

New Work Environments: An Upcoming Paradigm and How to Measure It

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1 Introduction

This report presents the outcomes of own research into indicators on **new work environments (NWEs)** and their direct impacts on society and the economy. The focus is on policy indicators, i.e. statistical measures which can be used for informing the policy-making process at regional, national or EU level. The document will not delve in any depth into organisation-level “key performance indicators”. Rather, it will propose a framework for measurement and a concise list of policy indicators on the spread of NWEs and their direct impacts. Based on these, the document will discuss a number of recommendations on the main stakeholders involved: firstly the European Statistical System and other *producers* of data; and secondly the European Commission, national policy-makers and other *users* of NWE-related data.

Before discussing required and already existing statistical measures for NWEs (sections 2 and 3), in the following we will briefly review the definition of NWEs applied throughout this document.

Because of the big amount of research into eWork and how to measure it, and because of the fact that the concept of NWEs embraces some of the constituent features of eWork, it appears most useful to start defining NWEs by reviewing the common understanding of key characteristics of eWork.

eWork is understood to comprise *any type of telemediated remote work* and includes the following types:

- eWork in individualised as well as shared-office based work settings. This refers only to the physical workplace of the worker, not to the question whether they share an office with collaborators/principals or not.
- collaborative work (virtual collaboration, virtual teams) and work which is performed in the context of principal-agent type relationships¹;
- work interaction which is inter-organisational, i.e. coordinated over the market (such as in client/contractor relationships and freelance work) and work interaction which is intra-organisational, i.e. coordinated internally in organisations².

This definition of eWork also includes phenomena such as virtual organisations 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.

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.

¹ In order to distinguish between tele-collaboration and traditional types of eWork (telework), it is useful to describe the latter as principal/agent relationships 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).

² 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). Moreover, inter-organisational transactions are often coordinated inside of quasi-fixed networks or co-operation structures, which means that they are not well described as taking place on the “open market” (Picot et al. 2003).

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 ³	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)

The research carried out in these areas, when related back to 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 six dimensions: collaboration, spanning of boundaries, team and project organisation, ubiquitous access to resources, 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. 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.

It is important to distinguish collaborative work contexts from other forms of coordination (see Laso Ballesteros & Salmelin 2005).. In this context it appears useful to refer to the typology of 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.

- Boundary spanning:** 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. With regard to the geographical boundaries, NWEs typically involve the transfer of work inputs and/or outputs via data telecommunications links across distance.

³ 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 1998).

Distance refers here to physical remoteness between collaborators. Remote work most often is being (implicitly) defined as meaning different sites/locations/addresses.

- **Team and project organisation:** 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. Virtual collaboration is understood to take place in teams, i.e. in groups of persons who work together for a longer stretch of time. A project is a temporary endeavour being undertaken to create a unique product or service. Projects are temporary. 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.
- **Ubiquitous access to resources:** New work environments do not only provide advanced possibilities for interacting with remote collaborators, they also offer anytime, anywhere access to resources such as access to codified information in databases, and digital applications (often containing ambient intelligence) which effectively support the adaptation of the working environment (tools, etc.) to the requirements of the specific task on hand. Ubiquitous access to information resources turned from science fiction into a realistic perspective with the advent of the Internet. IP-based applications are likely to dominate NWE tools in the near future.
- **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, for example, computer supported collaborative work (CSCW); for mobile communication and for ambient intelligence. 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.

In the following we will discuss some of the main elements deemed necessary for measuring spread and impacts of New Work Environments. Section 3 then focuses on how the present set of standardised data on work organisation (collected by the European Statistical System and related agencies such as the European Foundation for the Improvement of Living and Work Conditions) cover these phenomena. This will enable us to make suggestions about how the existing indicators and data collection mechanisms can be extended/modified to take account of the importance of virtual collaboration and NWEs for the competitiveness of the European economy.

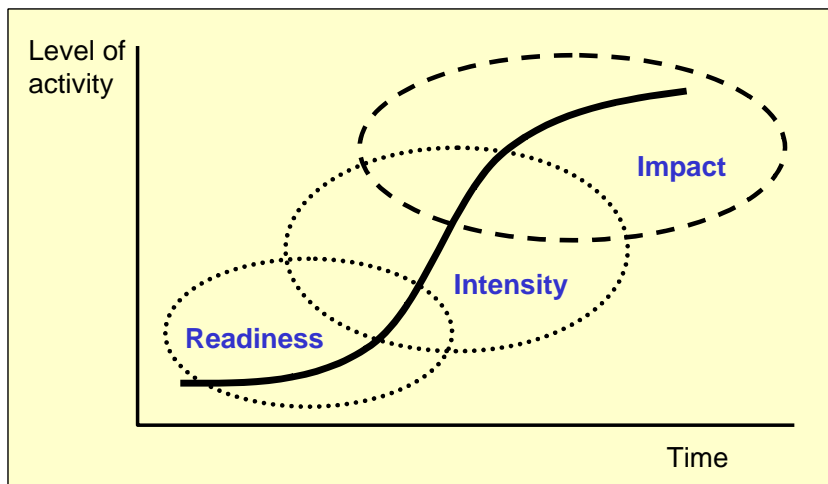
2 Indicator Requirements for Measuring NWE

2.1 Generic requirements

2.1.1 Types of Indicators

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 1 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 1: 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.a. to inter-enterprise relations such as outsourcing, joint ventures, licensing etc;
- knowledge supply/human investment/human resources;
- mobility;
- innovation/R&D and spin-offs.

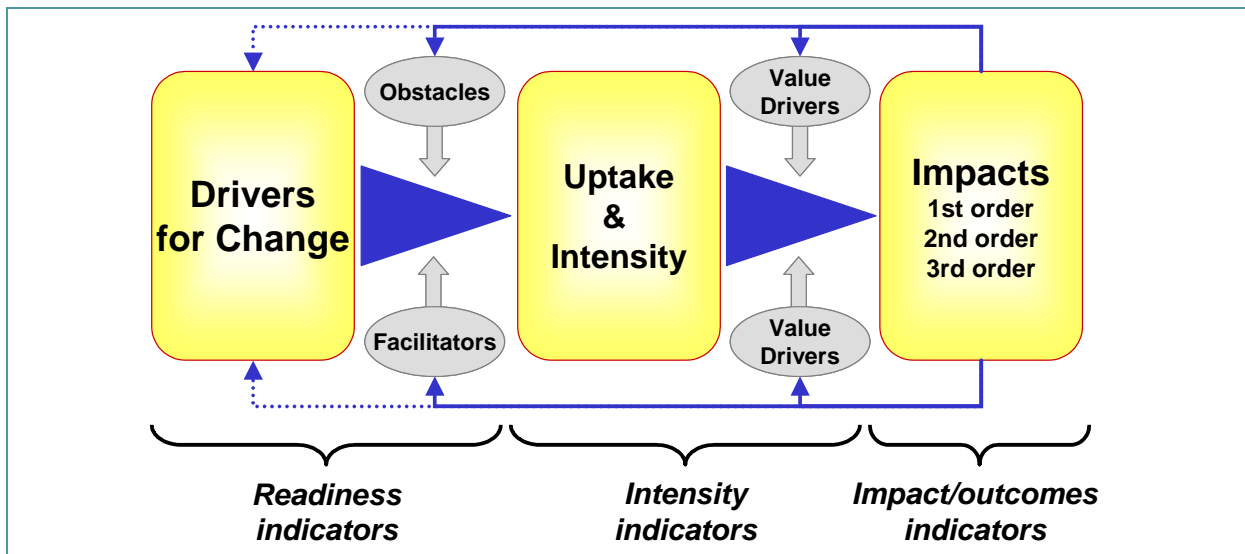
Outcome indicators relate mainly to the macro or societal level and describe

- 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 the purpose of this paper, 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 2: Factors affecting uptake of NWEs and their impacts, and types of indicator needs



Source: The author

Figure 2 shows the relation between types of indicators, as discussed above, and the main elements which have been identified in earlier stages of the research 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.

