



New Working
Environments
A Decade of
Achievements
**A Strategy for
the Next Decade**

... October 2006

European Commission
Information Society and Media



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Environments

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Achievements

**A Strategy for
the Next Decade**

1995 – 2005 – 2015

October 2006

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Foreword

Ever since the Third Framework Programme for Research, the European Commission has been active in the area of improving working environments to provide better access to work, increase competitiveness and support sustainability.

This started with Telework as a minor application across telecom networks and became, under the Sixth Framework Programme for Research, a wide domain of activities which built on technologies developed in other sectors like mobile communications, and which provides workers with improved mobility and extended collaboration capacities and capabilities.

New Working Environments issues have now gathered together a broad community of interested researchers and industrialists who have jointly developed the concept of Living Laboratories and are currently considering the setting up of a European Technology Platform (ETP) on which to test new ideas and their implementation.

New Working Environments are consequently expected to be key contributors to the i2010 objectives on growth through innovation and creation of jobs.



Bror Salmelin

European Commission, New Working Environments research unit



Jean-Pierre Euzen

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1. Context

1.1. Purpose of the report

The purpose of this report is threefold:

- to provide a brief insight into work done in the NWE domain in the ten years from 1995;
- to set out our five-year vision of innovation and implementation to support the i2010 initiative; and
- to define our future research strategy through Framework Programme 7 and beyond.

1.2. Target readership

The report stands alone and may be read by anyone with interest in securing the future prosperity of a European Union whose citizens are unified in a socially inclusive, cohesive, sustainable and economically vibrant society.

It contains the blueprint for the development and deployment of NWE technologies, not just to support New Working Methods and practices in established and knowledge based industries, but also in support of wider socio-economic improvements: the same technologies that underpin collaboration at work will also serve to support social interactions and the delivery of improved citizen-centric public services. As such, it will be of specific interest to the AMI@Work communities, Decision-makers, and the IST Committee.

1.3. Synopsis

The report presents the overall roadmap from FP3 through to FP7, illustrating how technological innovation has supported, and will continue to support successive achievements of policy objectives outside the ICT domain.

It sets out short-to-medium term plans to exploit recent ICT R&D outputs to support the fulfilment of the i2010 objectives in terms of:

- An Information Space to enable richness and diversity of digital services, for businesses, government and citizens at work, at home and in their leisure,
- Innovation, not just of the base technologies, but in the way that these technologies are harnessed to increase employment opportunities, particularly where such opportunity had been lacking, and quality of life for all,
- Societal Cohesion and Inclusion, reducing divisiveness whether caused by lack of means, lack of ability or lack of desire.

It then sets out longer term strategic objectives, recognising that innovation in ICT and other technologies is not the whole answer. Systemic Innovation is essential. Systemic Innovation embraces:

- People - who need the skills and the will to strive for improvements,
- Processes - that need to evolve to become more effective as well as more efficient,
- Technology - that both drives change and enables New Working Environments.
- Policies – to enable the building of partnerships and critical mass, and to guide innovation and implementation.

Systemic Innovation will require new systemic instruments to implement innovation and build partnerships, such as the Living Labs concept², and will be judged by its successes in many dimensions. It must succeed in terms of increasing the wealth, wellbeing and reputation of the people and sovereign states of Europe; but it must not neglect the environmental impact - the price of localised economic success must not include global ecological disaster. Ultimately, Systemic Innovation must include innovation in the conduct of global competition. Finally, strategic intent and outline plans needed to realise this ambition are set out.

1.4. Why this strategy will succeed

There is a strong foundation on which to build. The 1995 vision of the year 2005 may have seemed over-ambitious and too futuristic at the time - but much of what is now regarded as commonplace simply did not exist ten years ago. The capability and performance of ICT platforms have increased and their prices fallen - today's domestic desk side 'entry-level' system was the high performance mainframe of the mid -1990s that filled an environmentally controlled machine room. Ten years ago Broadband in the home was unheard of - and many commercial users sent magnetic tapes by motorbike because it was faster and more reliable than the Wide Area Network of the day; but now we have Multimedia Home Platforms, delivering the 'triple play' of digital television, voice telephony,

² A **Living Lab** is a public-private partnership addressing the needs and requirements from the industry in close collaboration with the public sector. It facilitates co-creation and innovation in real-life contexts in a systemic way, combining the technological and societal drivers.

and internet connectivity. Devices have become more portable with a wider range of functions: Electronic News Gathering no longer needs bulky specialist equipment - today's mobile phones can capture and distribute images around the world.

The proposed vision for the New Working Environment of 2015 may, at first glance, appear to be too futuristic and too ambitious. But lessons have been learnt from headline-grabbing ICT projects that have not lived up to their promise as well as from the many, usually unheralded, successes. There is a much greater insight into the importance of the non-ICT dimension in setting and achieving the ICT agenda. This ICT R&D agenda will not duplicate or usurp work outside its domain - but it will draw on and interact with other disciplines. By 2015, NWE will have completed its emergence from its chrysalis. It will be as unremark-

able as public and private transport. It will doubtless have its critics; it will doubtless suffer deliberate and accidental incidents. But it will evolve and improve.

1.5. Content

Section 2 describes how we reached the point we are at today, and sets the broad direction forward. Section 3 looks at Global innovation trends. Section 4 describes the very real challenges that Europe faces - both challenges internal to Europe and the need to respond within the context of Globalisation that touches ever more facets of life. Section 5 sets out the procedural, commercial and contractual 'tool kit' available and planned.

2. Steps in Policy and Research

2.1. FP3 Telework

People representing Policy, Unions and Employers addressed together the issues related to the uptake of telework in Europe.

Telework is usually understood as individual workplaces which have been made location flexible by the use of ICT, often being a relocation of the work from a centralised office environment to a decentralised workplace in the home of the worker, or a mobile workplace (anytime, anywhere).

In 1993 the main concern of the White Paper on 'Growth, Competitiveness, Employment, the Challenges and Way forward into the 21st Century' was related to work.

The action plan 'Europe towards the Information Society' designed by the European Commission in 1994 was promoting the development of infrastructure and services.

2.2. FP4 Telework

Thanks to the development of connectivity, it became possible to 'bring work to people, instead of bringing people to work'.

Related research was carried out within the ACTS, ES-PRIT and TELEMATICS APPLICATIONS programmes.

The social aspects of telework have been addressed by two Green Papers:

- 'Living and Working in the Information Society: People First' adopted in 1996, followed in July 1997 by the Communication 'The Labour Market and Social Dimension of the Information Society';
- 'A partnership for a New Organisation of Work', adopted in April 1997 resulted in the Communication 'Modernising the Organisation of work – a positive approach towards change' in November 1998, which was contemplating three directions:
 - facilitating the diversification of working relations as well as new forms of work,
 - ensuring optimum conditions for the introduction and uptake of new technologies,
 - taking social labour market policy initiatives with a focus on telework.

2.3. FP5 eWork

FP5 brought together in a single IST Key Action (KA II: New Methods of Work and Electronic Commerce) all research related to helping individuals improve the quality of their working lives and to helping compa-

nies operate more efficiently in trading goods and services.

The aim was to develop Information Society Technologies enabling European workers and companies, in particular SMEs, to increase their competitiveness in the global market place, whilst at the same time improving the quality of the individual's working life.

The term eWork takes a step onwards from previous notions of telework. While telework in the traditional sense is mostly focussing on individual changes of work location, most prominently at home, eWork also includes remote work in shared office premises, such as call-centres and (other) remote back offices. In addition to traditional telework, eWork is understood to cover tele-collaboration as well, i.e. telemediated work forms carried out by workers located in traditional office environments, as in the case of virtual teams which stretch across the boundaries of single organisations (eCollaboration).

