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Ambient Intelligence 2020
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Purpose

The "Ambient Intelligence in Everyday Life" or AmI@Life S&T roadmap was developed within the IPTS of the European Commission's Joint Research Centre in collaboration with ESTO - the European Science and Technology Observatory network. It addresses the potential of universal and trusted access to Ambient Intelligence technologies and the functions in everyday life, raising the issue of universal access to new technologies and functions. The methodology of technology roadmapping was adapted to R&D policy intelligence by implementing a "function-oriented" approach intermediate between technology-push and user-pull. This approach has provided fruitful ways of thinking about useful, accessible and trustworthy functions.

IPTS/ESTO S&T Roadmapping

The "IPTS/ESTO Science and Technology Roadmapping" project was set up to address three main questions:
- What are the major societal challenges facing Europe?
- What are the emerging technological responses to these challenges?
- What are the pathways between these challenges and responses?

Its main objectives were to inform research and development policy at European level through a series of problem driven technology roadmaps. The activity also sought to review and develop methodological approaches to mapping research and technology. Two pilot maps, "Ambient Intelligence in Everyday Life (AmI@Life)" and "The delivery of Healthcare in the context of an ageing society," were completed.

Ambient Intelligence Vision

"Ambient Intelligence" (AmI) refers to a vision of the future information society stemming from the convergence of ubiquitous computing, ubiquitous communication and intelligent user-friendly interfaces as envisaged in the ISTAG (Information Society Technology Advisory Group) Scenarios of Ambient Intelligence in 2010 (ISTAG 2001). It puts the emphasis on user-friendliness, user-empowerment and support for human interactions.

Will AmI Reach the Masses or Just the Niches?

AmI is more a vision of the future than a prediction. It is per definition normative and portrays a desirable future. By putting a major claim on being people-oriented, it also assumes that AmI will potentially be inclusive, providing of course it delivers up to its promises of being user-friendly, unobtrusive and controllable. But even if these promises are met, the fun-

damantal question remains open if AmI will be able to include a majority of people by delivering effectively useful, accessible and trustworthy innovative functions. If this is not the case, it will benefit mostly the young, urban and mobile techno-freaks thereby becoming an additional source of exclusion in society, also referred to as the "digital divide". It is the concern of policy-makers to influence the ongoing evolution towards more cohesion and inclusiveness or at least to mitigate some of its negative effects.

Scope of the Roadmap: Everyday Life

AmI@Life was scoped towards everyday life outside the professional sphere. Indeed, there seems to be no simple spillover of technologies from the office to the home. Six major application areas were considered as representative of everyday life:

- Housing, Mobility and Transport,
- Shopping and Commerce,
- Education and Learning,
- Culture, Leisure and Entertainment as well as
- Health.

Identifying key functions where AmI could "make a difference" made the linkage between technology developments and users.

The "Function-oriented" Approach

Traditional technology roadmaps tend to focus on the development trajectories of technologies to provide new products - Corporate TRM - or on detailed enabling technologies in the pre-competitive domain - Industry TRM. Within the AmI@Life roadmap, the methodology of technology roadmapping was adapted to R&D policy intelligence. A "function-oriented" approach was developed as an intermediate way between the technology-push and the user-pull approaches.
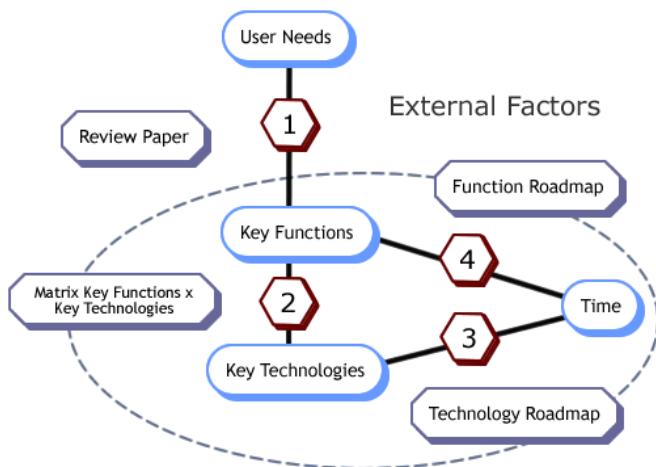

