INTERNATIONAL INNOVATION

Key note paper

ON THE WAY TOWARDS A SUSTAINABLE KNOWLEDGE SOCIETY - THE EUROPEAN APPROACH

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ABSTRACT

The European Union member states have agreed a common strategy for sustainable development as an integral part of the strategy for transition to a knowledge economy. The European Commission Framework Programmes form the main research platform supporting the process reaching these objectives.

The Information Society Technologies (IST) Programme launched a call for strategic roadmaps for applied research to direct European progress towards sustainable knowledge society. Main findings and innovative components from four such IST Roadmap projects are presented from the city (Towards Intelligent Sustainable Cities), construction (Strategic Roadmap towards Knowledge-Driven Sustainable Construction), collaborative work (Design for Collaborative Virtual Organizations in Dynamic Business Ecosystems) and corporate (New Partnerships for Sustainable Development in the Knowledge Economy) perspective.

Then, two examples of innovative communities are provided. A self-organising European research and innovation community is presented as the first example. The second example describes a living laboratory concept where public and private investments meet in a city environment supporting the creation of sustainable businesses and improved well being for mobile individuals.

Finally, it is discussed how systemic innovation can be encouraged in an ambient intelligent environment to support the transition towards a sustainable knowledge society.

Keywords : **Ambient Intelligence, Knowledge Society, Systemic Innovation**

1. INTRODUCTION

This paper discusses international innovation in three ways. Firstly, examples of selected recent Information Society Technology (IST) research roadmaps are given to describe how different sustainable knowledge society landing points can be reached. Secondly, two communities are presented as innovation incubators, or catalysts for systemic innovation. Thirdly, the concept of cities as living laboratories is introduced as a stimulating platform for innovation processes. The built environment, especially cities are presented as a natural meeting point of public and private investments supporting sustainable business opportunities.

The given examples focus on experiences within European collaboration, based on a rich diversity and strong cultural heritage of individual countries and regions with different history, priorities and constraints. The presented European systemic innovation approach is placed in a global context.

The European Union policies (EC 2002) define the priorities

- to become the most competitive and dynamic knowledge based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion, by 2010
- to perform transition to a knowledge economy in a global networked society
- with sustainable development at the heart of integrated policies for growth, employment, social cohesion and the environment.

One key challenge is to understand better the systemic relationships between different dimensions of sustainable development; the dynamics of a service-oriented networked knowledge society and its relationship to sustainable development.

Today research and development is carried out in an increasingly complex environment. The interdependencies between goods and services increase and new concepts of product ownership appear. Global competitiveness needs innovative capability. Innovation is regarded as a key driver of competitiveness. This can be achieved through a comprehensive programme of integrated research activities (Liikanen 2004). The European Commission (EC) Framework Programmes form an important technology development platform to obtain a critical mass that enables reaching these goals.

Innovation dynamics and innovation processes have changed from sequential to concurrent. All kinds of innovations interact in a multidisciplinary innovation space. This involves collaboration across the traditional boundaries. Bringing the technology and application innovations together into systemic innovation supports the transition to new paradigms.

Cities and the built environment should provide a healthy and stimulating living, working and innovation environment for present and coming generations. Therefore, Facilities and infrastructure must be planned, designed, constructed, operated, maintained and refurbished to perform several decades, even centuries, to meet the needs of their changing users in varying circumstances. Living in cities and occupying buildings has health impacts, it creates the biggest environmental burdens and it has important social consequences. It is economically important to manage the asset of constructed facilities and infrastructure.

2. INFORMATION SOCIETY RESEARCH ROADMAPS

The EC 5th Framework Programme launched an IST Call in spring 2002 to shape roadmaps paving the way towards different landing points of the knowledge society. The roadmaps were commissioned to direct future research in the 6th and 7th EC Framework Programmes. Almost 30 such one year research roadmap projects were funded in summer 2002 covering all industrial sectors. Key findings from some of them are presented here as international innovation supporting examples. It must be noted that strategic research roadmaps differ from technology (Sipilä 2002), product or industry roadmaps.

A look at the international innovation playground is shown in the following figure where a sample of 20 countries is positioned into four quarters of a sustainable knowledge society matrix according to their country indicator values. The matrix axes correspond to Environmental Sustainability (ESI 2002) and Information Society (ISI 2003) indicator systems. In some countries the acceptability of ICTs, understanding the environmental consequences of different decisions, access to information or participation in decision making is different than in other countries. National or local development strategies vary as well. The future steps in the countries, shown low in this illustration, do not need to follow the same path as that of the current forerunners - some staging posts may be bypassed and other counties overtaken, even very quickly. In Europe, the potential is significant especially within the newly associated states.