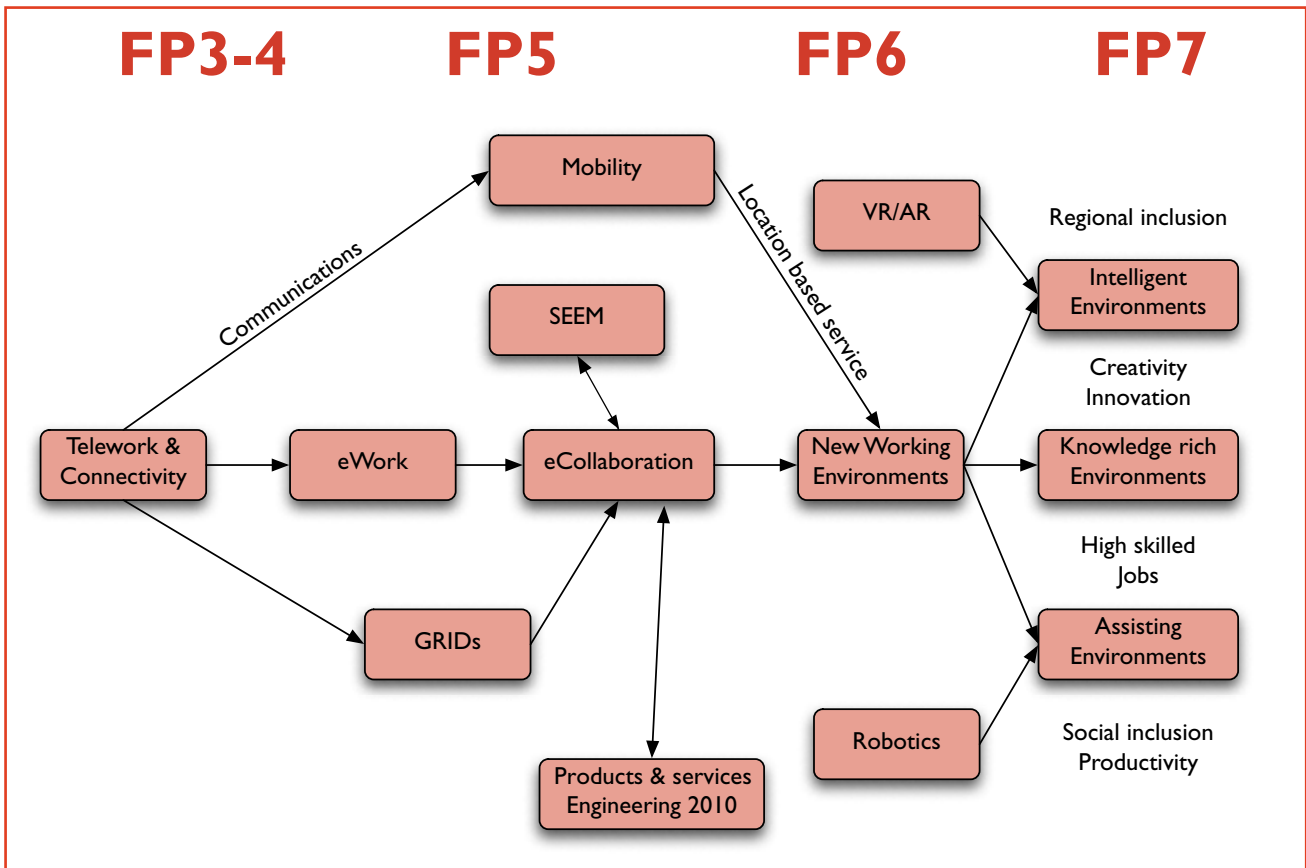
2.4. FP6 New Working Environments & Collaboration at Work

Related FP6 research aims at improving understanding of the changes and new opportunities in ways of working and doing business, together with the development of new technologies, methods and services – for the workplace and for support of teamwork, within and across the boundaries of organisations.

Following the developments of mobile communication technology, the research on telework and eWork got extended to mobile work environments. Location mobility, linked to the possibilities of increased connectivity anytime, anywhere, has been the first focus of emerging research. The growing technological capabilities steered a discussion on further aspects of mobility, including virtual mobility, operational and inter-actational mobility. Consequently, the aspect of networking and collaboration grew more important.

Strategy development in the New Working Environments area has also been or is still being tackled by some ERA projects (eg. BrainBridges, Agrofood) and by three Priority 8 Research and Policy projects (Seemseed: European Electronic Information Market, BEACON: Broadband policy, and EACE: New Working Environment Applications).³

³ Please find descriptions of all these projects on www.amiatwork.com under the chapter 'projects'.



The new strategic framework established by **i2010** – European Information Society 2010 – promotes an open and competitive digital economy and emphasises the role of ICT for innovation in the workplace and for the inclusion of all citizens in a cohesive society. This framework is complemented by the new Competitiveness and Innovation Programme and its priority on ICT funding.

Hence in the FP7 context, the current ‘New Working Environments’ domain will lead to research in Intelligent, Knowledge-rich and Assisting Environments.

2.5. FP7 Collaborative (Working) Environments

The research clustering done in FP6 by integrating the IPs with horizontal actions has reinforced the research agenda for FP7. The area of collaborative working environments is explicitly mentioned in the FP decision under the subheading of applications for business and industry, which highlights well the orientations of the work. The actual work programme is in preparation when writing this assessment report.

From the New Working Environments unit’s perspective, it is imperative that the research part of FP7 include the concept of Experience Application Research (EAR) recommended by ISTAG and executed in the Call 5 Strategic Objective ‘Collaborative Working Environments’. The EAR is not restricted to validation or deployment process, it is essentially a collaborative process fostering cross-disciplinary and systems innovation.

3. Current Innovation trends

3.1. Technology innovation

Since the early 1990s, and driven by the revolutions in IT hardware and software technologies as well as by the accelerating process of convergence across an ever diversifying landscape of fixed and wireless communication infrastructures and protocols (broadband Internet, IPv6, VoIP, GSM/UMTS, WLAN/WIFI, WIMAX), the strategic focus of research activities evolved from the successful development of **tele-work** applications (FP3&4, 1990-98), with ICT-enabled worker flexibility of time and place, through **eWork** (FP5, 1998-2002), with new Internet-based networked applications and services together with a multitude of novel mobile devices, sensory and display technologies changing the 'office' concept, equipment and design, to **new working environments** (FP6, 2002-2006), which have brought new work paradigms with more diverse, context-sensitive forms of **work collaboration** in an Ambient Intelligence (Aml) technology landscape. This **Aml landscape** together with its connectivity is the critical innovation enabler that brings previously atypical work and collaboration forms into the mainstream.

In the 5th FP, EU-supported R&D actions in the strategic areas of **eWork, sustainable workplace design and knowledge management for eWorkers** led to technical innovations in:

- flexible, mobile and remote working methods and tools;
- networked co-operative working environments and teamwork applications and tools;
- sustainable workplace design, introducing virtual and augmented environment concepts to the workspace⁴ and addressing architectural, physiological and resource-efficiency issues along with ICT innovation;
- advanced knowledge technologies for more effective teamwork and professional collaboration across work disciplines.

In the 6th FP, EU-supported R&D actions in the area of **New Working Environments** are expected to lead to technical innovations in

- products and services engineering and life-cycle management;
- mobile work services and applications;
- collaboration platforms and tools;
- location and context technologies;

⁴ Future workspaces based on an integrated design of virtual information spaces and real architectural spaces. Integration of ICT equipment into the physical environment ('disappearing computer').

- ontology's and semantic technologies;
- agent technologies;
- group presence technologies;
- multimodal interfaces;
- virtual, augmented and mixed reality;
- simulation and 3D visualisation;
- robot-human interaction.

Current R&D projects are developing technologies and systems for new, more flexible and configurable working environments, such as

- co-operation platforms for mobile & remote work;
- collaborative distributed work in networked organisations and (cyber) communities (including small businesses);
- adaptive, user-controlled multimodal broadband applications for the mobile professional;
- multimodal access to corporate knowledge flows, and workplace design.

Key results are expected in collaboration technologies and web services built on heterogeneous environments, with high semantic content.

Future Research focusing on '**Collaborative technologies and services @ work**' will develop, integrate and demonstrate collaboration technologies and processes such as advanced interfaces, the interaction process itself, media-rich communication, cognitive and semantic distributed network tools, knowledge sharing and management, enhanced environments, emotional (cognitive) interaction processes & supporting technologies, and finally web (grid) services for collaborative relations especially in P2P and (cyber)communities. Innovations are likely to be multi-disciplinary and systemic: technological innovation must be embedded in organisational and social innovations resulting in new workplace models and working styles such as are to be found in community-style workplaces and forms of self-organisation.

