# MODERN APPROACES IN THE CONTEXT OF AMBIENT INTELLIGENCE

**Ivancenco Constanţa Veronica**
*Academia de Studii Economice Bucureşti Facultatea Contabilitate şi Informatică de Gestiune Piaţa Romană nr. 6, sector 1, Bucureşti, CP 010374 Email: vivancenco@yahoo.de  Telefon: 0723587743*
**Gheorghe Mirela**
*Academia de Studii Economice Bucureşti Facultatea Contabilitate şi Informatică de Gestiune*
*Piaţa Romană nr. 6, sector 1, Bucureşti, CP 010374 Email: mirelaghe@gmail.com Telefon: 0723858611*
**Boldeanu Dana Maria**
*Academia de Studii Economice Bucureşti Facultatea Contabilitate şi Informatică de Gestiune Piaţa Romană nr. 6, sector 1, Bucureşti, CP 010374 Email: danabolde@gmail.com Telefon: 0721803603*

*Ambient Intelligence (AmI), as a new vision and concept of the tomorrow, gathers a few features regarding both the integration of technology in the environment and the capacity technology has to recognize the user and its context, the system capacity to intelligently answer users' requests.*
*The purpose of the present paper is to describe this emerging field of research and development which is rapidly gaining wide attention in that last few years, from an increasing number of researchers worldwide, especially from Europe.*
*Ambient Intelligence is considered the next step for Artificial Intelligence, in the context of supporting people in having a better access to the essential knowledge for taking better decisions when interacting with modern environments.*

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## 1. Conceptual framework of Ambient Intelligence

**Ambient intelligence** (Ambient Intelligence - AmI) is a basic concept for normative visions for information technology development in the European Union, a general framework for the future European information society. The European Commission's Information Society Technologies Advisory Group (ISTAG) [587] worked since 1999 on the vision of IST development in the 5th and 6th Framework Programme[588]. These visions and ideas are summarized by the concept of AmI.

During the last few years, AmI has been present in almost all discussions on the future of communication, a fact which is proven by the over 15 international conferences organized only within European frontiers: European Symposium on AmI - Eidhoven; Smart Objects Conference – Grenoble; International Conference on Concurrent Enterprising – Leiden (Netherlands); International Conference on Pervasive Computing - Linz and Vienna, to mention just a few of the most relevant.

The ambient intelligence expression is only on European version. Big companies like IBM are talking about "Pervasive Computing", HP about "cooltown", MIT about 'Things that Think" and Xerox about "ubiquitous computing". The giant Dutch electronics company Royal Philips opened in 2002 the doors of a HomeLab, an ambitious experiment in developing ultra-modern living systems and consider that what's driving the research: "Ambient Intelligence," is a 21st century cousin of artificial intelligence[589].

The ISTAG reports define AmI at a conceptual level and identify important technologies for achieving it. In the paper called "*Ambient Intelligence: From Vision to Reality*", ISTAG refers to the specific AmI components: smart materials, micro-electromechanical systems and sensor technologies, embedded systems, ubiquitous communications, I/O device technology, and adaptive software.[590]

Regardless of the term used, the competition is strong when it comes to defining a brand that will rule over anything that is related to communication and lifestyle in the decade that follows.

Ambient Intelligence brings a special perspective to the on-going research associated with technical fields like **ubiquitous computing**, **pervasive and proactive computing**, **ambient computing**, **embedded computing** and **smart objects**.

Ambient Intelligence has become well-focused by putting people and social contexts at the centre, while at the same time aiming to distribute, embed, coordinate and interactively deliver computing intelligence within the surrounding environment. The notion of Ambient Intelligence, as described above, is becoming a de facto key

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587 ISTAG, "Scenarios for Ambient Intelligence", European Commission, 2001, available online at www.cordis.lu/ist/istag.html
588Wierzbicki, Andrzej P. "The concept of ambient intelligence and decision support for telecommunications", Journal of Telecommunications and Information Technology, no. 3/2002
589Peterson, Karen "Home Sweet Ambient Home, from Philips", May 8, 2002, available online at http://www.10meters.com/homelab1.html
590  ISTAG, "Ambient Intelligence: From Vision to Reality", European Commission, 2003, available online at
ftp://ftp.cordis.europa.eu/pub/ist/docs/istag-ist2003_consolidated_report.pdf

dimension of the emerging Information Society, since many of the new generation industrial digital products and services are clearly shifted towards an overall intelligent computing environment.[591]

Ambient Intelligence without invasion of privacy represents a long-term vision for the EU Information Society Technologies Research program, with the aim of bringing together researchers across multiple disciplines: computer science, social sciences, physics, biology, engineering, design, architecture & philosophy to name a few[592].