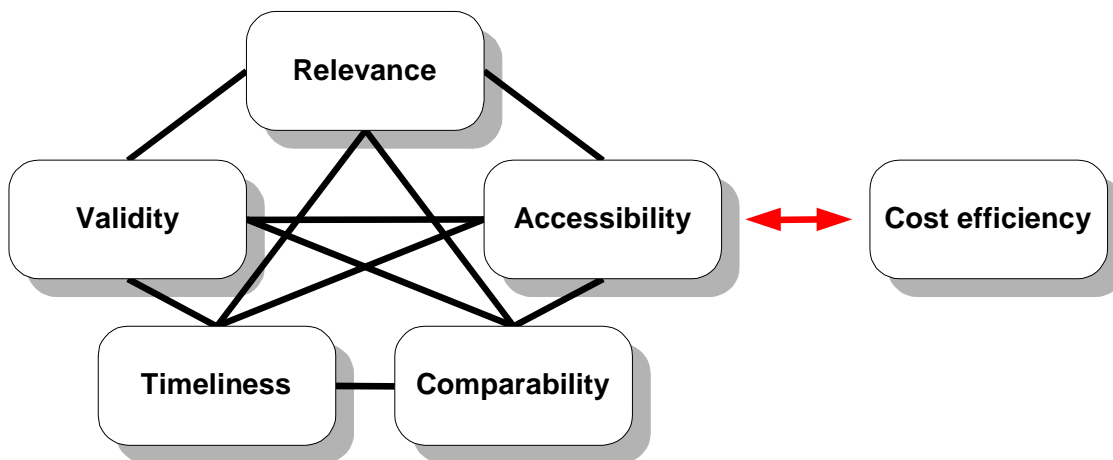
2.1.2 Methodological Issues and Quality Criteria

In general, the function of indicators is to transfer not directly measurable ideas and conceptions of reality (such as political “issues”) into quantifiable units. When the conceptions of reality are abstract and latent rather than concrete and observable they are called “constructs” (Nunnally & Bernstein 1994). In order to quantify and compare constructs, some rules of correspondence between them and observable variables have to be established. This process is usually called operationalisation and the result are called indicators.

If a number of indicators are combined in a way which increases their explanatory power, we speak of **compound indicators** or **composite indicators**. As Clayton (2002) points out, indicator aggregation into compound indicators requires policy choices rather than exclusively statistical judgements, and for this reason meets with scepticism on the side of the European Statistical System. However, innovative methods to present statistical data which meet the requirements of politicians as well as statistical experts are available.

Indicators have to be “rooted in theory”. Evaluation research has stated further desirable features of indicators which should render them useful for the measurement of constructs (SIBIS 2003). Based on Willeboordse (1998) we can break down quality of statistics, following the concept of Total Quality Management and Total Survey Design, into relevance (outcome focus), validity of estimates, timeliness and punctuality in disseminating results, accessibility and clarity of information, and comparability of statistics and coherence of underlying concepts. Another criterion not of quality, but closely related to it, is *cost-efficiency*. In fact there is a trade-off relationship between costs and quality criteria, as shown in Figure 3.

Figure 3: Quality criteria for survey-derived indicators



Source: BISER 2004

The box below lists major quality criteria set down for indicator development in the research.

Indicator Quality Criteria

Relevance

Indicators should refer (directly or indirectly) to current EU policy objectives.

They should strive to complement existing statistics in an optimal way.

They should be complete, i.e. account for all relevant routes to obtaining the outcome they want to explain.

They should allow for regular measurement in the future, if suitable.

Validity of measurement

Indicator operationalisations should be validated by external experts.

The instrument design should follow the general rules of questionnaire design.

The likelihood of social desirability bias is to be avoided as much as possible.

The translation of survey instruments should be subject to assessment by persons who are familiar with the research project and the target as well as source language.

Survey instruments to be translated must be annotated, explaining the research objective behind every question and giving all other information which might be relevant for the translator.

The fieldwork should be timed to avoid temporal factors from influencing the results.

In business surveys, the reporting unit (respondent) and the observation unit (e.g. establishment vs. enterprise) should be chosen to ensure the highest possible compliance with research objectives.

Effects of the choice of reporting and observation units on the conclusion drawn from the data have to be acknowledged when reporting results.

Population validity

It should be documented in which way the sampling frame diverges from the population originally devised as target population and about which arguments are being made. This includes information given about subgroups of the population which are not adequately represented.

The design of the survey should ensure response rates not to drop below thresholds to be defined.

This requires that fieldwork duration is long enough. As a rule, fieldwork duration should be planned so that non-response due to "no contacts" is below thresholds to be defined.

Non-response should be documented and reported in detail, using a template provided by the researcher.

Validity of design

Only differences and correlations that are significant at the 5 percent level are described as significant.

If differences or correlations are reported which are not significant at the 5 percent level, this must be clearly reported.

When time-series data is used or presented, all factors that can be assumed to have a significant influence on the comparability should be documented.

Timeliness and punctuality in disseminating results

The time between data gathering and publication of results should be as short as it is possible without decreasing the quality of the results to below a defined minimum level.

Decision about the trade-off between accuracy and timeliness should be informed by the half-life period of the information gathered. In case the value of the data decreases fast with the time lag between data gathering and presentation of results, cutbacks regarding accuracy may have to be accepted.

Accessibility and clarity of information

The presentation of statistical results should include all necessary information to let users judge about the validity of the arguments based on the data.

This includes the size of the sample or subgroups of the sample, and the weighting scheme used.

All problems which affected the data gathering process should be documented if there is the possibility that they could have a significant effect on the validity of the arguments based on the data.

The language in which this information is given should be comprehensible for the specific target group of the publication, to make them aware of any limitations to the validity of the arguments based on the data.

The raw and/or processed data of the survey is to be made available to the research community.

Comparability and coherence

The project design should enable a high degree of control over all stages of the survey preparation and fieldwork. This requires close co-operation with the survey organisation.

Indicators should strive for comparability/coherence with existing statistics, concepts and definitions.

If a deviation from existing concepts and statistics is suggested, it should be clearly justified on the basis of value added provided to the target group of users and the statistical community.

Cost efficiency

Indicators need to try to minimise the burden inflicted on respondents (respondent load), and the costs for the organisation that pays for the survey (e.g. processing costs).