3.2. Processes: Systemic innovation

Innovation in new working environments follows a holistic approach, capturing all the relevant elements. Apart from technology, it includes innovation in workplace design, skills, training and learning, work organisation and work processes, and innovation in the relevant broader societal frameworks (regulation).

Working is part of human life. Lifestyle aspirations, workplace and organisational business models and strategies, must now integrate social, business and en-

environmental concerns leading to viable sustainable consumption, production and working patterns, and must link technology development and business innovations with longer term societal goals.

Systemic innovation also raises the need for systemic instruments and policies for innovation. The Living labs concept and its focus on establishing networks for experimentation and learning have the potential to provide such a set of systemic instruments for innovation.

3.2.1. Concepts

The balance between policy and research is clearly seen in the following illustration. The main assets for growth and jobs creation in Europe are the 450 Million human brains, which are linked together thanks to collaborative (working) environments.

These collaborative environments catalyse the brains to create knowledge (services, competencies, products). The second call in FP6 focused on bringing the resources together for creating accessibility and seamless mobility. These, complemented with the fifth call objectives of finding and bringing the right competencies together, of sharing tasks and of collaborating, are expected to lead to enhanced productivity.

The combination of productivity with creativity and innovation is mandatory in order to improve competitiveness.

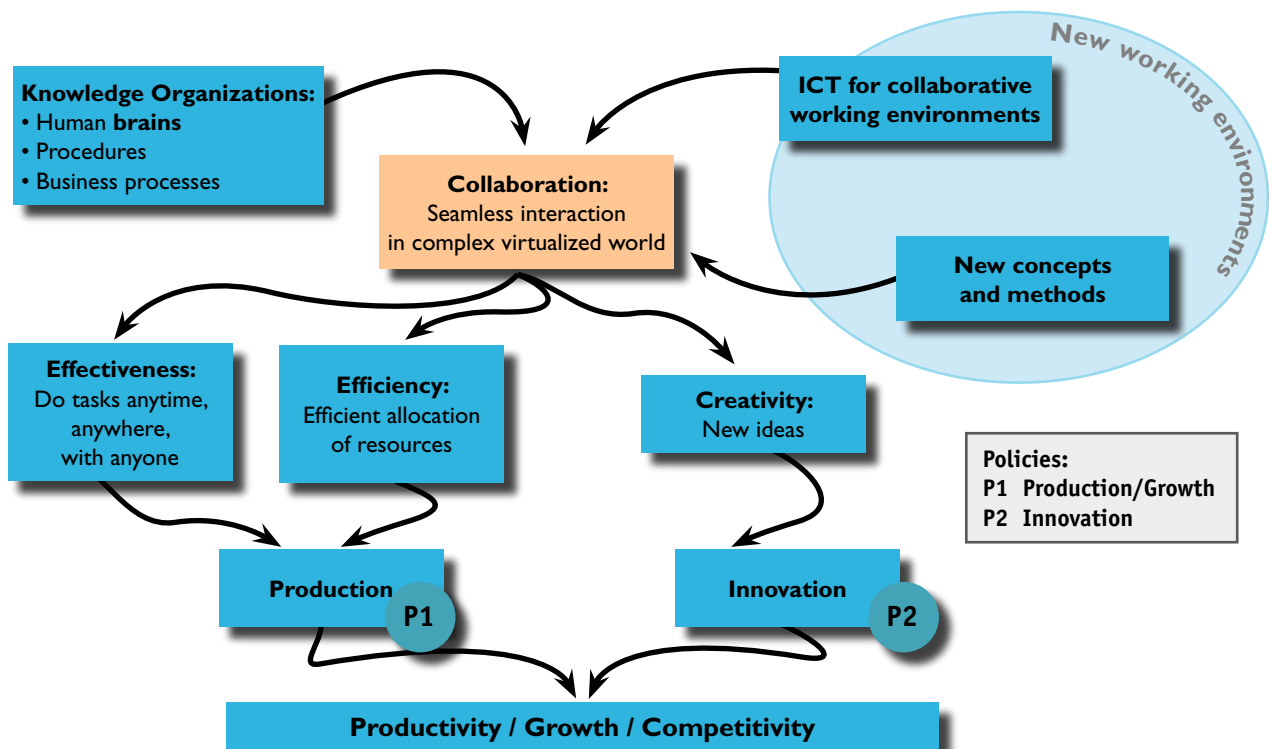
3.2.2. Methods

The New Working Environments unit of the European Commission's Information Society and Media Directorate-General fosters Information Society Technologies (IST) research to catalyse systemic innovation, in order to enable creative and productive, person-centric and collaborative, new working environments in Europe. To achieve this aim it is necessary to link, in a cross disciplinary manner, European 'dream team' communities for research and deployment.

The AMI@Work family links people in all 25 EU Member States and beyond for a European Research and Innovation Area (ERA) at work. This family facilitates new working environments innovation, ERA-wide and in EU research programmes.

The AMI family consists of self-organising communities, facilitated since June 2004 by elected leaders, and of the New Working Environments unit, together with related Commission services. These communities represent technology themes with a potential for cross-fertilisation and challenging validation environments with a significant technological, economic and societal impact. The AMI@Work family of ERA communities itself is a real-life collaboration experiment, allowing it to 'practise what it preaches'. These communities are created through web-based membership registration by interested individuals (see graph next page).

ICT for collaboration fostering competitiveness — Policy directions

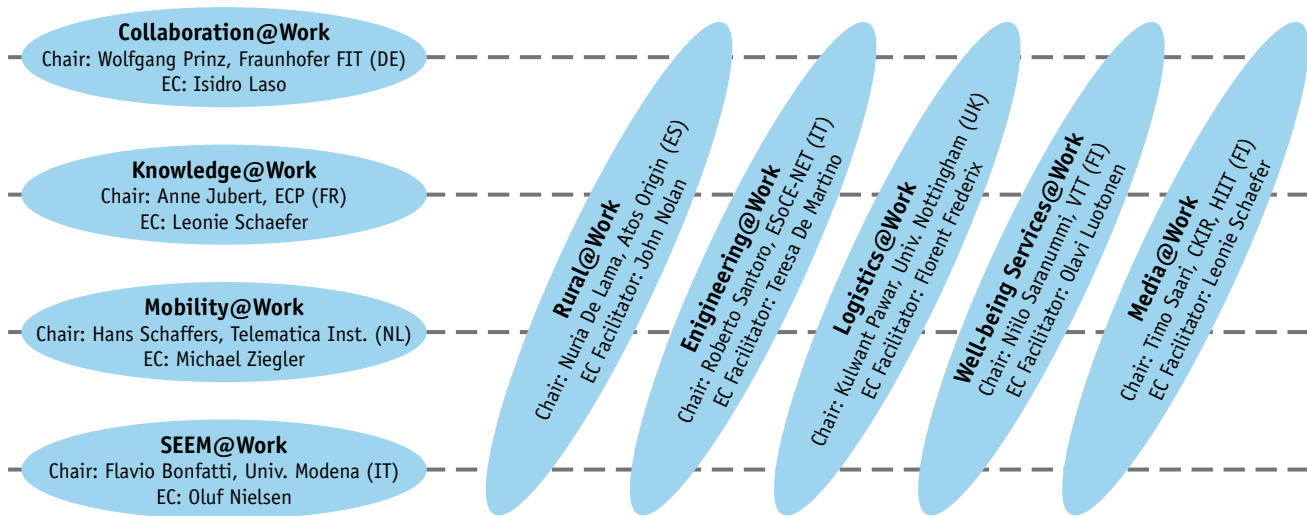


Communities as the best way to integrate for impact

research, development, demonstration, takeup, policy and legislation development

'horizontal' technology themes & SEEM

'vertical' challenging verification environments



Leadership@Work Special Interest Group, Chair: Seija Kulkii, CKIR (FI), EC Facilitator: Bror Salmelin
Leadership@Work Special Interest Group, Chair: Mats Erikson, CDT (SE), EC Facilitator: Olavi Luotonen

Living Labs EXTREMELY important for Systemic innovation

3.3. Policy: i2010 innovation cluster

In the new INFISO policy document (i2010 communication and impact assessment), the New Working Environment is fully included with two main policy priorities being:

- 1) the proposed European Network of Living Labs;
- 2) eLearning, eSkills and workplace added value chain.