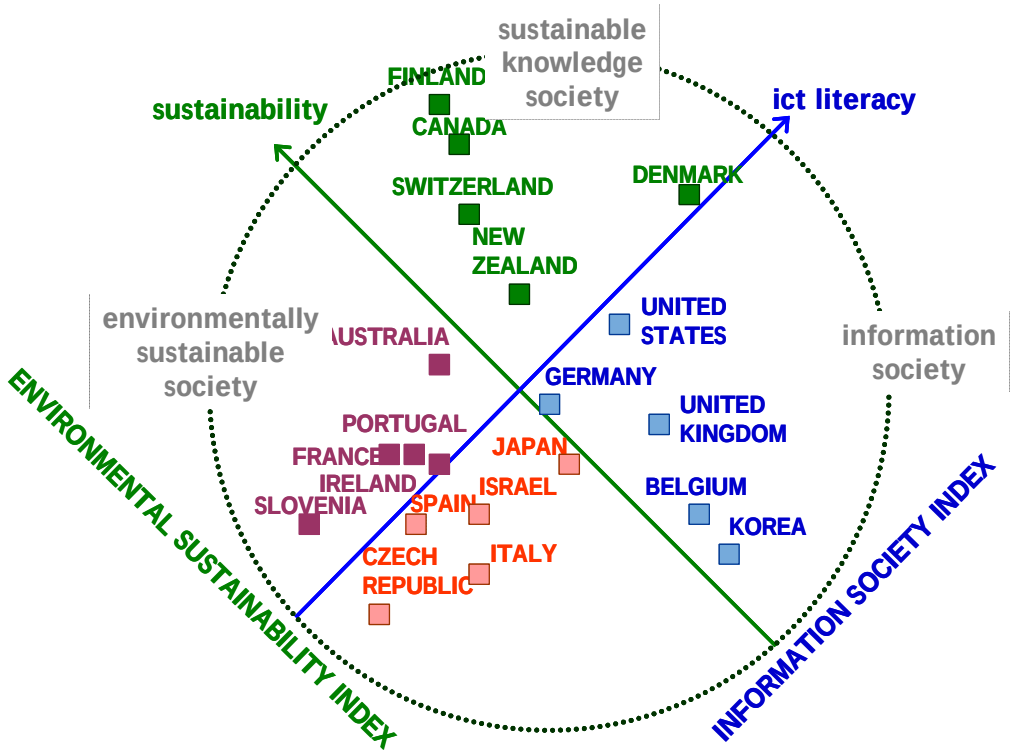

Figure 1. Environmental Sustainability and Information Society country indexes.

The previous figure is not sufficient for drawing conclusions about the progress of different countries. That would require a detailed analysis studying individual

indicators and their interrelationships instead of comparing aggregated country values as shown here.

ESI is a result of collaboration among the World Economic Forum's Global Leaders for Tomorrow Environment Task Force and the Universities of Yale and Columbia. It is a system measuring overall progress towards environmental sustainability, developed for 142 countries. The scores are based upon a set of 20 core indicators, each of which combines two to eight variables for a total of 68 underlying variables.

The other indicator system ISI was first launched in 1996 as the first global measurement of information wealth. Along the years new benchmarking variables have been added to reflect the technological progress. Broadband households, mobile Internet users and wireless telephone subscribers are examples of some newer variables, whereas some traditional indicators, like number of PCs or education level, still remain integral to the index.

2.1 SUSTAINABLE URBAN DEVELOPMENT AND INTELLIGENT CITIES

Intelcity roadmap faces the challenge of realising sustainable knowledge society visions in intelligent city environments aspiring in network of different communities from Sustainable Urban Development and Information and Communication Technologies (Curwell et al. 2003). Five alternative future visions and scenarios outline features of eDemocratic City, Virtual City, Cultural City, Environmental city and Post Catastrophe City. These city scenarios, intended as plausible alternative futures, both desirable and undesirable, were analysed to test the robustness of underlying questions or policy options.