With regard to the trade-off between level of detail and costs, the indicator should ask only for that level of detail which is being considered absolutely necessary.

If available, indicators should be calculated from existing statistics, even if this means a slight diversion from the indicator design being considered optimal. Only if the existing data is severely insufficient for the calculation of the indicator should fresh data be collected.

Three **observation units** will be of relevance in the course of indicator development for an analysis of NWE-related issues:

- the workplace and the working team,
- the firm (enterprise) or establishment (site), and
- the territorial unit such as the local, regional, national or international (e.g. EU).

In addition to observation unit, for each indicator to be collected a **reporting unit** needs to be defined, i.e. the person, household member, person in organisation to be interviewed.

2.2 Readiness Indicators

In the companion document⁴, a number of factors were identified which tend to drive the development and implementation of NWEs. In addition, the document 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 of organisations is of as much importance than 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.

⁴ "Available Evidence on Success Factors and Impacts of New Work Environments", empirica Working Paper Series.

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 2 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 2: 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 writing long reports. This skill is also linked to the importance of analysing complex problems in depth.	Some relevance as NWEs and virtual teamwork will mean that a higher share of workers will be carrying out management tasks.
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 purpose of this paper.

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, decentral 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).

2.3 Intensity Indicators: Uptake of NWEs and Value Drivers

2.3.1 Dimensions of NWEs: Introduction

The newer work environment literature gives insights into the factors to be considered when assessing NWEs. These need to form the basis of any attempt to benchmark NWEs and their impacts on the economy and society.

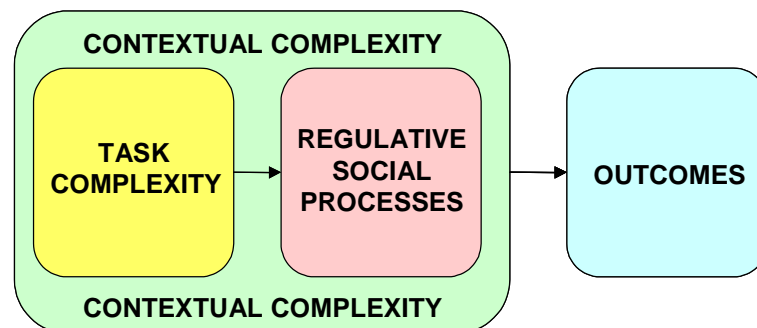
Shah and Pritchett (2004) distinguish between three groups of aspects:

- "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:

- 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;
- regulative social processes involving individual or collective subjects (e.g. interconnectedness, trust, desires, common goals, etc.).

Figure 4: Networked work as an activity system



Source: Based on Vartiainen (2006)

In the following we will discuss, for each of these four areas, requirements for core indicators, making reference to established measurement approaches wherever possible.

2.3.2 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 following⁵:

- 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.

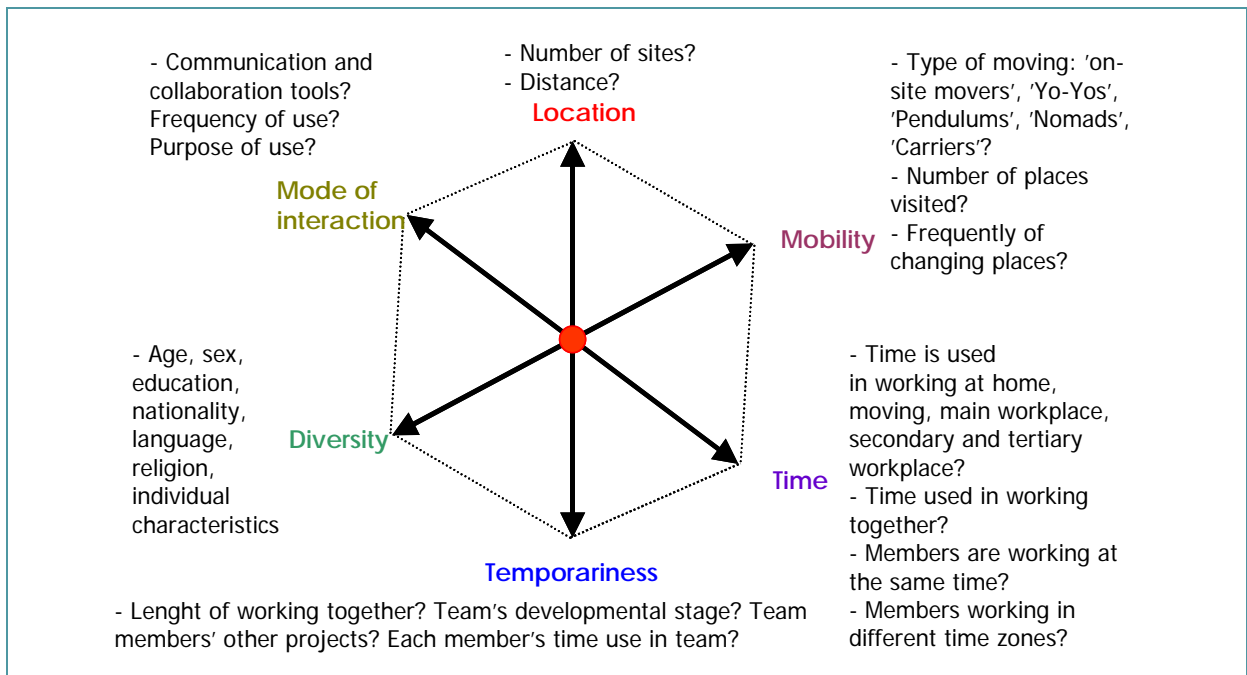
⁵ Partly based on:
http://changingminds.org/disciplines/change_management/diagnosing_change/complexity_analysis.htm

2.3.3 Contextual Complexity: Mapping NWEs

Vartiainen (2006) identified the following six dimensions which determine the contextual complexity of a work system that includes collaboration. He distinguishes between (see Figure 5):

- (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.

Figure 5: Physical, virtual and mental context features of work systems

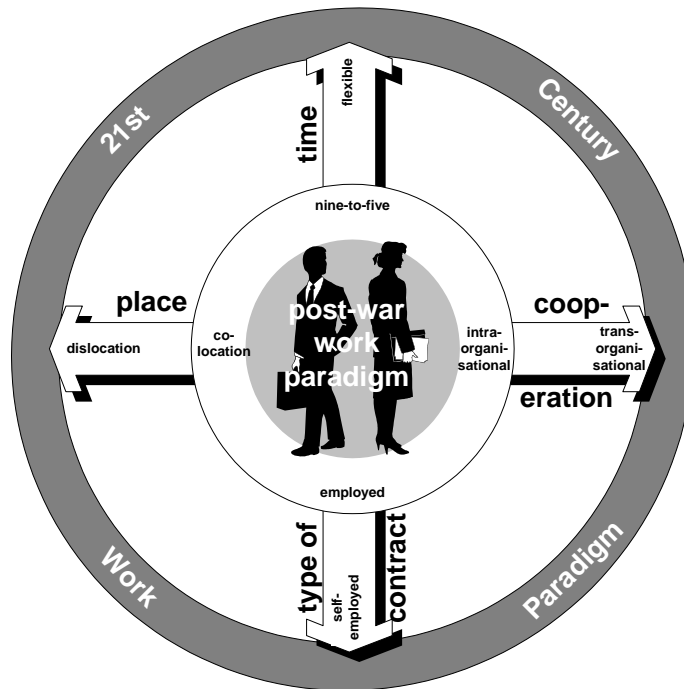


Source: Vartiainen (2006)

- (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.