These priorities and the number of new innovative applications in eBusiness are the main elements in the second innovation/investment cluster of i2010.

The INFISO-F4 contribution to the i2010 Impact Assessment is focussed on the following two main actions, to be implemented from the year 2006 onwards within the most appropriate funding programs:

3.3.1. Living Labs European Services

Living Labs constitute an example of how to successfully test emerging technology on real-life user environments, in order to assess how deployable it is and to further implement and commercialise innovations. The Living Lab concept developed by the INFISO-F4 unit is strongly sup-

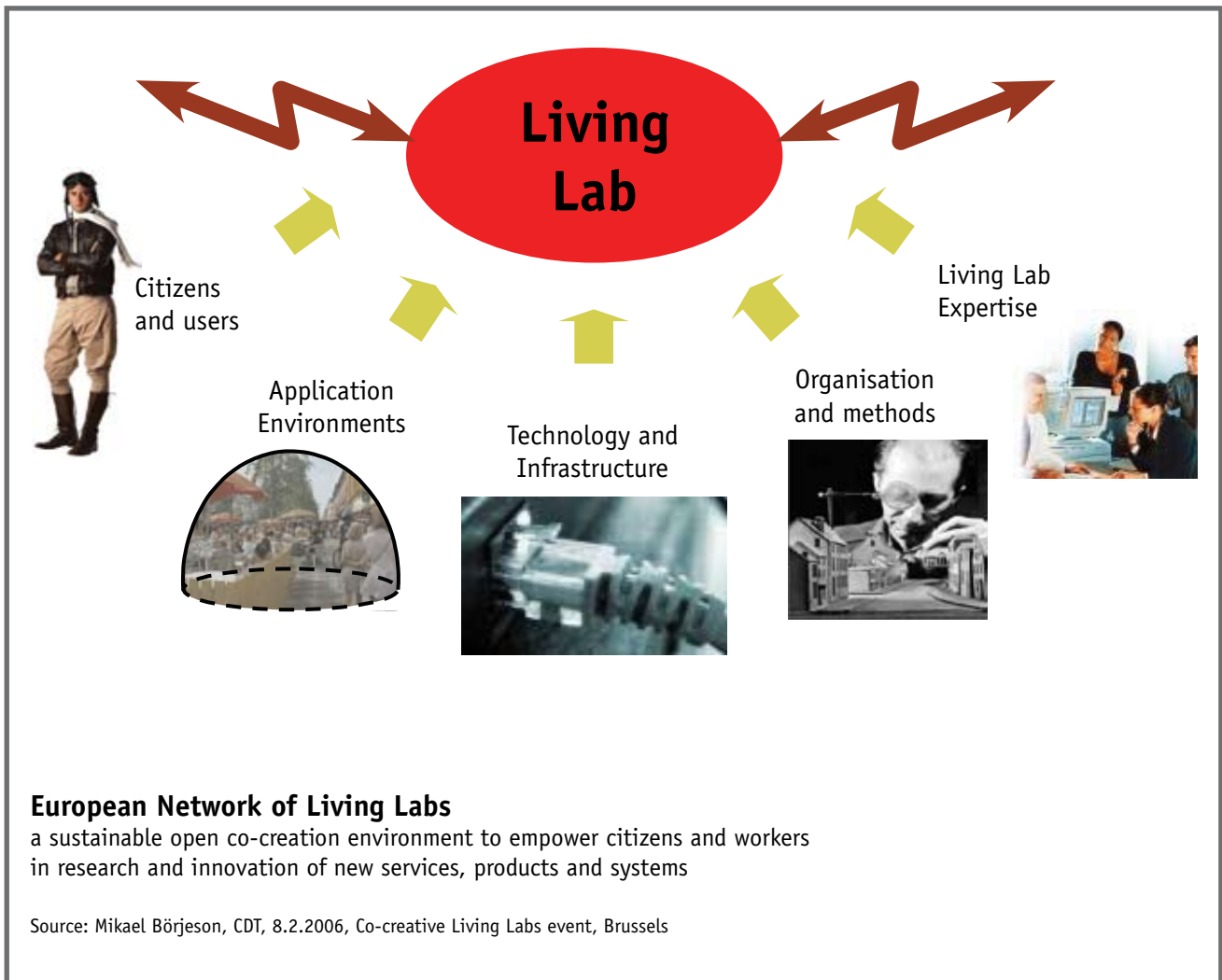
ported by industry because, by linking all industrial and societal innovation phases together, it reduces costs for demonstrations: the infrastructure is continuously re-used and it enables multi-demonstration analysis, where the effects in a complex environment can be analysed.

Real-life Living Labs stimulate new ideas, provide richer contexts for concrete R&D challenges and become natural environments in which to perform early and continuous validation (not just prototype-testing at the end). Concepts are developed in complete user contexts (users are not viewed as 'workers', 'patients', 'travellers' or 'citizens' separately).

Developing a European network of Living Labs will support the provision of services for broadly-based innovation deployment to industry, bringing technology test-beds into real-life user environments. The network will be an efficient innovation mechanism for emerging technology to be rapidly understood, adapted and put into operation (see graph next page).

3.3.2. Life Long Learning

It is of great importance to use research and innovation programmes to develop the value chain of Life Long Learning, eLearning and eSkills, in order to meet the needs of new working environments and to increase European industrial competitiveness. New or-



organisational solutions, new working environments and new practices, which are imperative for sustainable growth, are not feasible without the value chain of life long learning.

Through these concrete actions we could establish an innovation platform as a European public private partnership based on pre-existing local or regional initiatives (e.g. test beds and living labs). **The innovation platform is a new type of organised collaborative network for venturing and exploitation (project incubator), enabling environments for collaborative innovation.** Existing examples of corporate initiatives are the Venture Cup and the Nokia Forum. The technology focus could include business models, value chain distributions and social and institutional acceptance. There are already existing studies from 2005 and ongoing discussions with future stakeholders within Unit INFSO-F 4.

These two actions are based on the following elements of Innovation Policy to be implemented in Europe and are focused centrally to increase the impact of the integrated actions of DG INFSO in the fields of growth and job creation:

- Europe is facing a competitive challenge where ICT innovation and deployment play an important role, in economic, environmental and societal terms. Ac-

ording to recent studies the impact of work organisation on creativity and productivity corresponds to 25% of the productivity growth.

- **Experience Application Research⁵ (e.g. Living Labs) is a human centric approach to innovation and deployment, including reorganisation of work processes,** investment in ICT skills, collaborative working methods, organisational design, mobile applications and new workplace concepts. This highlights systemic (simultaneous societal and technological) innovation to achieve rapid deployment of research results.
- A European Network of Living Labs captures innovation from local, regional and national levels and promotes European networks within a multi-stakeholder model, potentially with a global dimension, all much in the spirit of the ERA.
- The European network of Experience Application Research Centres (EARC) will be established and developed from 2006 until 2010.

⁵ ISTAG Report on Experience and Application Research 'Involving Users in the Development of Ambient Intelligence', September 2004

3.4. People: Socio-economic innovation

Europe needs to fully develop its scientific and innovative potential to become more competitive and to enhance the welfare of its citizens. Europe needs more people at work, and working more productively, whilst protecting the environment, and can get them by triggering the further development of better and newer ways of working which encourage and support more entrepreneurship, innovation and flexibility.

Access to ICT is not enough. It is crucial that workers are able to assimilate innovation thanks to more advanced new working environments which can drive innovation onwards and productivity upwards.

The structural nature of the EU's productivity downturn is rooted in an outdated and inflexible in-

dustrial economy which has been slow to adapt to new conditions ensuing from the intensifying pressures of globalisation and rapid technological change, among other causes.

The EU innovation system needs to be fundamentally changed if the EU is to make a decisive shift towards realising the vision of a successful, innovation-based economy, capable of delivering lasting and high economic growth rates within an overall sustainable strategy.

The systemic nature of the innovation process needs to be fully recognised and the quality of the interrelationships between the different actions in the economic systems has to be significantly improved.