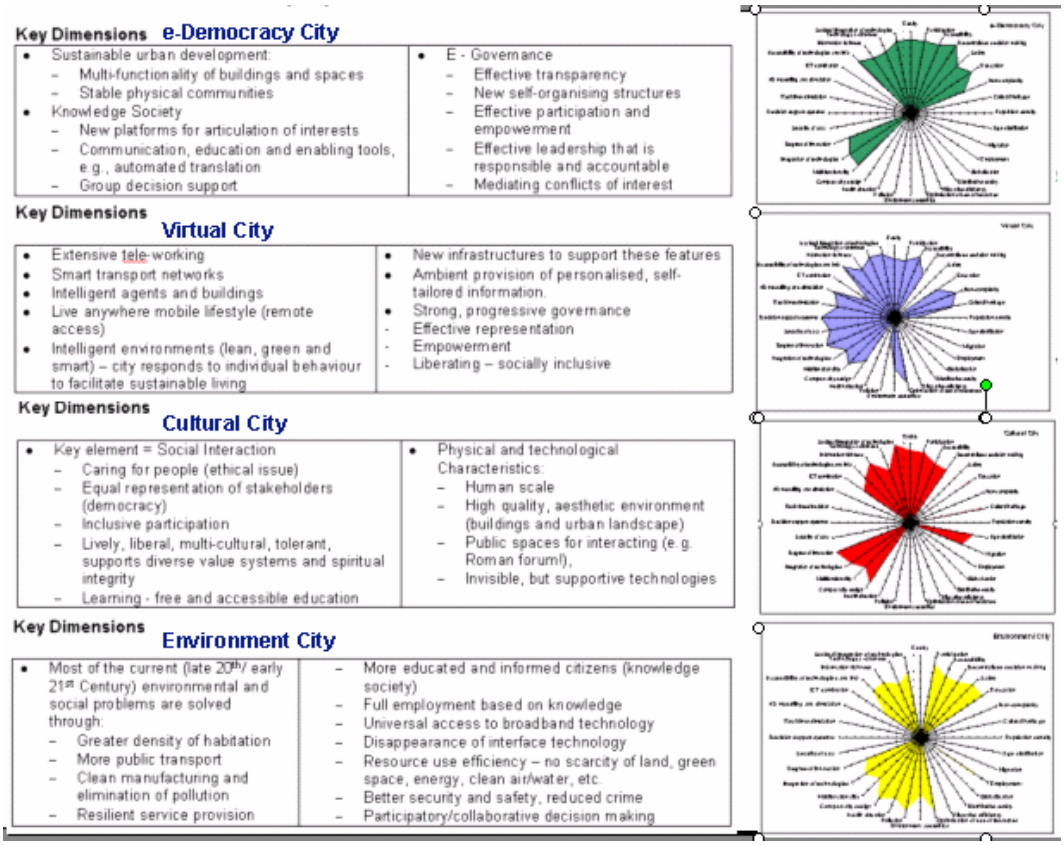

Figure 2. Intelligent sustainable city scenarios.

The stakeholder meetings in different European regions showed distinct priorities, boundary conditions and development paths in different countries. Varying scenarios were also combined in some city visions to have distinct development taking place simultaneously in various quarters in the same city. (Huovila et al. 2002) Finally, research priorities integrating Sustainable Urban Development and the ICTs were listed in 3 years (2006), 5 years (2008) and 10 years time (2013) to accomplish the Intelcity Roadmap.

2.2 ICT IN CONSTRUCTION

The Strategic Roadmap towards Knowledge-Driven Sustainable Construction (Hannus et al. 2003) is based on the vision that construction sector is driven by total product life performance and supported by knowledge-intensive and model based ICT enabling holistic support and decision making throughout the various business processes and the whole product life cycle by all stakeholders. The Roadcon roadmap aims at total life cycle support consisting of different dimensions, such as adaptive and self-configuring systems, ambient access, collaboration support for distributed virtual teams, digital site, flexible interoperability, knowledge sharing, model based ICT, smart buildings and embedded systems, and performance driven process.