Fig. 1: The "function-oriented" approach

The main feature of this approach consists in crossing "key functions", "key technologies" and "time" two by two. See figure 1 below:

- **Scanning of the application areas** in order to identity key functions.
- **Identification of the key enabling technologies** needed for the development of these functions. Since Ambient Intelligence is a true cross-cutting vision the development of practically all ICT have been considered.
- **Mapping of these key technologies over time**. The "**technology roadmaps**" synthesise the time horizon of the necessary technological breakthroughs and the critical bottlenecks.
- **Mapping of the key functions over time** by integration of the two previous steps. The "**function roadmaps**" synthesise the major milestones, potential breakthroughs or disruptions, critical paths for the developments of key functions and alternative scenarios.

The identification of the functions, technologies and the time-lines were derived from a careful and iterative process of analysis and synthesis of previous works and from brainstorming.

Technology and Function Roadmaps

The main outcomes of the study consist of detailed graphical representations of functions which "will make the difference" for AmI in everyday life - "function roadmaps" - and of key technologies indispensable for the development of the former - "technology roadmaps". The time scale reaches from 2005 to 2020 and beyond. Colour codes are used to indicate the uncertainty of the developments. See figure 2 below. In all areas substantial developments are likely to occur before 2010, prototypes depending mostly of technological feasibility and wider diffusion of user acceptance. Health and entertainment, especially gaming, are identified as two of the driving areas.

Enabling and Constraining Factors

User-friendliness, including advanced and multi-modal interfaces and interoperability, is essential for the wide acceptation of AmI applications. Similarly, concerns over trust, security and privacy issues have to be addressed so as not to hinder the diffusion of AmI.

Opportunities

It is shown that due to their emphasis on human-centred innovation, AmI functions have the potential to contribute to wider access to ICT functions and thereby to social inclusion, par-

ticipation and cohesion. New forms of socialisation will con- | tinue to emerge.

Applications	Key Function	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	>2020
Cultural Heritage	Preservation of cultural heritage	Large-scale digitalisation of written materials			Increased interconnection of databases			Large scale digitalisation of multimedia materials												
	Organisation of cultural heritage				Generalisation of content-based classification and indexation															
	Access to and retrieval of cultural heritage	Online libraries				Generalisation of retrieval of cultural heritage on demand														
	Intelligent heritage and cultural tourism (historical sites / museums / exhibitions)	First generation interactive and augmented reality exhibitions						Multi-sensorial, multi-modal exhibitions												
								Tourism in some areas limited to Net access		3D exhibitions using holographic displays										
Cultural Participation	"Out-of-house" cultural participation and recreation					Widespread use of virtual reality for education and recreation												Widespread use of virtual environnements		
	Creation & Art					Multi-sensorial, multi-modal, augmented reality works of art						Computers have humanlike creativity							Direct brain-brain communication of information and feelings	

Fig. 2: The culture function roadmap

Access to Future Technologies

Some applications of ICT technologies in terms of useful, accessible and trustworthy innovative functions have been highlighted. These functions are effectively the starting point and leading dimension of the approach, before key technologies and time. This is one of the main specificities and added values of the outcome compared to the existing corporate and industry roadmaps. The "function-oriented" approach provides fruitful ways of thinking about useful and accessible services and about the interrelationship between the technological and the human - economic, social, political and demographic - dimensions of Ambient Intelligence. The Roadmapping project makes clear that, given the complexity, diversity and richness of everyday life, a one-shot full implementation of AmI is unrealistic. Rather, gradual and partial diffusion can be expected. A recommendation for policymakers is to improve the access to future technological developments, diversity and flexibility at all steps of the value chain. Certainly technological developments are necessary but far from sufficient for the realisation of the AmI vision. Even, the relevance of the AmI vision, that it is going to increase the well-being, make life easier or more attractive, is not universally accepted among IST researchers and policy-makers. There would be a need for complementary exercises of scenario and trend building to further link economic (cost), political (incentives) and social (skills, user groups) factors to the technological and functional developments already represented within the roadmaps.

Selected Sources and References

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