Increased investments in education, training and lifelong learning to better exploit the technological advances act as driving forces for more dynamic innovation growth towards the global knowledge based economy.

4. Sustainability challenges

The EU's Sustainable Development Strategy aims, together with the Lisbon Strategy for growth and jobs, at a more prosperous, cleaner and fairer Europe. Sustainable development is about achieving a competitive, socially just and environmentally friendly economy that delivers higher added value in all products and services, improved energy efficiency and a better 'life – work balance' with more eWork in local communities and better land-use planning.

Europe has to reinforce the emphasis on ICT supporting the revival of the ambitious Lisbon strategy with the ultimate aim of becoming the most dynamic and competitive knowledge based economy capable of sustainable economic growth with more and better jobs and greater social cohesion and respect for the environment.

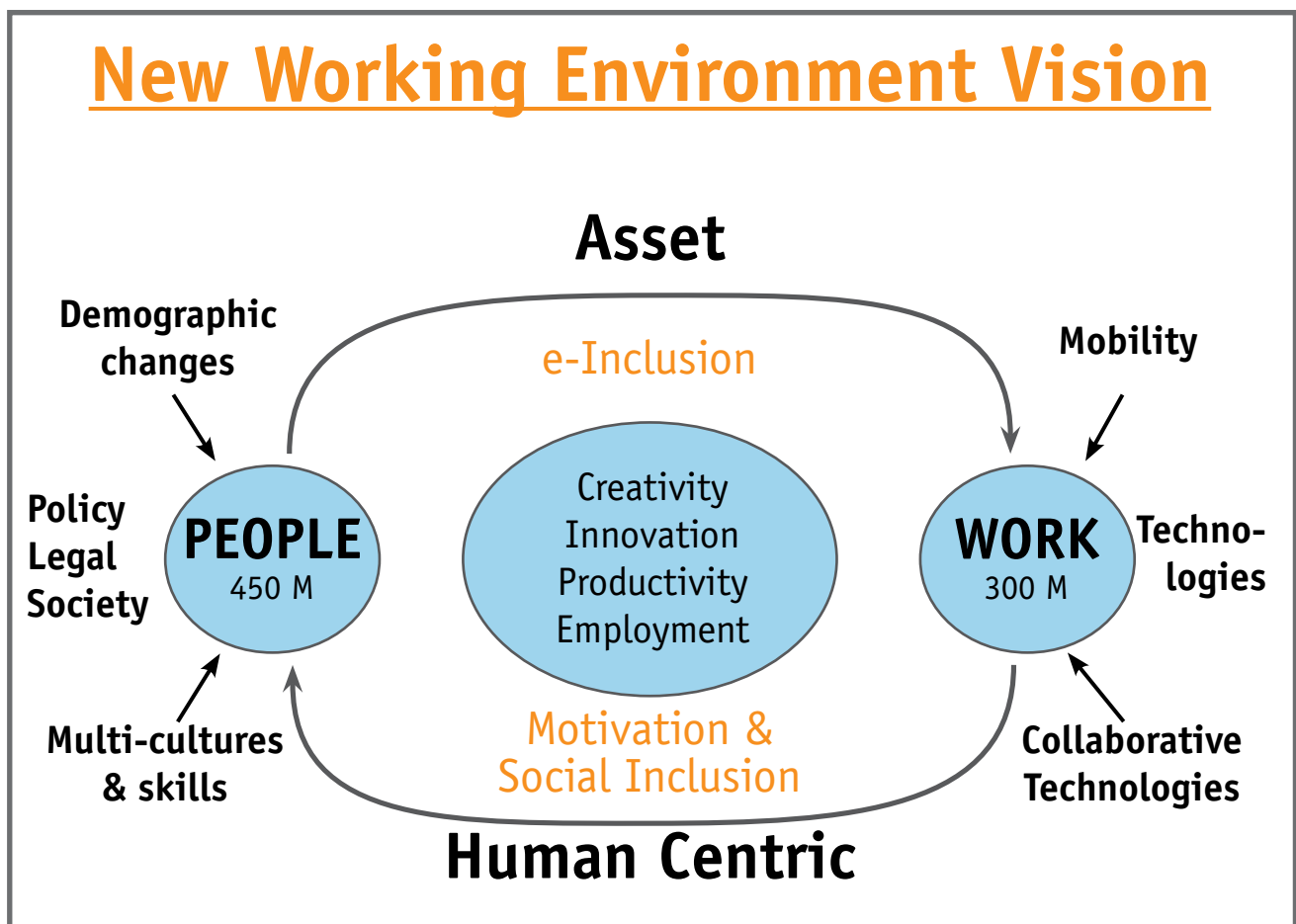
Preserving social cohesion, protecting the environment and increasing entrepreneurship and inclusion in work can be achieved by addressing the digital divide, increasing human capital and the quality of work and combating climate change. Decoupling economic growth from resource use and promoting frameworks for corporate social responsibility are other key contributors to achieving the Lisbon Strategy.

The **EU sustainable development strategy**, developed in June 2001 and currently under revision, is composed of two main parts. The first focuses on a number of key unsustainable trends that pose serious threats to our current and future well-being. It proposes headline objectives and a series of policy measures. The priorities are to:

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

The second, more ambitious part of the strategy revises the very way that policies are made. It calls for a new approach to policy-making to ensure that the EU's economic, social and environmental policies mutually reinforce each other.

Leading businesses in Europe realise now that the economical, environmental and societal impacts of their activities have to be integrated in a meaningful



way if they want to meet concerned consumers' demands for products and services that can live up to the highest sustainability standards.

The increasing concern of people and employees about the profound impact of business on society and its surrounding environment has resulted in research and development of several different guidelines and instruments on how to better manage, measure and reward corporate social performance.

Europe's ambitions and direction for Sustainability have established the Global standard. However, the ensuing economic burden has presented significant challenges to European industries.

Europe's consumers, both businesses and citizens, seek to achieve their own desired balance between costs and performances. Too often, the source of their preferred balance is outside Europe. The real challenge for Europe is not just to have the World's best environmental and social policies, but to demonstrate their short-term and micro-economic advantages. European policies, both at EU and Member States levels, need to foster and to stimulate more internal growth than other regions can achieve. Key focus areas for growth are shown in the core themes of the New Working Environment Vision:

4.1. Economic challenges

The ICT contribution to sustainable development requires a paradigm shift in how to organise labour and life style with more flexible approaches to mobility and greater acceptance of new concepts such as life-long learning. The effective use of new applications and tools also provides strong incentives for changes in citizens' and companies' behaviour towards more sustainable approaches.

4.1.1. Intangible knowledge economy

In the industrial economy dominated by mass production systems, the knowledge content of goods was low and the most important step in the production process was manufacturing. Firms relied on economies of scale for market performance i.e. the tangible aspects of production factors were the most important.

In the knowledge economy, the knowledge content of both goods and services is high and the pre-manufacturing phase is important for value creation. Therefore organisation of research and work is important. Knowledge management is driving their competitive standing. Value creation is ensuing from individuals and firms forming, and being part of, networks. These networks exist not only within firms but between firms and they operate in various contexts: production, distribution, marketing, research and develop-

ment and innovation of new user driven extended products and services.

An organisations' ability to organise and control a network is a key determinant of its competitiveness in which intangible assets only create value when they are bundled with other assets, such as work organisation, human capital, innovation and tangible assets. Its collective intangible assets, essentially made up of social capital, allow communication and exchange to take place; the main level where these can be measured is at the local level, because the set of interactions of individuals is defined at that level.

The possibility for individuals to use their creative assets is leading to more creative firms based on a human-centric approach. The individual employee's competences consist of applied information and skills as a capacity to act in certain ways, thus resulting in a potential to develop those further into team competences and contributing to the firms' competences and capabilities to develop further.

A social capital measurement system needs to be developed for understanding the new value creation processes in the knowledge based economy where encouragement and support for network creation are important policy measures for successful innovation and knowledge diffusion. In the current knowledge society, application, creation, recycling and sharing of knowledge are crucial to growth and development, and companies' intangible assets are seen as a hidden driver because they are not included in the traditional accounting model and are mostly ignored in the decision-making process for RTD investments.