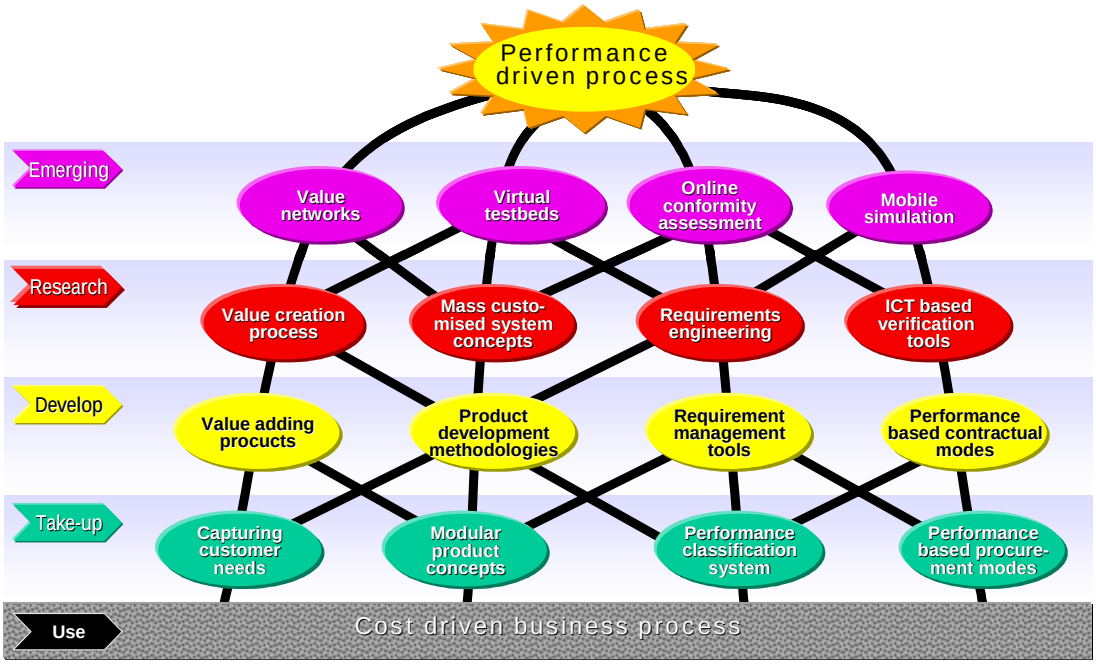

Figure 3. ICT supports the transition towards performance driven processes.

The current situation in construction is closer to the prescriptive-based than to the performance-based practice (Lee et al. 2003). Customers, however, are increasingly aware of whole life costs, perceived value and intangible assets. The vision is that performance driven process ensures conformity to customers' needs and emphasises on end user satisfaction and value. ICT solutions support for capturing and fulfilling predefined performance criteria. As the service component becomes an essential part of core business, the traditional value hierarchy in the sector will be transformed. Choices of material and the functionality of structures will be based on whole life considerations. Users choose service packages for housing, e.g.

increasing the flexibility. It is essential to understand customer needs and integrate them to production processes

2.3 VIRTUAL ORGANISATIONS AND BREEDING ENVIRONMENTS

The vision statement of Design for Collaborative Virtual Organizations in Dynamic Business Ecosystems (Camarinha-Matos et al. 2003) is that in 2015 most enterprises will be part of some sustainable collaboration networks that will act as breeding environments for the formation of dynamic virtual organizations in response to fast changing market conditions. As a result, a strong and cohesive social fabric is built in response to turbulence and uncertainty.

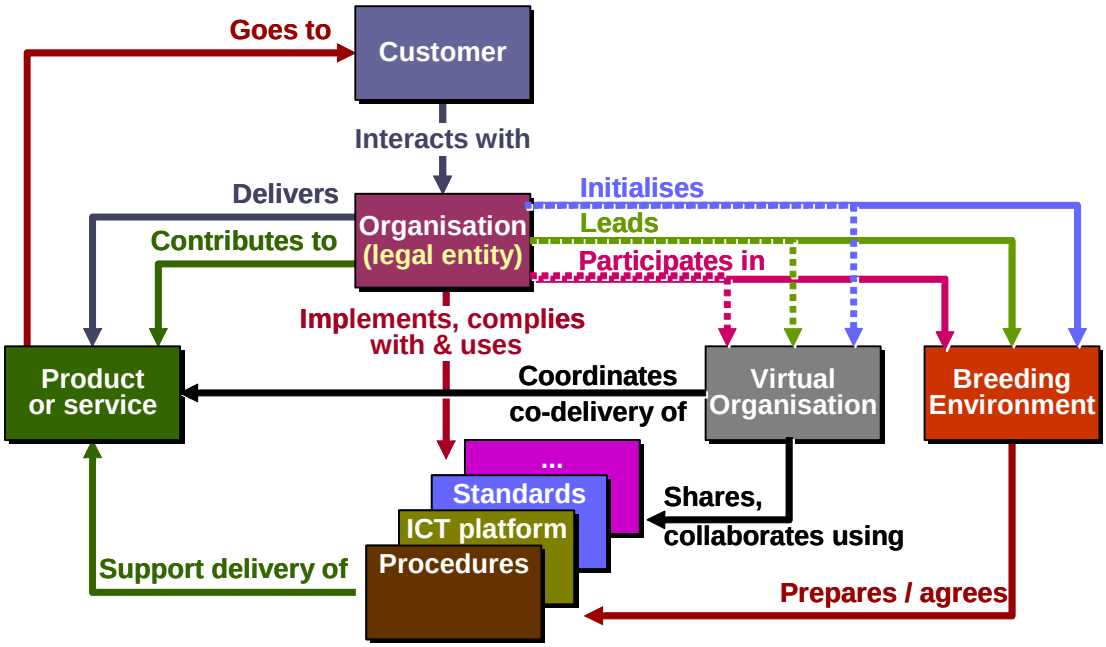

Figure 4. Breeding Environments and Virtual Organisations.