Shortly, *ambient intelligence is a future information society environment with intelligence embedded anywhere but in an unobtrusive fashion*, with the emphasis on[593]:

> greater user-friendliness;
> more efficient services support;
> user empowerment;
> support for human interactions.

## 2. ISTAG Scenarios for Ambient intelligence

*As a result of a European program the aim of ambient intelligence involves the convergence of several computing areas and is meant to describe in different scenarios what living with AmI might be for the ordinary citizens in the year of 2010.* In order to answer to an important question bounded of critical aspects of AmI, meaning "What aspects of AmI would people soonest buy?" ISTAG asked the Institute for Prospective Technology Studies (IPTS) from Seville to develop a series of "scenarios for ambient intelligence".

There are four principal scenarios described in details in the ISTAG Report are referring to the relationships between humans and personal communication devices in a business environment, the necessary technological requirements and technologies to use for travel and commerce and global resources for social learning, group dynamics and so others. The suggestive names of these scenarios are the following:

> Scenario "Maria" – road warrior
> Scenario "Dymitrios" – digital Me (DMe)
> Scenario "Carmen" – traffic, sustainability, commerce
> Scenario "Annette and Solomon" – an ambient for social learning

The AmI scenarios are not predictions. They describe plausible present and future and do not forecast specific trends in technologies. The aim of the scenarios is to improve the people general understanding and vision of the development of AmI and its possible future impact.

The main structuring differentials between the scenarios are[594]:

> - Economic and personal efficiency versus sociability/humanistic drivers (goals)
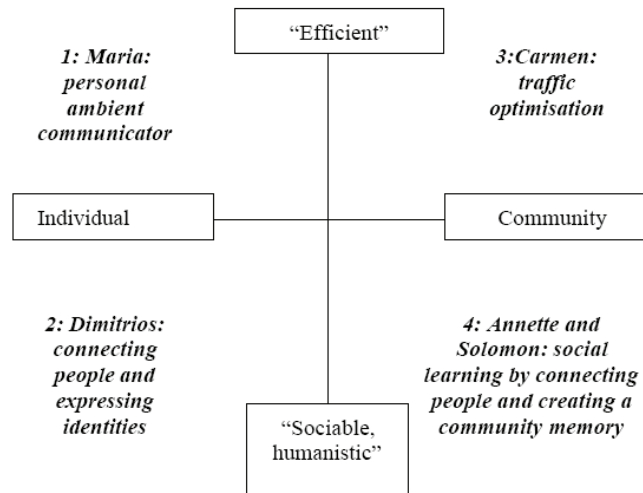> - Communal versus individual as the user orientation driver (actors).



Figure 1. Paths and alternative developments of AmI[595]

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591 Stephanidis, Constantine "A European Ambient Intelligence Research Facility at ICS-FORTH", Oct. 2006

592 G. Riva & et.al. "Ambient Intelligence The evolution of technology, communication and cognition towards the future of human-computer interaction", IOS Press, 2001, available online at http://www.ambientintelligence.org

593 Wierzbicki, Andrzej P. "The concept of ambient intelligence and decision support for telecommunications", Journal of Telecommunications and Information Technology, no. 3/2002

594 ISTAG, "Scenarios for Ambient Intelligence", European Commission, 2001, available online at www.cordis.lu/ist/istag.html

595 ISTAG, "Scenarios for Ambient Intelligence", European Commission, 2001, available online at www.cordis.lu/ist/istag.html