The key challenge is now to create greater transparency in the process of identifying and reporting those intangible assets. Actions to support companies' competence developments and skills, and investment in intellectual capital reporting tools and best practice sharing, are important elements for becoming tomorrow's successful innovators.

4.1.2. 24 hours a day, 7 days a week

As the Euforia⁶ Knowledge Society Foresight Delphi survey shows in its 'working conditions' section, trends in the knowledge society are blurring the traditional separation of private and working life, and threatening the work-life balance of workers.

How will this balance evolve given the emergence of new mobile technologies? Will work become more dominant and pressured and will a 24-7 culture proliferate, or will we succeed in maintaining a balance between work and life?

⁶ EUFORIA is a foresight project of the European Foundation for the Improvement of Living and Working Conditions dedicated to provide improved information about the implications of the 'knowledge society', especially for working life and living conditions.

New work-related problems currently arising are long working time, inadequate possibilities to manage time, stress and ensuing chronic diseases. As new processes and structures for collaboration in new types of social networks emerge – e.g. professional communities – the question arises about the impacts on human needs and considerations. A strong relation exists with the longer-term evolution of human behaviour and identity, as well as the emerging new patterns of socialisation.

4.1.3. Productivity

Creativity and Innovation will grow if driven by commercial needs. Productivity, as a simple volumetric output measure, needs not to increase, but the per-capita Economic productivity must be raised by a combination of increased employment opportunity and entrepreneurial activity. The moral high-ground that Europe now enjoys in terms of environmental and social protection must be retained and translated into economic advantage at both micro and macro levels.

The Technologies that support and enable New Working Environments must be created, seen and measured in this context.

4.1.4. Work Organisation / Competitiveness

Globalisation and outsourcing strongly affects the global distribution of work and the reconstruction of value networks around the globe. Companies are exploring new ways for organising their daily work as well as their supply chains. This brings forward the issue of balancing between the need for decentralisation and self-organisation, and the requirement for minimum levels of planning and co-ordination. It can be assumed that in combining the power of both, more efficient, creative and productive organisational structures will arise.

4.2. Social challenges

New Working Environments cannot be fully addressed without covering related social aspects which may have an impact on the European Social Model, especially in the employment field. Considerable attention is being given to the challenges of effectively leveraging the competencies of people working together.

To boost employment and productivity, Europe has to improve the adaptability of workers and at the same time attract more highly qualified people to the labour market, by investing more effectively in human capital. Experienced workers should also be valued

and their experience and knowledge exploited and blended into the next generations' drive towards innovation and with its fresh enthusiasm in the best way possible; age should not be a discriminatory factor, particularly in view of policies which tend to increase the retirement age. Take up of e-Work can also help to solve organisational problems in this sense.

4.2.1. Inclusion

Demographic change

Europe's patterns of demographic change and their impact on pension systems oblige it to pay particular attention to older citizens, including elderly workers. There is pressure on these to continue working, and mobile and collaborative technologies have a role to play in this. Active ageing is now recognized as being central to enterprise development. However difficulties encountered by some older users of technology mean that attention must be paid to job design and to the usability of computer technology.

European enlargement

In a potentially more unified Europe with one common market for labour and competencies, national and cultural differences will no longer hinder flexible and dynamic forms of work organisation. In contrast, there is a need for work environments to exploit the cultural and national characteristics better for the benefit of individual workers as well as regions. However, many new Member States are not yet aligned with the traditional EU-15 and face tough social cohesion challenges, in areas like income distribution, labour market inclusion and educational opportunities, and there is a risk that major lags and gaps could remain for a long time.

Rural inclusion in the Information Society

ICT research and development results can have a wide impact on the development of rural and remote areas in Europe. The essence is to make those areas more attractive, less isolated and more productive by using modern knowledge society technologies in an innovative way. This calls for *systemic innovation*, which means *simultaneous actions from policy, technology and societal innovation perspective*.

Rural areas cover 80% of the European territory and 20% of the population. Experience shows that the mobilisation of the rural constituency is not easy, and more specific user-driven and customised approaches for rural areas are required. The objective would be to involve that constituency from the beginning in ICT R&D efforts to support fast prototyping of novel interaction concepts, and to emulate rural environments in the context of Living Laboratories.

Traditional industries such as agro-food, forestry, and fisheries are often seen as the rural industries, but the knowledge economy can be central to many more sectors which create growth and well-being in rural areas. The FP5 project RURAL WINS classified rural areas in several categories, including those areas close to urban ones. Besides this project, DG INFSO funded a more sectorial roadmap project, AFORO.

The leading principle is inclusion in the wide sense: to enable people in remote and rural Europe to fully participate in the knowledge society as citizens and as professionals. Therefore there is a need to look not only at the people permanently living in rural and remote areas, but also at that population which spends a part of their time or are from time to time in those regions. This covers citizens spending time in their secondary homes, and tourists and professionals travelling through rural and remote areas. Professional examples are the increased inspection work required by the Common Agricultural Policy and the food chain safety management.

4.2.2. Relocation versus delocalisation

Industries will always move production or service centres to locations where it is economically advantageous to site them. The equation is complex, with many factors to consider; and New Working Environments can dramatically alter the relevance of certain factors. For example, proximity to customers and consumers was once only a geographic measure, but now it includes dimensions such as cultural empathy, language and dialect; purchasing decisions are no longer simply based on the availability of a product but are based on the choice between competing products with different features and performances.

The ongoing dramatic globalisation process is transforming the economic structures of the developed and developing parts of the world; witness India as an emerging knowledge service provider in sharp competition with EU in ICT software industries, and China consolidating its global position in manufacturing by triggering more outsourcing of key manufacturing, including RTD, outside Europe.

Europe's response has to embrace an open, systemic innovation-based economy, which recognises these forces and pro-actively rides them to generate the economic and employment benefits to be obtained by staying ahead in the race.

Relocation can play an important role in promoting the competitiveness of the EU as some outsourcing firms experience productivity gains; indeed it allows dynamic EU firms to hold on to the higher value added stages of the production chain.

Furthermore the industrial restructuring triggered by relocation may contribute to a better allocation of resources within the EU economy. In this way relocation could facilitate technology transfers to the New

Member States, increasing at the same time business opportunities for EU firms benefiting from the wealthier growth of these countries.

An appropriate strategy needs to be defined to face the challenges raised by relocation. It should develop new areas of comparative advantage for the EU economy by developing the knowledge-based economy and by improving the functioning of EU labour markets in relation to related requirements, and better inform policy makers about this phenomenon, not only focusing on the perceived risk but also on the competitive advantages to be gained by developing and using ICT better to reap those benefits.

4.2.3. Human Capital and Mobility

During FP5, the INFSO unit 'Human Capital and Mobility within IST Research' set up over fifty Marie Curie Industry Host Fellowship contracts and eight Training Accompanying Measures, through which nearly two hundred researchers will have received early stage training, mainly in industry. Under FP6 the 'New Working Environments' unit is clearly the best-fit home for the human capital work (researchers are a particular sort of worker whose working environments need specific tailoring, and who can make peculiar demands on, and use of, new technologies) and it provided the resources to support director F as member of the related Groupe Interservices Recherche GIR-HRM.

The Commission has been promoting careers in research, including removal of obstacles to mobility, through a white paper in 2003 and on 11th March 2005, through 'The European Charter for Researchers and the Code of Conduct for their Recruitment' that '*recognise the value of geographical, intersectoral, inter- and trans-disciplinary and virtual mobility as well as mobility between the public and private sectors as an important means of enhancing scientific knowledge and professional development at any stage of a researcher's career.*' The DG INFSO F4 unit has contributed to both of these documents, emphasizing the need for employers of researchers to provide up-to-date ICT infrastructures, including those necessary for remote collaboration.

4.2.4. Free time versus working time

Since the Industrial Revolution, working time was well defined, with strict schedules applying to every worker.

The Information Age brought two new elements in the organisation of work scheduling:

- Flexitime allows people to choose the time they are at the office on a daily basis,
- Telework allows remote workers to work from home, with the possibility of switching at anytime between work and non work activities.

New tools providing mobility and remote collaboration have drastically increased the possibility for anyone to connect and be reached anytime, anywhere. Following on from the possibility of non-work activities within 'normal' working hours, work can now intrude into private life; the previous 'separate workday and life time' gives way to 'blurred work and life'.

