and helpful. A major part in the move towards decision support is knowledge management and especially the adaptation of knowledge for local use.
- § Interoperability across different networks and across service providers and data stores is a must for patient data to be shared. On top of the functional interoperability semantic interoperability must also be created for Patient data to be shared by expert in its appropriate context.
- § The next step after simple BPR application is to take a more learned look at health services and use the concepts of other business domains, such as CRM, SCM and ERP to focus on

how resources are utilised in health services and thereby apply customer / service segmenting principles to health services.

- § The genomics work continues at the proteomics level. This will allow the development of more complex diagnostic and therapeutic methods and solutions.

Research

- § For patient data to be shared truly in a clinical context the vocabulary used in medicine needs to be better structured. For modelling and structuring of medical language based semantic web technologies and ontologies are needed.
- § Context awareness is important for two reasons. First, data that is acquired is context sensitive and applications: Applications that are context sensitive and can recognise what the user is aiming to do. They should thence be able to provide according guidance, menus, and make available the relevant information.
- § Performance indicators are needed in order to measure the effectiveness and cost and efficiency of health services delivered in the various segments. This requires coupling with the ICP / evidence based medicine strand with real clinical practice.
- § Systems biology seeks to bridge the continuum from genomics and proteomics to cells and systems. Research in this area currently focuses on system models of e.g. the heart and cell. The field will rely heavily on GRID technologies for the necessary processing power, data storage and knowledge management.

Emerging

- § It has been said (not proven yet) that the phenotype of a human being is determined to 1/3rd by her/his genetic code and 2/3rds by his/her conditioning. Independent of what this ratio is the combination of the genetic code with the conditioning data (electronic health/patient record) enables the development of targeted personalised diagnostics and therapies.
- § Key aspects of any information system are trust, QoS, security and privacy. In the care of health data these requirements are even more important as the data must be available when needed in a location where it is needed and at anytime when it is needed, i.e. ubiquitously. For people (patients, citizens, service providers) to use the system they must be able to trust it and the service quality must meet the expectations and needs of the users.
- § Performance indicators will allow health services to be measured objectively, i.e. contrasting costs (use of resources) against health gains. This will enable new means to structure and pay for health services.

Regenerative medicine is already an established field of research and commercial activity. Work in stem cell technologies is finding new applications and extending the field. A further extension will come from nanotechnologies combined with "biology". This will allow applications in health but also applications in non-health domains that can be characterised as "bio-inspired".

Endnotes

¹ http://europa.eu.int/information_society/activities/atwork/index_en.htm

² <http://www.cordis.lu/ist/so/collab-work/home.html>

³ According to Williamson (1975), transaction costs are influenced by the degree of insecurity in the environment, the specificity of products to be transferred, and the frequency of transactions. Insecurity, e.g. in the form of limited prior knowledge about how the product should actually appear or how the market environment will develop, leads to the danger of opportunistic behaviour. As a means to reduce the danger resulting from opportunistic behaviour, social embeddedness and relations that create trust between co-operation partners are of great importance (Granovetter 1985). Trust may be institutionalised in networks of individuals that do not have internal hierarchies and other features of companies, but nevertheless provide a common sense and mutual interdependence. Therefore, instead of a clear distinction between market-based coordination and hierarchical coordination, we can observe a three-fold structure with both of these at the ends of a spectrum where the mid-point refers to network-based coordination. Sydow (1996) calls such vertical and horizontal co-operation between small companies with the aim of reaching economies of scale and scope, 'quasi internalisation' (see also Köszegi 1999). Indeed, we can expect that the more coordination takes place on the market (instead of intra-company), the more important network relationships become. One reason is the significance of structures that channel information to make it easier for freelancers to stay in touch and also to build trust relationships that 'enrich' the communication inside the network and possibly also to external people. Networks also provide benefits in the form of network externalities (synergies), e.g. through better possibilities for information sharing and the establishment of a common knowledge base. The key question is what are the determinants at the micro-level that influence the relative advantage of a business model based on one of the three basic models of coordination? The most advanced contribution to this issue comes from Reichwald and Möslin (1999: 167) who stress the importance of the degrees of uncertainty of markets and complexity of products as key determinants. We return to this point in the following sections.

⁴ In the USA the term telecommuting is more widely used. It was established by the work of Nilles et al. (1976) in the mid 1970s.

⁵ Definitions which also include unpaid work-related activities quickly arrive at figures of between a quarter and half of all workers doing work at home (Di Martino 2001:33; Ylöstalo 2003:85).

⁶ It should be noted here that this distinction has become less clear-cut in recent years, since many transactions inside of companies are nowadays managed very similarly than market transactions, e.g. in the case of individual profit centres which together make up a larger, often multi-national corporation (see Malone 2004).

⁷ For persons who conduct the major part of their work through networked work environments, we can use Laubacher and Malone's term "**eLancer**" (Malone & Laubacher 1999).

⁸ Definition similar to Empirica (2002), p. 48.

⁹ This is not to say that there are not large numbers of people doing traditional, low-qualified and typically manual work at home in Europe (cp. Felstead 2000), but these are not subsumed under telework because no data communications links exists between home workplaces and a central site.

¹⁰ This term was used in a study on the “Elusive Office” by Huws, Korte and Robinson (1990).

¹¹ <http://charlie.dgrc.crc.ca/cgi-bin/Sylvie/Blog/casarch.pl?2004/03/15/3.txt>

¹² Kim gives an example: “Simply contributing to a shared goal does not constitute collaboration. A janitor working at a company certainly contributes to a company's well-being, which indirectly helps that company achieve its goals. But that janitor is not collaborating with the rest of the company unless he or she truly shares the collective, bounded goal. This generally requires interaction with the rest of the company about the overall goal.”