The key features of VOmap roadmap can be summarised as well founded collaboration models, management systems for breeding environments replicable to a large variety of sectors, generic and invisible infrastructure and re-utilizable service toolbox based on interoperability standardization, extensive use of pervasive computing, virtual organization management principles adapted to emerging behaviour in complex networks, accepted mechanisms to handle innovation and new value systems, social responsibility including life maintenance based on a suitable ethical code and comprehensive international legal framework for virtual organizations. Distributed innovation management will become a decisive task for virtual organisations. Efficient innovation processes are a clear competitive advantage for those networks (Eschenbächer et al. 2004).

2.4 CORPORATE RESPONSIBILITY AND STAKEHOLDER REPORTING

New Partnerships for Sustainable Development in the Knowledge Economy (Allee et al. 2003) Roadmap is about measuring progress towards a sustainable and inclusive society. It provides a systemic view of developing and integrating new measures for the assessment of qualitative aspects of economic, environmental, social and cultural dimensions. It emphasizes that the reporting systems developed and used by

corporations do not really correlate to the needs of cities or citizens. More transparency is requested by different stakeholders. Triple bottom line reporting considering also both economic and social and environmental aspects of companies' outcome may affect in decision making of individuals, organisations and governments.

The main statement in Neskey Roadmap is to increase the transparency of companies and cities in a compatible way. That requires enabling technologies that support social change and collaborative process technologies with an open source ICT platform for gathering, managing and disseminating data. The 360 degrees accountability of business and cities can be built on intangible indicators and valuation, sustainability reporting and measurement, and integration of methodologies.

From the built environment point of view (Huovila et al. 2003) in the short term it is possible to make a direct contribution to sustainability through the better management of existing buildings, using modern energy management technologies and services. In the medium term, it is possible to make a direct contribution to sustainability by investing in the improvement of the built environment on the basis of a lifecycle or total-cost-of-operation analysis. This should explicitly link changes to the built environment with work and work-force productivity due to flexible buildings and better working conditions. In the long term, it is possible to contribute to sustainable development by linking patterns in the evolution of telework, homework, mobile work with changing demographics of cities and the planning of future urban environments.