While new ways of organising work have the potential to empower people to make individual arrangements regarding work and private life, the system can also lead to difficulties in maintaining a good work-life balance. The concept of a given person being 'at work' or 'at home' no longer applies as the type of activity may change at anytime according to interruptions.

Benefits for work should not be to the detriment of private life. The Network4Value study (Sustainable Value Creation in Networked Working Environments) has addressed this issue.

4.2.5. Collaboration with robots and artefacts

'Long accepted by industry to improve factory quality, performance and efficiency, robotics has for at least three decades been a key technology in engineering industries for increasing industrial productivity and for competitive manufacturing. Robotics is now at a decision point where its scope is dramatically expanding. 21st century robot machines will be used in all areas of modern life in the form of surgical devices, machines to explore space and conduct hazardous tasks on earth, robot assistants in the home or work place and the most exciting toys and entertainment devices child-kind has ever seen!

The major challenge for the 21st century is to develop robotic systems that can sense and interact with the human world in useful ways. This will result in robot technologies being embedded in literally thousands of future products, each one having huge commercial potential.

Such future robot systems will affect a broad range of social and economic activities. They will transform everyday life as well as industrial processes [...]. R&D initiatives in this field will strongly contribute to the creation of new opportunities towards European employment and growth...'⁷

The Japanese Humanoid Robotics Group (HRG) has been investigating fundamental technologies of humanoid robotics including the design, dynamics simulation, motion control and motion planning of humanoid robots.

The EU must also address the development of robots, including the human – robot collaboration issues.

Trivial and repetitive work tasks can be replaced and performed by intelligent robots supporting the individual in his various roles, whether situated in the home, leisure or work context. More research is needed to better understand and transform complex user requirements into user friendly products and services.

4.2.6. Collaboration with Artificial Intelligences

In the Knowledge Society there will be a need to manage significant volumes of data. In the same way as mechanical robots can take over trivial and repetitive work tasks, information robots will be taking over more data processing tasks.

We are already comfortable with machines that store and allow us to retrieve data, and we are becoming increasingly comfortable with search engines or email services that filter or prioritise the presentation of data. Interactive Voice Response (IVR) is commonplace in many call centres, both for inbound and outbound call handling. Network Management software invisibly re-routes our data to avoid congested pathways or failed nodes; configuration management tools identify software components that could benefit from updates. In business, automated dealing systems buy and sell currencies, stocks and commodities.

Artificial Intelligence has a significant role in the future of the Knowledge Society. If, for simplicity, we regard the architecture as comprising a 'network' and a set of 'nodes', the following examples illustrate how software robots might evolve.

- At the 'network' level, autonomous or semi-autonomous software artefacts will detect and prevent 'malware' from affecting both the network and connected nodes and may also trace and isolate a source node. Whilst this concept is not novel, the way it is implemented will improve - for example, anti-virus software might become part of network traffic engineering services with enhanced heuristic virus recognition facilities linked to bandwidth allocation services.
- At the 'node' level, human-computer interaction will move from 'command and response' to 'intelligent dialogue' with the node understanding and using much more contextual information to filter, consolidate and present not raw data but useful derived or inferred information, knowledge or wisdom.

More research is needed to better understand and transform complex user requirements into user friendly products and services.

4.3. Environmental challenges

By taking a proactive approach the EU can turn the need for environmental protection and social cohe-

⁷ 'Building EUROP, the European Robotics Platform: The High Level View' July 2005.

sion into opportunities for innovation, growth and jobs.

There are significant opportunities⁸ for contributing to fighting Climate Change through ICTs, which can rationalise energy management in housing and offices, make passenger and freight transport more efficient, and enable a radical product-to-service shift across the economy.

Further research is needed for creating a better understanding on how to better apply ICT in areas such as:

- E-materialisation: the shift from products to services, dematerialisation and rematerialisation,
- Intelligent transport systems on increasing transport performance,
- Sustainable mobility,
- ICT equipments electricity consumption,
- ICT-supported facilities for the management and distribution,
- ICT-supported systems for recovery and recycling of waste,
- ICT supported new working environments.

On the other hand, the rapid technological evolution and the growing demand for new enhanced services is reducing the life cycle of much ICT equipment, thus generating the risk of dramatically increasing the volume of e-waste: further research will therefore be needed to optimize the eco-design of such equipment and encourage its reuse whenever possible.

The potential for a stronger economic impact could be reinforced if it were connected more closely to socially responsible corporate behaviour which has to be seen as a major continuous learning process for organisations and stakeholders. An approach would be to trigger more take up and best practices sharing, to enhance more knowledge about CSR, and to encourage more dialogue between companies and the relevant stakeholders.

⁸ See the European Commission Green Paper on 'A European Strategy for Sustainable, Competitive and Secure Energy' released on March 8, 2006.

5. Mechanisms

This section describes the mechanisms and commercial Instruments that are relevant in the short term.

5.1. Financing R&D

Financial support for R&D is crucial. By its very nature, research is a journey from a well-defined starting point into the unknown. Even if the journey of discovery does not find the intended end point, this does not mean that the journey was fruitless. However, in a corporate world where many businesses are avoiding risk and are seeking ever shorter cycles to gain payback from spending on investments, longer term research without the guarantee of exploitable results can be difficult to justify. The Business Case for research needs to be robust; and the risk needs to be offset. Industry must be encouraged to participate in R&D and actively supported when it does so. This is the role of the National and International public sector in funding for innovation.

Europe is part of the global R&D effort and it must recognise the need to act in a global market. There is a need to cooperate globally as well as to compete globally. The commercial value of R&D results needs to be understood and if necessary protected.

The report by the Independent Expert Group on R&D and Innovation⁹ stresses the need for urgent action and the role of the public sector: in establishing a pervasive culture in which innovation is celebrated; in providing financial support for industry and science to conduct innovation; and in formalising a regime for protecting intellectual property.

The New Working Environment strategy in FP7 will be to support R&D as in previous framework programmes, but specific attention will be paid to:

- dissemination of celebratory publicity (not results) to a wider audience - potentially seeking active engagement with all stakeholders from citizens through to senior political figures,
- commercial management of intellectual property generated by R&D.

5.2. Living Labs

The AMI@Work communities have facilitated the inclusion in the European policy initiative i2010 – A European Information Society for growth and employment – of a European network of Living Labs, as

described in the Indicative List of Actions for the i2010 Priority 2, Innovation and Investment in Research: ‘Developing a European network of Living Labs in the concept of eWork, providing services of large deployment to the industry, bringing technology test-beds into real-life user environments.’ (See www.europa.eu.int/i2010: i2010 Extended Impact Assessment, p. 88.)

A European network of Living Labs can create a win-win-win Citizens-Private-Public partnership. The Living Lab is where the user meets the product and service provider in a co-designer partnership. This co-creation sets users, citizens, in the centre of new innovation and societal experimentation, to create new systems, services, products, business models and societal models.

In enterprises, a concurrent engineering approach has enabled functions to collaborate, allowing faster time-to-market or time-to-fulfilment and better ‘hit rates’ for reaching successful products and services. Virtually extended enterprises have widened the concept to concurrent enterprising. Living Labs now have the potential to co-create ‘concurrent enterprising on a societal scale’, with faster time-to-fulfilment and better ‘innovation hit rates’ to be enjoyed by citizens, companies and public sector alike.

5.3. European Technology Platform

The European Commission is supporting several Collaborative Working Environments (CWE) related projects to promote early deployment of CWE technology in Europe, in support of a number of services in different sectors. The **CLOCK** project, selected in the IST Call 5, aims at establishing a strong co-ordination activity to ensure effective communication between CWE projects and external stakeholders, and to carry out various other tasks necessary to pave the way for the creation of a **European Technological Platform** dedicated to Collaborative Working Environments.

5.4. Standardisation

Collaborative working environments projects can provide contributions to official and to de facto standardisation, by gathering and synthesizing user requirements and channelling these to the relevant standardisation organisations.

A minimum set of standards is required in order to ensure interoperability of collaborative environments,

⁹ ‘Creating an Innovative Europe’ January 2006

which is a prerequisite to effective remote multi-lateral collaboration.