The Figure 1 shows a cross of two axes which delimit the AmI scenarios and provides a structure that isolates some of the main features and alternative development paths for Ambient Intelligence. Very interesting are the critical factors for the implementation of the above scenarios, specified in the IPTS-ISTAG report. These factors are socio-political, business-economic, technological and others. The main technological factors are listed as following:

very unobtrusive hardware (miniaturisation, Nanotechnology, smart devices, sensors etc.)

seamless mobile-fixed communication infrastructure (interoperability, wired and wireless networks, service-oriented architecture, semantic web etc)

dynamic and massively distributed device networks (e.g. service discovery, auto-configuration, end-user programmable devices and systems etc.)

natural feeling human interfaces (intelligent agents, multimodal interaction, context awareness etc.)

dependability and security systems (self-testing and self repairing software, privacy ensuring technology etc.)

## 3. Ambient Intelligence versus Artificial Intelligence

The two terms, "intelligence" and "ambient" suggest a change of perspective: if the technology goes to the background, the user gets to occupy the forefront; in the user-system interaction, the system is the one that must adjust to the user's peculiarities and not the other way around. This new vision provides interfaces with "intelligence".

The intelligence contained in the information components is expressed via:

- the social nature of the user interface  - expresses the degree in which the system behavior is appropriate for the user's customs, knowledge, intuition and situations;

- the system's adjusting capacity with respect to the user and the environment – is done by understanding the context and learning as a result of interactions with the user.

The main target of the interfaces of the future is multimodal communication (sometimes called "multi-sensor"), a communication that effectively combines the adjusting capacities of ambient intelligence systems and the natural perception and expression possibilities of the individual (speaking, handwriting, gestures).

The concept of ambient intelligence gathers a few features regarding both the integration of technology in the environment and the capacity technology has to recognize the user and his/her context, the system capacity to intelligently answer users' requests[596].

Ambient Intelligence technologies integrate sensing capabilities, processing power, reasoning mechanisms, networking facilities, applications and services, digital content and actuating capabilities distributed in the surrounding environment. While a wide variety of different technologies is involved, the goal of Ambient Intelligence is to either entirely hide their presence from users or to smoothly integrate them in their surroundings as enhanced environment artifacts rather than technological gadgets. This way, the computing-oriented connotation of technology essentially fades out or even disappears in the environment, providing seamless and unobtrusive interaction paradigms. Therefore, people and their social situation, ranging from individuals to groups, be they work groups, families or friends and their corresponding environments (office buildings, homes, public spaces, etc) are at the centre of the design considerations as we can see in Figure 2.