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 (see Figure 6).

Figure 6: 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 section 0, 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 7). 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**

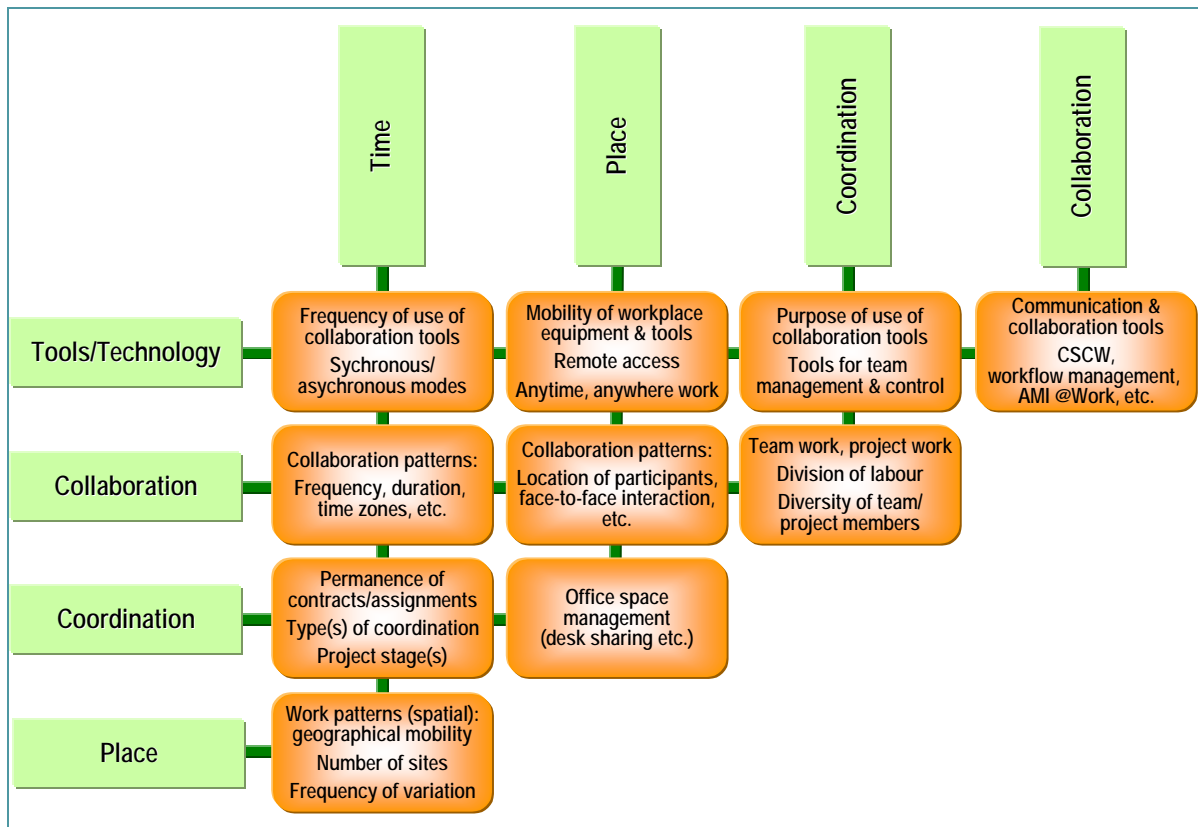
Frequency and intensity of use of communication and collaboration tools, differentiated by types of purposes;

(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 7: Matrix of Indicator Dimensions for Describing Contextual Complexity of New Work Environments



Source: The author

- **Time ⇔ 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 ⇔ 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 ⇔ tools/technology**

Mobility of workplace equipment and tools (applications depending on fixed versus mobile end devices);

Uptake and patterns of multi-locational 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.).

2.3.4 Regulative Social Processes

Following Vartiainen (2006), 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 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 3. Table entries are not meant to be exhaustive.

Table 3: 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 (region/country)			

Source: The author

2.4.1 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).

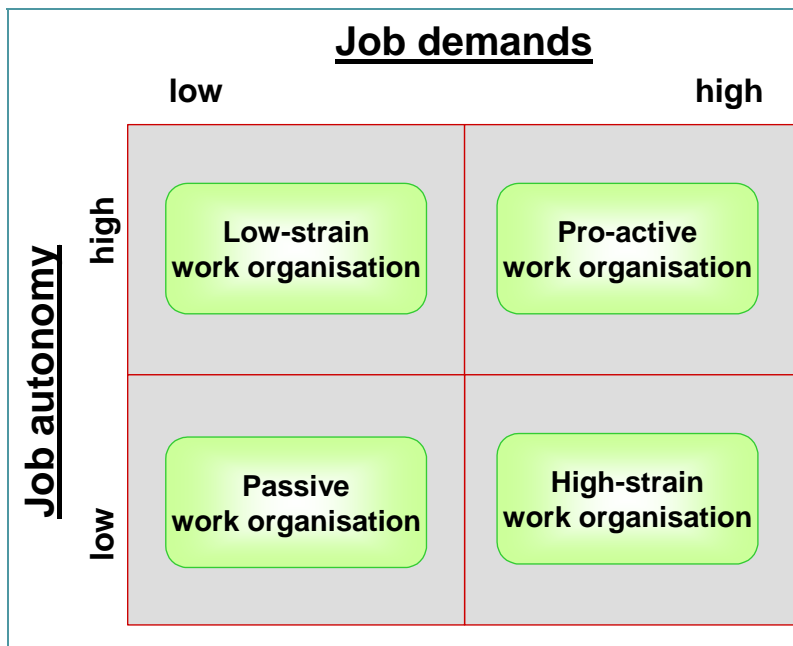
The exact choice of performance indicators depends, of course, on the type of product and sectoral environment the organisation is operating in (see Appelbaum et al. 2000).

2.4.2 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 8).

Figure 8: The “time constraints ↔ 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.

Perceptions 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 2.3.4).

At the firm level, secondary outcomes which have been identified in the companion document⁶ 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.

2.4.3 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

⁶ “Available Evidence on Success Factors and Impacts of New Work Environments”, empirica Working Paper Series.

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 both 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** growth 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.

2.5 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 4: 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-locational eWork (spread)	Unmet demand for generic/specialist skills
Virtual collaboration at the workplace	Total factor productivity (growth)
(Cross-border) Virtual collaboration among firms	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 author

3 Existing indicators on New Work Environments

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 this paper) remains sketchy at best.

A number of other sources of cross-country and national data on related issues exist. These are listed in sections 4.2 and 4.3 of this document. 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.

3.1 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 a survey respondent), 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.