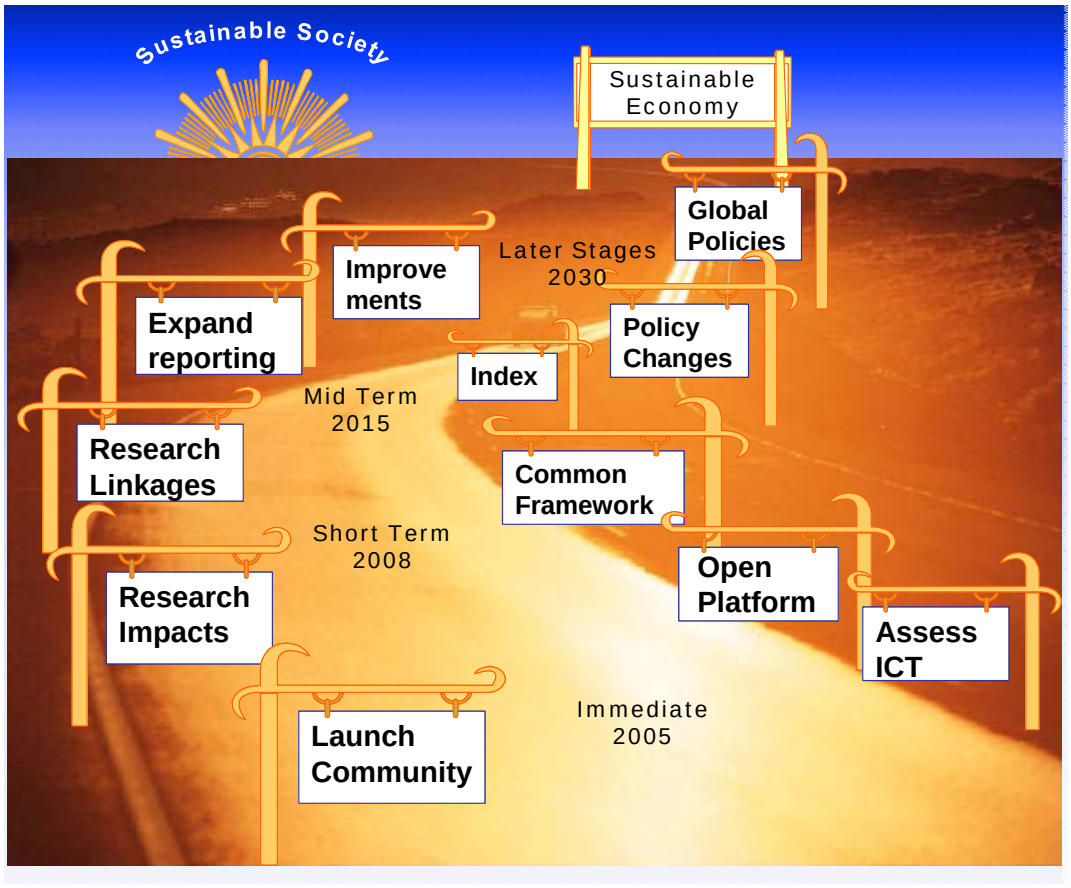

Figure 5. Sustainable society landing points in Neskey roadmap.

Decision making within companies is ultimately driven by a 'business case' rationale. In cities, on the other hand, decisions making is driven by a 'public service' rational that incorporates a 'business case' at the mezzo or macro-economic level, as well as a 'social case'. The two cases are not perfectly separable. They coexist in a system of trade-offs relating to the need for investments that support economic growth of the city and the need for investments that ensures the city provides a good quality of life for its citizens. It is possible in principle for enterprise and cities to contribute to a common cause such as 'sustainability' for entirely different reasons. However this requires a clarity-of-cause that does not as yet exist either at city or at enterprise level in most parts of Europe or the world.

In particular, a common language and a shared set of concepts will contribute to the design of policy level sustainability interventions that effect enterprise by helping to move debate beyond adversarial patterns of lobbying via networks of influence, towards a more rational democracy based on forms of open negotiation and enlightened self-interest.

3. INNOVATIVE COMMUNITIES

Two examples are given as innovative community building cases: the International Group of Lean Construction (IGLC 2004) and Ambient Intelligence at work (AMI@Work 2004). Their common nominator is a shared interest between experts on a novel collaboration field. Their institutional formalities are not highly visible, membership fees are replaced by enthusiasm and constitutions by innovative visions.

The International Group of Lean Construction gathered first time together at VTT in Espoo in 1993 and has met annually ever since (once in Australia and in Asia, three times in South and in North America and twice in Europe). The nature of its annual workshops is to call together researchers and practitioners sharing common interest towards lean construction philosophy. New findings are disseminated to end users and new research paradigms are discoursed within this informal research community. IGLC published a book (Alarcon 1997) of its early achievements as one concrete deliverable.

Ambient intelligence at work family of European Research and Innovation Area Communities is an initiative to catalyse systemic innovation. It is a European Commission initiated self-organising community in movement. It operates currently in eight interest groups, such as Engineering@Work, Mobility@Work,Well-being Services@Work and Knowledge@Work. The AMI@Work interest groups are facilitated by elected leaders. Those families, or tribes, share and develop further future objectives of key challenges in their domains. In some of them the platform is built on ongoing research projects funded by the Commission. In others the members prepare together new ones.

The concept was first tested in Brussels in July 2003 with almost 100 participants discussing the initiative and its communities. AMI@Work launch preparatory workshop was held in Brussels in March 2004 with over 200 interested participants. Budapest hosted the second launch preparatory Workshop in May 2004 and the main launch was finally in held Brussels in June 2004 with some 300 participants concluding the next steps for the coming year.

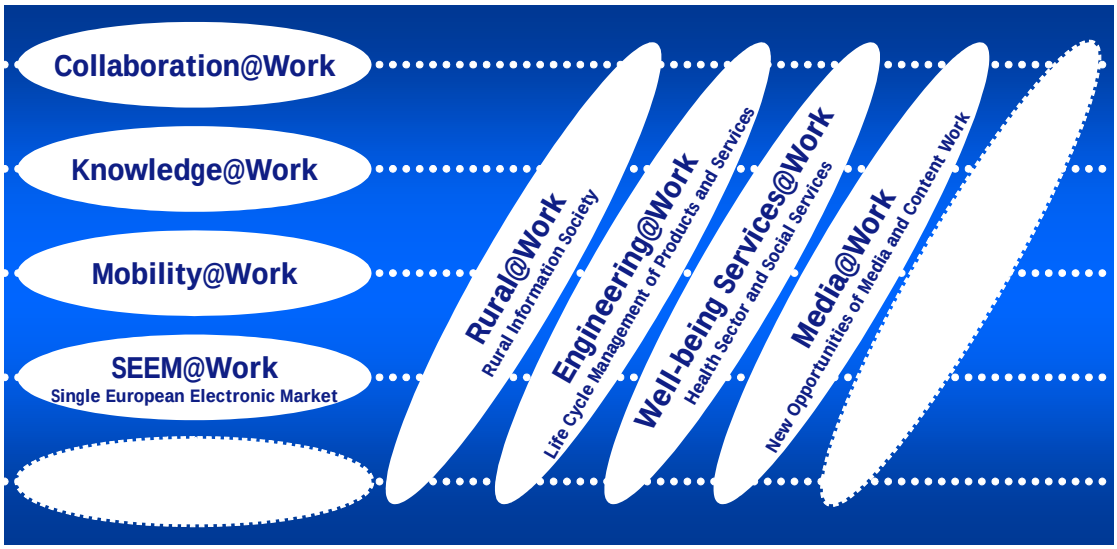

Figure 6. AMI@Work family members.