5.5. Innovation Campus

An Innovation Campus is a physical or virtual environment for bottom-up technology-led innovation. Contrast this with Industrial Universities (q.v.) which seek top-down business-driven innovation. An Innovation Campus is more rigorously commercially staffed and managed than ‘fora’ or standards committees (where participants are largely volunteers) drawing together related or potentially related multi-disciplinary teams. The Campus offers permanent facilities with long term R&D goals - blending the remit of the Future and Emerging Technology with tactical research, with the results being tested in either demonstrations or proofs-of-concept under the auspices of the Innovation Campus or in Living Labs. A key feature is the ability to cross-fertilise ideas and developments from a wider range of themes than is feasible in even the largest Integrated Project.

In FP7 the New Working Environment strategy will be to promote the establishment of such faculties for the purposes of researching the underlying technologies needed for pervasive computing and ad hoc networks and to create a primarily public domain of knowledge.

5.6. Industrial Universities

Driven by industrial needs, these physical or virtual faculties study technologies and sciences relevant to a specific industry (e.g. automotive; aeronautical; agricultural ...) in order to solve real-world problems. Faculties that attract researchers from multiple commercial organisations and academia to conduct pre-competitive work, can be supported at least in part from public funds, but corporations are naturally at liberty to establish their own corporate University with the goals of both education and innovation. Privately funded faculties can contribute to the public knowledge pool in many ways, for example: conferences and publications, participation in Networks of Excellence and co-operation with Innovation campuses. An Industrial University will operate in a very similar way to an Innovation Campus but with these two differences: the focus is from the business application and the paradigm for transferring results to the public domain is heavily directed towards commercial rather than scientific exploitation.

In FP7 the New Working Environment strategy will be to regard such faculties as both a source of inspiration for real world problems to be used as test cases for research and also as a customer for

the intellectual property generated by Innovation Campuses. As with any customer-supplier relationship, mutual understanding leads to better and more effective product.

5.7. Commercialisation Support

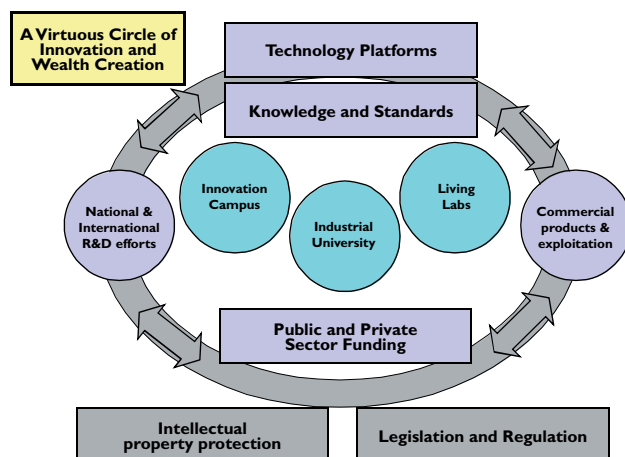
Commercialisation support is different from establishing a regime for protecting the commercial interests in intellectual property. Commercialisation Support is needed to take the products of research and create a saleable product. Even in the Knowledge Economy it is vital to ensure that tangible products are brought to market. The Competitiveness and Innovation Programme will support early stages of preparing a product for market.

The strategy that the New Working Environments unit will adopt is to ensure that there is a clear and supportable exploitation path for the output of the R&D activities it commissions.

5.8. A Coherent Strategy

Each of the individual mechanisms will yield value even if nothing else were to be done. However, by taking a coherent view of all the activities it will be possible to generate increased value from a ‘virtuous circle’ of creation and exploitation of knowledge. The related challenge is to bring together many stakeholders and budget holders to achieve this strategic ambition.

In addition to its own resources and the efforts of the Advisory Group, the New Working Environments unit envisages a number of additional support actions and studies to underpin its operation.



6. Research Actions

In 2020, European Organisations, Companies as well as the Society will be endowed with the capability to collaborate over time and space, within and between organisations and communities. This capability will be essential to achieve flexibility and to be innovative by making the best use of the knowledge and competences available. Furthermore *ICT solutions will enable productivity and innovation through empowered and motivated people by facilitating new forms of work in manufacturing and knowledge intensive businesses.*

In 2020, Collaborative Environments will offer a seamless ubiquitous hardware and software infrastructure composed of resources providing a new blend of activity-oriented, context-aware flexible software services supporting patterns of natural human interactions, human to machine interactions, and to collaborative gadgets and robotics, which all interact in a dynamic and pro-active fashion.

ICT research is needed for seamlessly integrated hybrid (virtual and physical) goal-oriented, pro-active and culturally aware collaborative environments to enable productivity and innovation through empowered and motivated members of effective teams and communities, of practice and of interest, across domains and organisations boundaries.

Research elements focus on:

1. Developing an 'upperware' platform supporting a high level reference model for Collaborative Working offering a seamless ubiquitous infrastructure composed

of resources that will provide activity-oriented, context-aware flexible pervasive software collaboration services supporting patterns of natural human interactions, also to collaborative gadgets and robotics.

2. Integrating ICT technologies into advanced tools for collaborative working designed for group usability and ensuring a better integration of workers and more efficient, creative and sustainable collaborative working practices in service industries and more traditional sectors. It will apply social computing concepts so as to become people and knowledge centric, not data-focussed.
3. Development of comprehensive context based, collaboration aware, pro-active and anticipative ICT solutions to support unstructured and multi-threaded collaboration activities and to reduce interruptions. These ICT solutions will be validated in real living laboratories following the Experience and Application research approach with an early user involvement in the development of the ICT solutions for collaborative working.

In 2020 digital factory manufacturing solutions will enable flexible production supporting customisation, and will integrate product development, manufacturing, sales and maintenance in single integrated collaboration environments across enterprise boundaries. Through virtual engineering it will be possible to reduce the number of full scale tests of products to one test based on the virtual prototype.

7. Strategic research and innovation agenda section

Global division of work will be a major development, but work-life balance issues could hinder its full development and undermine current social models. Mobile workspaces can support the globalisation of supply chains and work environments, but they require new forms of leadership, coordination and management. The vision of e-professionals collaborating in self-organising communities is among the promising models for the future; it will require new business models, work regulations and IPR arrangements.

The key strategic challenge is to realise the potential inherent in the various innovations in the area of mobile and collaborative working, to the benefit of business, society and people. To that end a number of major directions must be pursued. These directions include:

- The creation of better work regulations, IPR, policies, processes, business models and applications for flexible working anytime and anywhere,
- The development of standards and infrastructure allowing for interoperable and plug-and-play mobile and collaborative work environments,
- To develop a better ability for contextualisation of teamwork environments, and for mobile team workspaces, to make collaborative workspaces responsive to external changes,
- To apply technologies to activities now clearly gaining in importance (e.g. multi-disciplinary and dispersed teams handling an emergency situation),
- To realize a paradigm shift from application oriented to activity oriented collaborative systems, supporting co-operation and interaction in terms of collaborative activities instead of technical functions and applications.

In order to implement the strategic agenda for innovation and to realize the potential that is inherent in the innovations addressed, the following actions are recommended:

- To enhance current key domains of innovative working environments. Exploit and transfer existing knowledge on technology acceptance and implementation from current innovation domains to so far untouched work settings.
- To stimulate the collaboration between various research groups and companies worldwide and communities such as AMI@Work operating across the 25 EU Member States for the IST research programme dedicated to eWork, in order to cope with the new realities of global working.
- To set up a network of Living Labs in the area of innovative work environments, in order to explore and demonstrate the potential of the various mobile and collaborative working scenarios, to support the collaboration between users and developers, to create and disseminate good practices, and to understand the human and social impacts.
- To strengthen the focus on multi-disciplinarity in mobile and collaborative workspace innovation, bringing together technical, social, organisational, behavioural and business disciplines.
- To bring together the separated discourses related to working environments, hosted by different government departments and the different European Commission Directorates-General.
- To include the issues of New Working Environments in the platform for action of the European Sustainable Development Strategy.

It will be interesting to see how these research and innovation challenges can be linked through the various instruments available, like the Framework Programme for Research and policy actions.

This report shows the pathways to the future of a more competitive industrial Europe.

European Commission

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A Strategy for the Next Decade

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