3.2 Progress in Indicator Development on Related Phenomena

3.2.1 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-locational 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-locational 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 5, based on data from a random-sample European survey conducted in 2003 as part of the BISER project⁷, shows how this looks in practice.

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-locational 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

⁷ For details, see www.biser-eu.com

and meeting venues, and temporary locations while travelling. This is confirmed by evidence collected through a pilot survey in the STILE project⁸, which developed an eWork module to be included in national labour force surveys (Altieri et al. 2005).

Table 5: ICT-supported multi-locational work – working locations

ICT-supported multi-locational work					
Base →	(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-locational workers. Source: Gareis et al. 2004.

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”⁹.

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)

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

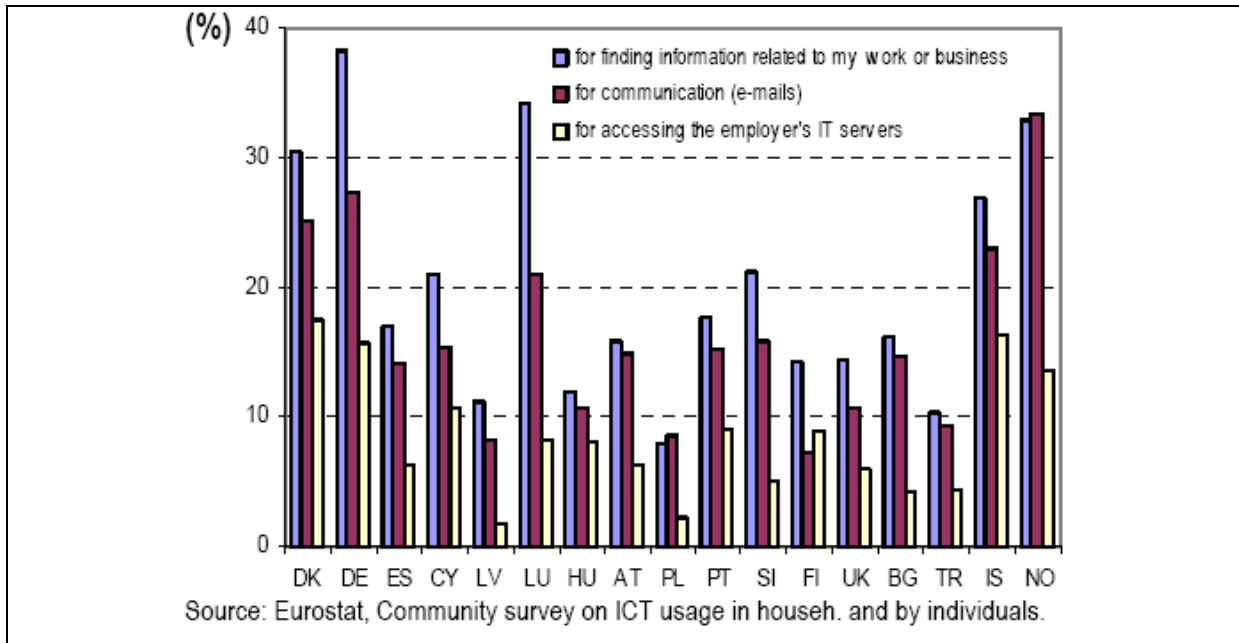
- a) At home
- b) At place of work (other than home)
- c) At place of education
- d) At other places
 - d1) Public Library
 - d2) Postal Office
 - d3) Public Office, town hall, government agency
 - d4) Community or voluntary organisation

⁸ Note that for the STILE pilot survey, non-random samples were used.

⁹ See Statistics in Focus, 40/2005, p

- d5) Internet Café
- d6) Neighbour, friend or relative's house

Figure 9: Proportion of Internet users performing selected work activities outside the premises of their employer (2004)



Source: Eurostat 2005

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.

3.2.2 Collaboration at Workplace Level

While these approaches open up various possibilities for producing statistics on multi-locational, 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 6 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 in tele-cooperation (as defined above) with the number of teleworkers (see Figure 10) 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

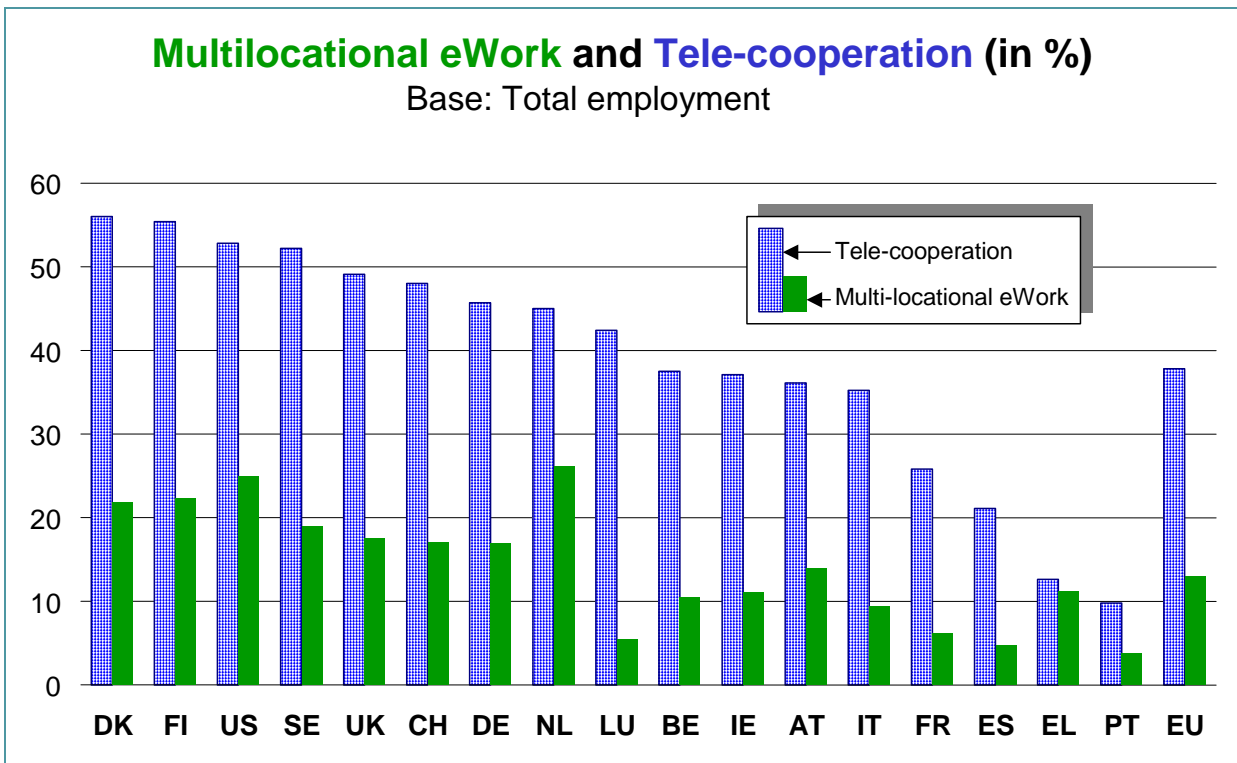
that ICTs enable work to be brought to the worker (telework) instead of transporting workers to work (commuting). But work inputs and outputs are also increasingly transmitted between traditional workplaces via ICTs. This is a process which involves all parts of the economy and, as the SIBIS pilot data show, already more than a third of the EU workforce.