4. THE BUILT ENVIRONMENT SUPPORTING MOBILE INDIVIDUALS – LIVING LABORATORIES ACROSS EUROPE

Living laboratories are presented as a process innovation supporting concept. The idea is to provide self sustaining business opportunities in cities or neighbourhoods forming a natural meeting place for public and private investments and interests. From the research perspective, user studies may be conducted in that environment supporting niche development. The living lab approach empowers mobile individuals through the development, provision, deployment, training, and take-up of applications and services supporting the individualisation of both site independent and site dependent environments. It will create a paradigm shift enabling mobile work at all times, in all places, and in all contexts.

Innovation process and ambient Intelligence across interlinked cities and communities is the clear ambition. The impacts will be achieved through concrete steps connecting existing mobile work laboratories in various locations to inter-connected living labs. These will serve as key hubs, integration channels, and show cases for further take-up. It uses an iterative thematic approach centred around delivery of context based applications and services to mobile workers and site specific applications and services to enable mobile work in the built environment. These serve as the catalysts for mobile workers and users in the living lab network. The living labs in turn act as the baseline and launch-pad for development of next generation mobile work environments.

The kind of work that can be done on a mobile basis, when truly enabled by the supporting infrastructure, user friendly applications and interfaces together with flexible spatial and desk solutions, could considerably decrease the need of traditional office space (e.g. 70 %). At the same time it may set new needs for flexible connectable work space at homes and public environments. The objective is not to stress individuals to work around the clock, but increase the quality of life e.g. by avoiding non value adding time wasted commuting.

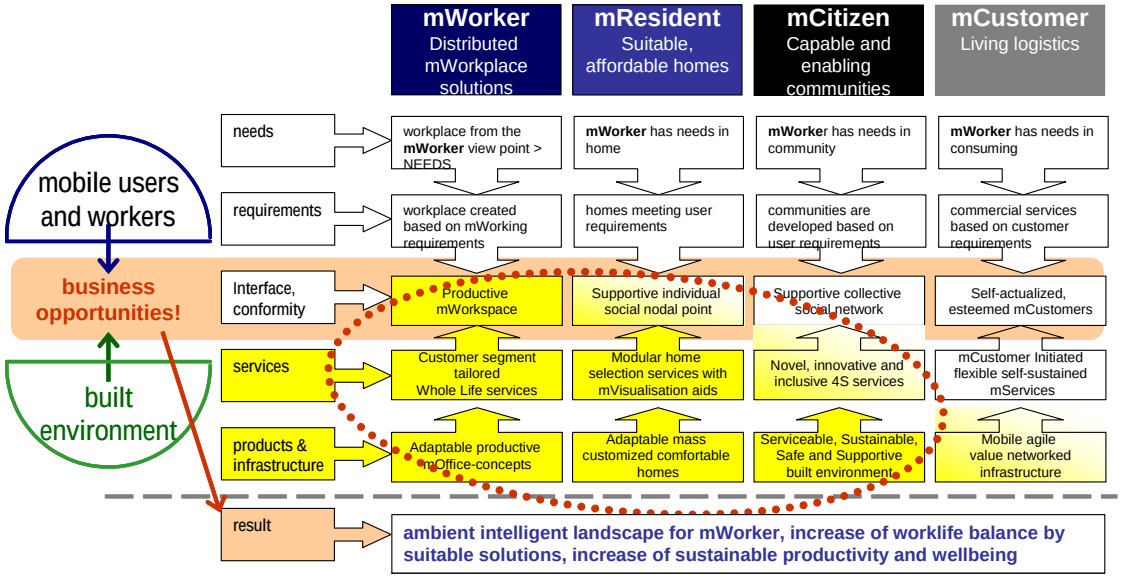

Figure 7. The built environment supports individual mobile life.

Contemporaneously with the potential of deliberating important quantities of office rooms of low rate of occupancy a huge global market is open for sustainable refurbishing of environments to meet the needs of the mobile individuals of future knowledge society. The big question still remains if the real estate and building sector is willing and capable of providing customer driven services over the whole life of constructed assets for their owners and users.