¹³ In the 1970s, when interest in new forms of work organisation was high mainly as a means to improve quality of working life, worker well-being was considered to be a goal by itself. In current times, however, strategies which do not address the economic interests of the company as well are largely absent.

¹⁴ For a discussion of some of the recent scientific breakthroughs on which this observation is based, see Layard 2005: 11-27.

¹⁵ The main data sources for these strands of research are the World Values Survey, the German Socio-Economic Panel (SOEP), the U.S. General Social Survey, and Eurobarometer.

¹⁶ As Hofstede (2001; 2005) has shown, risk aversion differs considerably between countries, which indicates that utility functions also vary across countries. This might be one of the reasons why US-Americans tend to regard the provision of social security as less important than people in most European countries.

¹⁷ The authors did not find, however, evidence that changes in job satisfaction in Germany during that period can be explained by changes in perceived job security. In the UK, the study found that perceived job security increased in the 1990s, while job satisfaction decreased.

¹⁸ Empirical support for this proposition has been provided, for example, by: Dennis & Valacich (1993), Gallupe et al. (1991), McGrath (1991), Valacich et al. (1994).

¹⁹ Empirical evidence can be found, for example, in: Daly (1993), Farmer & Hyatt (1994), Hollingshead et al. (1993), Strauss & McGrath (1994).

²⁰ See evidence provided in Siegel et al. (1986), Straus & McGrath (1994), Weisband (1992).

²¹ For an overview, see Hirokawa & Gouran (1989)

²² Here the indicator measuring accessibility by car and weighting regions by GDP has been chosen, because ICT-based business processes usually have below-average movement of physical goods (which would have been a reason to choose accessibility by lorry).

²³ see Türk et al. (2003a; 2003b)

²⁴ Partly based on: http://changingminds.org/disciplines/change_management/diagnosing_change/complexity_analysis.htm

²⁵ “Available Evidence on Drivers, Success Factors and Impacts of New Work Environments”, network4value Working Report.

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- ²⁶ For details, see www.biser-eu.com
- ²⁷ Note that for the STILE pilot survey, non-random samples were used.
- ²⁸ See Statistics in Focus, 40/2005, p
- ²⁹ Commission of the European Communities (2000), Joint Employment Report 2000, Statistical Annex. Here, this indicator is called EO7.
- ³⁰ **network4value** project kick off meeting, Brussels, February 02-03, 2005
- ³¹ For the actual case studies please refer to the Task 2 Report
- ³² The value drivers can be found at the end of each case study. A complete list can be found in the appendix of this document
- ³³ See: <http://www.cordis.lu/ist/ka2/roadmap.html>
- ³⁴ See: <http://www.roadcon.org>
- ³⁵ See: <http://www.roadcon.org/support/index.html>
- ³⁶ The roadmaps on ambient collaboration and ambient knowledge sharing are based on corresponding roadmaps developed in the ROADCON project.
- ³⁷ Resource consumption is understood here in a wide sense, and includes resources used up during the production, delivery, use and disposal of a product or service. Compare the concept of Material Impact per Service Unit (MIPS) of the Wuppertal Institute (see Digital Europe (2003) *Making the Net Work: Steps Towards A Sustainable Networked World*, Forum for the Future). A related concept is the ecological footprint analysis which approximates the amount of ecologically productive land and sea area it takes to undertake a certain activity, by accounting the use of energy, food, water, building material and other consumables. See Chambers, N. et al. (2000) *Sharing Nature's Interest: Ecological Footprints As An Indicator of Sustainability*. London: Earthscan.
- ³⁸ Commission of the European Communities (2005) '2004 Environmental Policy Review', COM(2005)17 final, Brussels: European Commission.
- ³⁹ See Kotkin, J. (2001) *The New Geography*, 2nd edition, New York et al.: Random House.
- ⁴⁰ See Craig, J. and Greenhill, B. (2005) *Beyond Digital Divides? The Future for ICT in Rural Areas*, Wetherby: Commission for Rural Communities.
- ⁴¹ Pamlin, D. (ed.)(2002) *Sustainability at the Speed of Light*, Solna: WWF Sweden.
- ⁴² Pamlin, D. and Thorslund, E. (2004) 'IT and Sustainable Development – A Central Issue for the Future'.
- ⁴³ <http://www.sustel.org/>
- ⁴⁴ See for example: Goodman et al. (2004) 'Encouraging Green Telework', Forum for the Future.
- ⁴⁵ Becher, C. et al. (2005) *Elektronische Arbeitsmärkte. Empirie der Struktur und Funktionsweise elektronischer Arbeitsmarktplätze in Teilarbeitsmärkten*, München and Mering: Rainer Hampp.
- ⁴⁶ See Huovila, P. (2003) 'NESKEY Presentation', Sustainable Construction Indicators Workshop, Sophia Antipolis, 28.10.2003.

⁴⁷ Laso Ballesteros, I. & Salmelin, B. (2005) 'Ami-endowed Collaboration@work', in Riva, G. et al. (eds) *Ambient Intelligence*, IOS Press.

⁴⁸ see Pamlin and Thorslund (2004).

⁴⁹ See Pamlin (2002).

⁵⁰ The roadmap on global concurrent engineering is based on the performance based approach roadmap that was developed in the ROADCON project.