Table 6: 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-cooperation: DK	0.2		
Total (all employed)	100		

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

Figure 10: Telework and Tele-cooperation in EU15 Countries in 2002 (in % of total employment)



Source: Own calculation based on data from SIBIS 2002/2003, see Empirica (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.

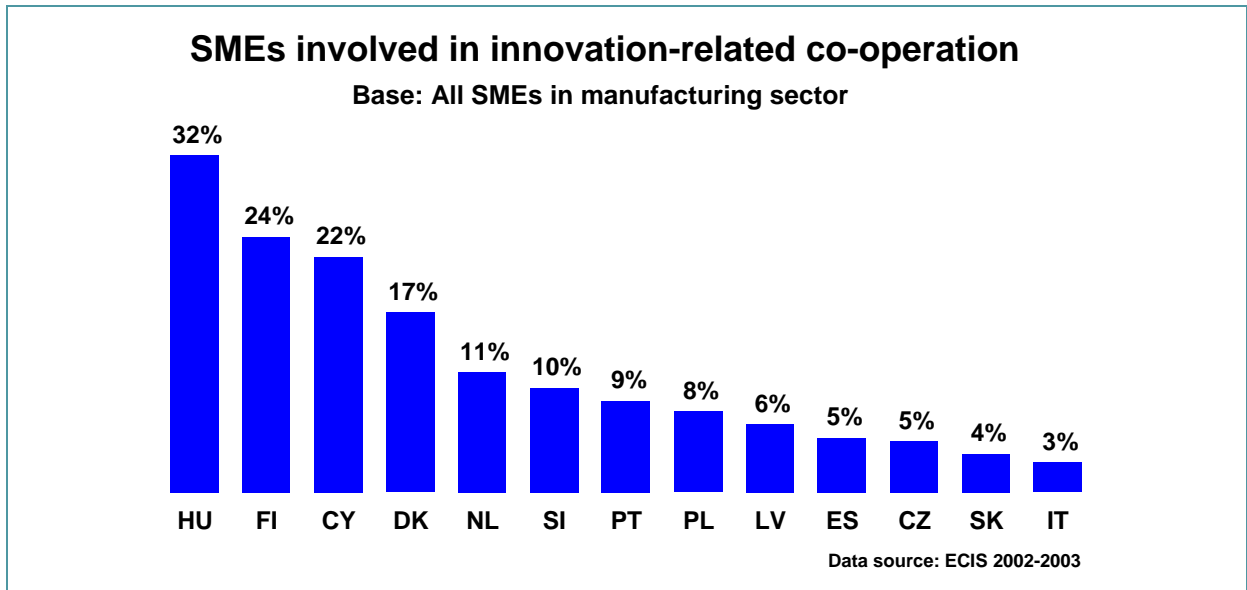
3.2.3 Co-operation and Collaboration at Organisational Level

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" (see Figure 11). Distinctions are made between the type of cooperating partner:

- 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.

Figure 11: SMEs involved in innovation related co-operation



Source: Data from Eurostat (2006)

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.

4 Synthesis: A 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 2 let us conclude that there are considerable gaps in indicator availability.

This chapter lists and describes the indicators which are deemed to be of most potential value for covering the issue of New Work Environments by data collected through the European Statistical System.

The table in section 4.1 lists suggested indicators for statistical coverage of NWE-related constructs / developments. There are four different types of indicators:

- ❶ indicators which are already established in the European Statistical System, but have not yet been utilised for analysing NWE related developments;
- ❷ 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;
- ❸ 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;
- ❹ indicators which are not existing 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.

4.1 Suggested 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 <u>Add.:</u> Prices for broadband access basket	Enterprises/ IT managers (or other)	❶ 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 <u>Add.:</u> Prices for mobile broadband access basket	Population by location across the country / Administrative data collection	❷ 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)	❸ Indicator may exist in some national surveys, but not included in the ICT Usage Enterprise Survey yet	ICT Usage Enterprise Survey
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	❹ Work in teams is covered by ESWC (Q26.B + 26B.1) and by national working conditions surveys ❺ 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	❻ Not existing yet (related to earlier indicator on tele-cooperation piloted in SIBIS and BISER)	Upgraded European Survey on Working Conditions

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Inter-firm collaboration	<p>Share of firms involved in collaboration in innovation related activities</p> <p><u>Add.</u>: Share of firms involved in collaboration in other activities (not related to innovation)</p> <p>Operationalisation of “collaboration”: “Collaboration means active participation in joint R&D and other innovation projects with other organisations (either 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.”</p>	Enterprises/ Senior managers responsible for R&D	<p>①/④ Collaboration for innovation related activities is covered by the ECIS. Similar variable included in EB “Innobarometer”.</p> <p>Operationalisation of collaboration similar to ECIS.</p>	European Community Innovation Survey
Physical worker mobility	<p>Share of workers spending part of their working time away from their main place at work <u>and</u> (if applicable) their home office.</p> <p><u>Add.</u>: Frequency and percentage of working time spent away from main place at work and home office.</p>	All in paid work / all in paid work	<p>⑤ Related to variables about worker mobility piloted in SIBIS and BISER surveys.</p>	Upgraded European Survey on Working Conditions
Digital skills	<p>Self-reported confidence in:</p> <ul style="list-style-type: none"> ○ using a search engine to find information on the Internet ○ using e-mail to communicate with others ○ downloading and installing software onto a computer ○ identifying the cause for computer problems ○ understanding text written in English 	All in paid work / all in paid work	<p>⑤ Adapted from eUSER; similar variables are contained, for example, in the SIBIS and BISER surveys</p>	European Union Adult Education Survey (in preparation)

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
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	⑤ Similar question contained in the UK 2001 Skills Survey	European Union Adult Education Survey (in preparation)
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	⑤ 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	① 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	④ 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	② 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	② The component questions are included in ESWC (Q30.A,B,D) and by national working conditions surveys	Upgraded European Survey on Working Conditions
Uptake & Intensity Indicators				
Task complexity	Share of persons in paid work whose job has a high / medium / low task complexity. <ul style="list-style-type: none"> ○ Task complexity index to be calculated from replies to scaled questions: ○ 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	②/③ 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	④ 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-locational 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 locational category (mobile, clients' premises, home, other), and technologies used.	All in paid work / all in paid work	②/④ 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	④ Not existing yet.	Upgraded European Survey on Working Conditions
(Cross-border) Virtual collaboration among firms	Share of firms involved in online collaboration in innovation related activities with partners in foreign countries <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 (cross-border)	Enterprises/ Senior managers responsible for R&D	④ Not existing yet, but related to indicator in ECIS	European Community Innovation Survey
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	④ 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	②/④ Piloted in SIBIS survey	Upgraded European Survey on Working Conditions

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
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	②/④ 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	④ 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.	④ Not existing yet – based on pilot survey developed by Vartiainen (2006)	Upgraded European Survey on Working Conditions
Impact Indicators: 1st Order				
Gross rates of return	Ratio of gross operating surplus to the gross stock of fixed reproducible assets.	Enterprises/ senior manager	① 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	①/④ 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	① 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	① Existing indicator	Established enterprise surveys; Community Labour Force Survey