5. SUMMARY AND CONCLUSIONS

This paper proposes sustainable knowledge society as a common intended and desirable vision. International innovation is justified to be a prerequisite that enables reaching this objective supporting the seamless transition process. Four recent IST research roadmaps are presented from the city, construction, collaborative work and corporate perspectives. Two self organising interest groups are given as examples of innovative research communities. Finally, the living laboratory concept in cities is presented as a promising innovation breeding environment bringing customers and suppliers together integrating at the same time both public and private sector interests and investments.

These examples, described more in detail in the references provided, show the clear ambition towards not only technological, but also social and cultural innovation, processes which can lead to our future sustainable knowledge societies.

One challenge will naturally be how to bridge innovations with research and place. Since it is often claimed that innovations don't always take place in office kind of facilities we must think about how to transform workplaces to a more stimulating form and shape. The other dimension, supporting location and time independent access to information and communication, is of utmost importance.

The final conclusion is that investment in cities (e.g. sustainable ICT infrastructure) supporting systemic innovation has enormous potential to incubate self sustaining

business opportunities and to improve well being and quality of life of present and coming generations.

6. REFERENCES

Alarcón, L. F. (ed.) 1997. Lean construction. Balkema, Rotterdam.

Allee, V. & Luyckx, M. 2003. Neskey Roadmap. New Partnerships for Sustainable Development in a Knowledge Economy. www.neskey.org. Partners: EPPA, GRI, GeSI, AccountAbility, VTT. 31 July 2003.

AMI@Work 2004. AMI@Work Family of ERA Communities. An Initiative to Catalyse Systemic Innovation! CE-NET Newsletter n° 11. May 2004.

Camarinha-Matos, L. & Afsamanesh, H. 2003. Virtual Organizations draft Roadmap. Roadmap Design for Collaborative Virtual Organizations in Dynamic Business Ecosystems. www.vomap.org With contributions from: M. Ollus, F. Strurm, H. Loeh, G. Konzilia, António Abreu. February 2003.

Curwell, S. & Hamilton, A. (ed.) 2003. Intelcity Roadmap. Towards Intelligent Sustainable Cities. http://www.scri.salford.ac.uk/intelcity/documents/documents.htm. April 2003.

EC 2002. Visions and Roadmaps for Sustainable Development in a Networked Knowledge Society, Report of a Workshop co-chaired by the Presidents of the Brussels EU Chapter of the Club of Rome and the Factor 10 Institute. February 2002.

Eschenbäuer, J. & Hahn, A. 2004 Strategies for Distributed Innovation Management in Virtual Organisations in: Proceedings of the 10th International Conference on Concurrent Enterprising. ICE 2004 Adaptive Engineering for Sustainable Value Creation. Sevilla, Spain 14-16 June 2004.

ESI 2002. Environmental Sustainability Indicators. http://www.ciesin.columbia.edu/indicators/esi/rank.html.

Hannus, M., Blasco, M., Böhms, M., Cooper, G., Garas, F., Hassan, T., Kazi, S., Leinonen, J., Rezgui, Y., Soubra, S. & Zarli, A. 2003. Construction ICT Roadmap. Strategic Roadmap towards Knowledge-Driven Sustainable Construction. www.roadcon.org. 30 September 2003.

Huovila, P., Lombardi, P., Mitchell, C. & Westphal, C. 2002. Report on Regional Needs and Feedback on Visions. Intelcity WP2 Deliverable ID2.4 http://www.scri.salford.ac.uk/intelcity/documents/documents.htm. 20 December 2002.

Huovila, P., Kazi, S., Kiviniemi, A. & Ahlskog, J. 2003. Report on the Built Environment. Neskey WP4 Deliverable D4.2. www.neskey.org. 30 July 2003.

IGLC 2004. International Group for Lean Construction. http://cic.vtt.fi/lean/

ISI 2003. Information Society Index. http://www.worldpaper.com/2003/oct02/isi2.html.

Lee, A. & Barrett, P. (ed.) 2003. Performance Based Building. 1st International State-of-the-Art report. Annex: PeBBu Domain Synthesis Reports. CIB Publication 291. November 2003.

Liikanen, E 2004. Mobile Communications: Future Visions and Challenges. Speech/04/291 by Mr. Erkki Liikanen, Member of the European Commission, responsible for Enterprise and the Information Society at the launch event Applications and Services for the Mobile user and Worker. Brussels. 8 June 2004.

Sipilä, M. (ed.) 2002. Communication Technologies. The VTT Roadmaps. VTT Research notes 2146. Helsinki.