596 Aarts, Emile, Marzano, Stefano (editors) The New Everyday: Vision on Ambient Intelligence, 010 Publishers, Rotterdam, The Netherlands, 2003
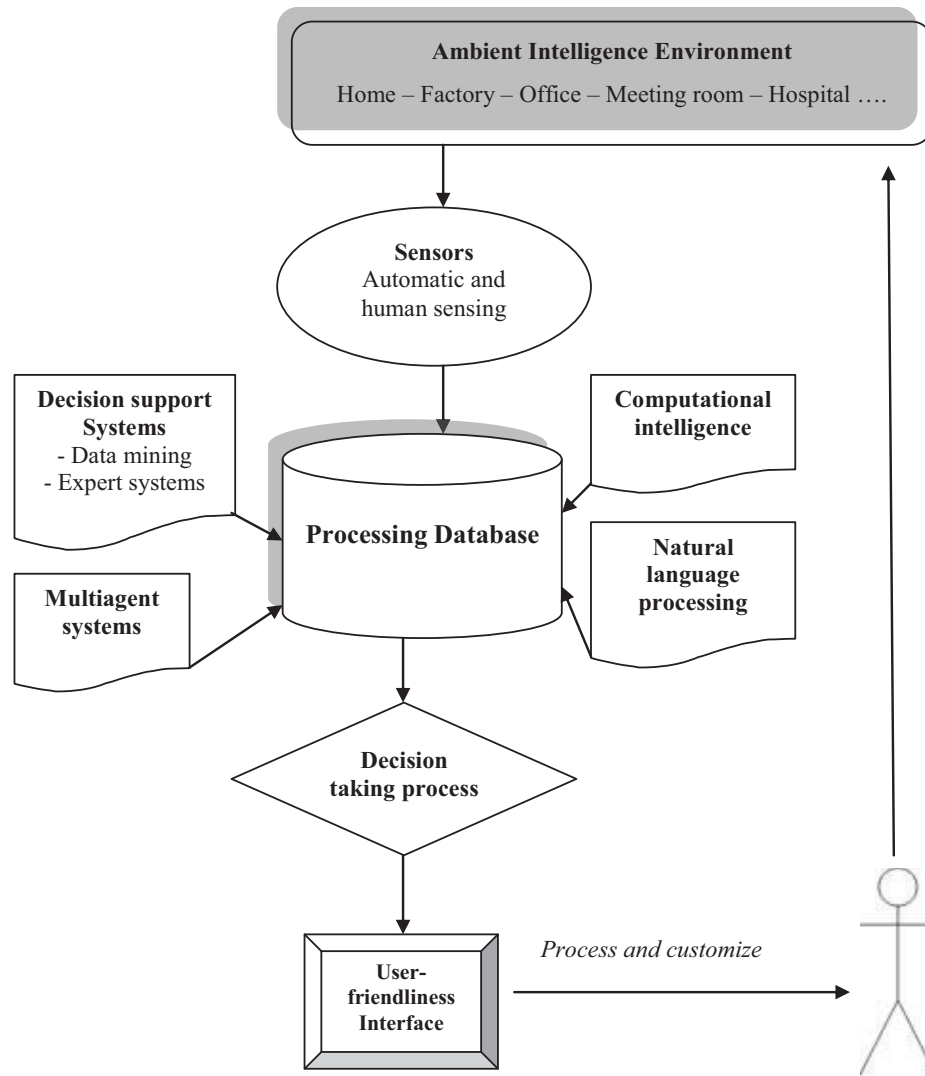
Figure 2. The structure of Ambient Intelligence system

Figure 2 shows the importance of Artificial Intelligent (AI) component within an AmI system. AmI environment is seen and sent through different sensors (human, net sensors like GPS for example, raw sensors, audio and speech image, etc.). To offer decision maker models of action and pertinent decisions, AmI system includes both an operational, technical component (hardware, operating systems, communications, databases, computer graphics, etc) and an intelligent one which includes methods and techniques of AI (processing language natural, text mining, expert systems, machine learning, etc). Human component plays an important part next to the previous components, both decision taking and perceptions sent will interact with the AmI environment.

According to Ramos and his colleagues in 2008 AmI systems should be able to interact intelligently with humans and this interaction requires context awareness. In AmI systems, context awareness will involve such factors as mixed-initiative interfaces, adapting to users and situations, learning by observing users, consciousness of the current situation, and scalable intelligence[597].

The system capacity to intelligently answer users' requests gathers three defining features of ambient intelligence, namely:

customization (to the perceived specific needs of the user);

adjustment (in order to consider the time modification of the user's knowledge and behavior) ;

anticipation of the user's desires.

## 4. Conclusions

The present development of the informational environment is a natural one in which business environment has to adapt, to integrate the best techniques and tools (Data Mining techniques, statistics algorithms, artificial

597 Ramos, Carlos, Augusto, Juan Carlos, Shapiro, Daniel "Ambient Intelligence - the Next Step for Artificial Intelligence", IEEE Computer Society, Volume 23, Issue 2, March-April 2008, Page(s):15 - 18

intelligence, neural networks, fuzzy logics, genetic algorithms, etc.) that will allow a data analyze in real time. Also, it will be the foundation for multidimensional analysis of financial data to provide pertinent answers to relevant decision makers within a specific organization. Moreover, centralized and synthetic information which provide the best decisional support is a *sine qua non* condition for an efficient management system.

The research underlines the necessity of using methods and techniques like multiagent systems, fuzzy systems, logic programming and other tools to develop an AmI system. AmI can't be completely achieved without AI. The structure of system activities through particularizing of actors (users) rolls which will diversify the variety of AmI systems.

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