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Capacity to change	<p>Share of enterprises using virtual collaboration which report a positive impact on the capacity to change in the reference period.</p> <p>Time to action to be operationalised as follows: The effect on your organisation's ability to adapt quickly</p> <ul style="list-style-type: none"> o to fluctuations in demand, o to unexpected changes in the market environment (if applicable), o to lack of available skills on the labour market (if applicable), o to new market opportunities. 	Enterprises using virtual collaboration / senior managers	❶ Not existing yet.	to be established
Impact Indicators: 2nd Order				
Job satisfaction	<p>Overall job satisfaction, 6-point scale (not satisfied at all to fully satisfied)</p> <p><u>Add.</u>: Satisfaction with elements of the job:</p> <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	❶/❷ 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	❷ included in ESWC	Upgraded European Survey on Working Conditions

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Job autonomy / job demands: Pro-active work organisation	<p>Share of workers with contract of employment who</p> <ul style="list-style-type: none"> ○ can choose/change their methods of work, ○ <u>and</u> their order of tasks or their speed or rate of work, ○ <u>and</u> who have high participation in decision-making (see above), ○ <u>and</u> who are participating in adult education and training (see above), ○ <u>and</u> who do part of their work in teams (see above), ○ <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>	<p>All workers with contract of employment /</p> <p>All workers with contract of employment</p>	<p>②/⑤ Component variables are included in the ESWC.</p>	<p>Upgraded European Survey on Working Conditions</p>
Perceived stress	<p>Share of persons in paid work who report being affected by stress.</p>	<p>All persons in paid work /</p> <p>all persons in paid work</p>	<p>② contained in ESWC</p>	<p>Upgraded European Survey on Working Conditions</p>
Individual labour market opportunities (perceived)	<p>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)</p>	<p>All persons in paid work /</p> <p>all persons in paid work</p>	<p>② included in ISSP</p>	<p>Upgraded European Survey on Working Conditions</p>
Subjective well-being	<p>On the whole, are you very satisfied, fairly satisfied, not very satisfied or not at all satisfied with the life you lead?</p>	<p>All persons in paid work /</p> <p>all persons in paid work</p>	<p>② Contained in the Standard EB as well as in World Value Survey.</p>	<p>Upgraded European Survey on Working Conditions</p>

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
Impact Indicators: 3rd Order				
Levels of (un)employment	Persons in employment as share of total population (Eurostat definition)	Total labour force / total labour force	❶ 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	❶ 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	❶ Indicator was suggested in an earlier Commission report ¹⁰ and can be calculated using CLFS data	Community Labour Force Survey
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.	❶/❷ 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	❸ 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	❶ Existing indicator (OECD)	Established accounts
GDP growth	Gross domestic product, change between reference years	Member State / established accounts	❶ Existing indicator (OECD)	Established accounts

¹⁰ Commission of the European Communities (2000), Joint Employment Report 2000, Statistical Annex. Here, this indicator is called EO7.

Core Indicators	Definition	Unit of observation / Reporting unit	Relation to existing indicators	Suggested data collection mechanism
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	❹ 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	❶ Existing indicator	Eurostat databases on transport statistics
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	❹ Not existing yet.	Upgraded European Survey on Working Conditions

4.2 Existing Cross-country Data Sources for Indicators Related to New Forms of Work Organisation and NWEs

Name of data source	Description (incl. target, survey unit)	Responsible	Country coverage	Frequency
ALL – International Adult Literacy and Life Skills Survey	GPS (people aged between 16 and 65); pilot in 2001, first survey in 2002	Statistics Canada, OECD	CD, USA, CH, N, NL, BE, IT, China, others	2002
BISER – Benchmarking the Information Society: eEurope Indicators for European Regions	General Population Survey: Target: total population aged 15+; total sample size: 11,369. Business survey: Target: all establishments 5+ employees; total sample size: 8,579. Representative samples in 28 NUTS II regions across the EU	BISER consortium led by empirica.	28 NUTS II regions across EU (excl. LUX)	2003 (one-off)
CLFS – European Community Labour Force Survey	Households	Eurostat with NSIs	EU25	annual (quart. since 1999)
Cranet-E – Cranfield European Human Resource Management Survey ¹¹	Target: Human resource managers in companies Sample: 8,050 responses (15% response rate)	Cranfield	EU + BG,CZ,EE,HU,PL,SI + AU,CD,CY,IN,IL,JPNZ,N,R,ZACH,TWTN,TR,US.	5 rounds since 1990, latest: 1999
CVTS – Continuing Vocational Training Survey	Target: DMS (enterprises > 9 workforce); Sample: e.g. 3,200 companies in Germany	Eurostat with NSIs	EU	1994, 2000, 2006
DTI International Benchmarking Study	Companies (DMS) (500 in the UK, 300 in other countries)	DTI, Romtec (prev.: Spectrum)	UK, FR., DE, IT, SE, US, CA, JP	annual since 1997; latest published: 2004
EB – Eurobarometer Flash “Entrepreneurship 1-5” (160, 146, 134, 107, 83)	GPS (8063 in all EU Member States, 507 in USA)	CEC/ Gallup Europe	EU25, USA	2000-2004 (annually)

¹¹ Questionnaire see <http://cranet.biu.ac.il/SOC/sb/cranet/sode.html>.

Name of data source	Description (incl. target, survey unit)	Responsible	Country coverage	Frequency
EB – Eurobarometer Flash 120 “Working Conditions (Flexible Employment)”	GPS	CEC/ Gallup Europe	EU15	2-3/2002 (one-off)
EB – Eurobarometer Flash 88, 97, 103112, 125, 135 “Internet and the Public at Large”	GPS (~30 000 in EU15 + Norway, Iceland)	CEC/ Gallup Europe	EU15	10/2000 - 11/2002 (discontinued)
EB – Eurobarometer Flash 164, 129, 100 “Innobarometer”	DMS	CEC/ Gallup Europe	EU25	2-yearly, latest: 2004
ECHP – European Community Household Panel	60,000 European households	Eurostat with NSIs	EU	The total duration of the ECHP was 8 years, running from 1994 to 2001
ECIS – European Community Innovation Survey & Community Innovation Survey Light ¹²	Target: Companies with 10-49 employees (small), 50-249 employees (medium-sized) and 250 + employees (large).	Eurostat, CEC	EU	1993, 1997, 2001, 2004 (light), 2005
EMERGENCE Employer Survey	Target: organisations with 50+ employees, all sectors Sample: 8000, representative Topics: eWork, electronic outsourcing of selected services	IES/ NOP	EU + HU, PL, CZ + additional countries in following years	2000 (one-off)
ENSR – Enterprise Survey	Target: Enterprises Sample: 8,000	n.a.	EU + LIE, N, CH, IS	annual since 1992, latest published: 2003
EPOC – Employee Direct Participation in Organisational Change Survey	Target: organisations with more than 25/50 employees Sample: 5,786	European Foundation for the Improvement of Living and Working Conditions	DE, DK, E, FR, IT, IE, NL, PO, UK.	1996

¹² Source: http://europa.eu.int/estatref/info/sdds/en/innovat/innovat_cis_base.htm

Name of data source	Description (incl. target, survey unit)	Responsible	Country coverage	Frequency
EQLS – European Quality of Life Survey	Target: Individuals in private households Sample: 26,000 (face-to-face interviews)	European Foundation for the Improvement of Living and Working Conditions	EU25 + IS,NO,CH	2003, 2007
ESW – European Survey on Working Time and Work-Life Balance	Target: Both personnel managers and – where available – employee representatives in enterprises with 10+ employees; Sample: 20,000, all sectors	European Foundation for the Improvement of Living and Working Conditions	Europe (EU-21 : EU15 + CY,CZ,HU, LV, PL,SI)	2004-2005
ESWC – European Survey on Working Conditions (prev.: ESWE)	GPS (aged 16 to 64), N = ~21,000 (in 2000, excluding NMS)	European Foundation for the Improvement of Living and Working Conditions	EU25+	1990, 1995, 2000/2002, 2005
ETUS – Harmonised European Time Use Survey (TUS)	GPS	Eurostat, NSIs	EU	2001 (1 st)
EUSI – European System of Social Indicators	Collects and presents harmonised data from various sources	ZUMA, EuReporting Project Consortium	EU15, CH, CZ, HU, NO, PL, US, JP	various
Eurostat ICT Usage Enterprise Survey	DMS (enterprises >9 employees); reporting unit: IT manager of unit	Eurostat, NSIs	EU	annually since 2001
Eurostat ICT Usage Household Survey	GPS	Eurostat, NSIs	EU	annually since 2002

Name of data source	Description (incl. target, survey unit)	Responsible	Country coverage	Frequency
IALS – International Adult Literacy Survey	GPS (2000 to 8000 adults aged 16-65 per country)	OECD, Statistics Canada, others	1994: CD, DE, IE, NL, PL, SE, CH (part), US. 1996: AU, BE, IE, UK, Z. 1998: CR, DK, FI, HU, IT, NO, SI, CH (rest).	1994, 1996, 1998
ISSP – International Social Survey Programme	ca. 1000 per country	various national social research institutes	Module on “work orientation”: AT, UK, IE, IT, NL, NO, DE, HU, US plus (only 1997): FR, DK, PL, ES, SE, CH, CZ, PL, JP.	1989, 1997, 2005
STILE Pilot Survey on Telework	Target: Multi-locational eWorkers Sample: non-random, n=718 Topics: Testing of pilot module on eWork for inclusion in CLFS	STILE consortium	BE,HU,IT,UK	2002 (one-off)
VET – Vocational Education and Training Survey	Administrative data collection; data collection on <i>initial</i> vocational education and training	Eurostat, DG XXII, CEDEFOP	EU	Five-yearly: next 2006

4.3 Existing National Data Sources for Indicators Related to New Forms of Work Organisation and NWEs

Name of data source	Description (incl. target, survey unit)	Responsible	Country coverage	Frequency
PASO – Panel Survey of Organisations	Target: Panel of organisations Topic: human resource management practices and policies; organisation of work; internal and external labour markets; skills.	K.U.Leuven (Katholieke Universiteit Leuven)	BE	2002, 2003, 2004
National Working Conditions Survey, Bulgaria	Topics: quality of life and working conditions.	Ministry of Labour and Social Policy, Working Conditions Fund	BG	2001, 2005
Measuring the Quality of Working Life in the Czech Republic	Topics: nature and organisation of work, work performance, motivation, job satisfaction and internal communication	Czech Ministry of Labour and Social Affairs (MOLSA)	CZ	
BIBB/BAuA – Employee Survey 2005/06 ¹³ (formerly BIBB/IAB Survey)	Target: Persons in paid work Sample: 2005/06: 20,000 respondents; 1998/99: 34,343 respondents Topics: Employment situation, working conditions, education, training, skills, etc.)	BIBB, IAB, BAuA, BMBF	DE	1979, 1985/86, 1991/92, 1998/99, 2005/06
SOEP – German Socio-economic Panel	Topic: Includes large number of variables on working conditions.	German Socio-economic Panel Study (GSOEP)	DE	annual
DWECS – Danish Work Environment Cohort Study	Topics: Working conditions, health and lifestyle of Danish employees Target: All persons in paid work, including both employees and the self-employed. Sample: 10,000 adults (panel)	NIOH (National Institute for Occupational Health) and	DK	since 1990

¹³ See <http://www.bibb.de/de/wlk21738.htm>

Name of data source	Description (incl. target, survey unit)	Responsible	Country coverage	Frequency
Trends for Risk Factors in the Danish Work Environment	Administrative data collection based on the registry of occupational illnesses and symptoms, compiled by the Working Environment Authority.	Danish Working Environment Authority	DK	annually since 2000
Use of ICT in Nordic Enterprises Survey	Companies (postal survey); response: DK 2440, FIN 1655, S 1901, N 2712.	Nordic national statistical agencies	DK, FIN, NO, SE	1999/2000 (1 st); 2000/2001 (subsequently harmonised with Eurostat ICT Usage Enterprise Survey)
Working Life Barometer in the Baltic Countries 2002	Target: Persons in paid work	Ministry of Labour, Finland	EE, LT, LV	1998, 2002
National Survey on Working Conditions (Encuesta Nacional de Condiciones de Trabajo), Spain		INSHT	ES	1997, 1999, 2003
Quality of Life in the Spanish Workplace	Topic: Situation for workers in the workplace, activities they carry out and their relations at work, subjective information arising from the workers' own perceptions about their working conditions.	Spanish Ministry of Labour and Social Affairs	ES	Annually since 1999
Finnish Quality of Work Life Survey	Target: entire working population in Finland. Sample: 3,000 – 6,000 persons, face-to-face interviews	Statistics Finland	FI	1977, 1984, 1990, 1997 and 2003
Quality of Work in Italy ('La qualità del lavoro in Italia') Survey	All sectors, including self-employed people and entrepreneurs.	Isof	IT	2002
Permanent Quality of Life Survey	Topic: Working conditions, health (as part of overall quality of life) Target: Dutch workforce.	Central Bureau of Statistics in the Netherlands	NL	Annually since 1989
Working conditions in Portugal	Topic: Working conditions	DETEFP, Ministry for Labour	PT	2000, 2005
AMU – Work Environment Survey Sweden (Arbetsmiljöundersökningen)	Almost 10,000 people per survey.	Statistics Sweden (SCB)	SE	two-yearly since 1989

Name of data source	Description (incl. target, survey unit)	Responsible	Country coverage	Frequency
ESS – National Employers Skill Survey (ESS)	Target: Organisations with 1+ employees Sample 2003: 72,100 employers	National Statistics UK	UK	Annual since 2003 (replaces the annual Skill Needs in Great Britain)
LTW – Learning and Training at Work Survey		National Statistics UK	UK	Annual since 2003 (replaces the annual Skill Needs in Great Britain)

5 Conclusions and Recommendations

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 research 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-locational 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 of 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.

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