

Ubiquity and Other Elements: User Challenges, the Value Chain and Business Opportunities in the Future Ambient Intelligence World

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Abstract

The objective of the Eurescom project PROFIT (Potential pRofit Opportunities in the Future ambient InTelligence world) was to explore the potential socio-economic impact of Ambient Intelligence. This paper reports firstly on qualitative fieldwork in the UK, Norway, Finland and Hungary, concerning work/home boundaries and user perceptions of a future Ambient Intelligence environment. Findings reveal concerns about non-independence, loss of control, security, privacy, and system failures, and the unwanted breaking of boundaries by ubiquitous devices. Secondly, the paper reflects on the new business perspectives that may arise both in response to customer needs and as a result of the introduction of AmI into the Information society; and examines emerging business models, value chains and key regulatory concerns. The project ultimately produced a new, grounded scenario and recommended actions for the telecommunications industry, regulators and governments - in order for them to develop the opportunities and understand the challenges of AmI.

1. Introduction

The radical changes in the Information Society, driven by progress in Information and Communication Technologies (ICTs) and their adoption, has opened a fast path towards a vision of Ambient Intelligence (AmI). Ambient Intelligence is regarded by some as synonymous with ubiquitous computing. However, the Ambient Intelligence vision goes beyond a notion of having computers all around us, which are 'always on' - and therefore thinking beyond ubiquitous services and applications towards AmI's other elements. Ambient Intelligence is the convergence of three technologies: ubiquitous computing, ubiquitous communication, and intelligent user-friendly interfaces. It is generally acknowledged that a user-centred, social approach is vital to the successful development of this AmI vision [1], and never has it been so pertinent to explore people's life worlds and how AmI devices can be usefully and positively incorporated into them. AmI also offers tremendous business opportunities and challenges to telecommunications operators and service providers. It is vital to understand these opportunities.

This paper describes work undertaken to examine the socio-economic dimensions of AmI and to develop a new, grounded scenario and potential migration paths for its future users and providers. Firstly, it explores qualitative fieldwork, and secondly socio-economic analysis, from the Eurescom project 'PROFIT' - involving a collaboration of ICTs researchers from Norway, Finland, Hungary and the UK.

The first section looks at user aspects. For users, the ubiquity of AmI devices will provide a challenge to their established work/home boundaries, which may be particularly unpalatable for those with children, or who do not like to mix work and home life because of the distractions involved. The other elements of AmI raise concerns about non-independence, loss of control, security, privacy and systems failures, and will need to be addressed if AmI is to experience widespread adoption. Unmet needs, such as automating the mundane and helping people to be more in control of their lives, offer context-aware service opportunities.

The second section examines business aspects. For businesses, there are three main areas of change: the development of new organisational forms and strategic approaches; the adoption of management

structures and systems that favour flexibility and adaptiveness; the merging of home, work and public spaces. However, regulatory limits on the nature of competition will serve to limit profitability of telecommunication companies.

2. User acceptance of ubiquity and other AmI elements: work/ home boundaries and reactions to existing AmI scenarios

Radical changes in the Information Society have opened a fast path towards a vision of "Ambient Intelligence" (AmI). Yet AmI has some key underlying assumptions which challenge the way some of us currently lead our lives and expect to live them in the future. The first of these assumptions involves ubiquity - that ubiquitous services and applications are beneficial and a user need in all circumstances. In fact, ubiquity leads to a de facto blurring of work/home boundaries which may be unacceptable to people with particular household circumstances, types of employment and philosophies. The AmI vision of the future has also been materialised in particular ways by ISTAG (Information Society Technologies Advisory Group) and WWRF (Wireless World Research Forum) scenarios. These manifestations, involving certain assumptions about user acceptance and behaviour, are also mostly subject to negative user perceptions. This section of the paper explores user acceptance issues of both ubiquity - in terms of work/ home boundary issues - and user perceptions of AmI scenarios, as revealed through qualitative fieldwork. However, it begins by exploring these two user acceptance issues in terms of the extant literature.

2.1. Exploring Ubiquity, Work/Home Boundaries and User Perceptions of AmI

Existing telecommuting technologies such as laptops and mobile phones with Internet capabilities, and remote access to office servers, already form the beginnings of an era of ubiquitous services and applications. They blur the idea of work taking place both in a geographically separate office and during set working hours. Nippert-Eng's [2] classic study of the boundaries of work and home suggested telecommunications technologies are boundary-attenuating or modifying – they place pressure to integrate work and home. However, a vision of AmI devices which are ubiquitous and 'always on,' potentially breaks down the notional boundaries of work and home to an even greater extent than in Nippert-Eng's study. Other authors have suggested people's work/home and public/ private boundaries as an important challenge for the AmI vision of the future. Aarts and Marzano [3] suggest that AmI is important in the increasingly blurred boundaries between work and life. AmI also has tremendous monitoring and surveillance capabilities. Punie's report [1] posits that the home of the future could be a place where people are disconnected from too intrusive AmI devices – home then becomes a sanctuary. Yet although the issue of boundaries has been flagged as an important one for Ambient Intelligence, few pieces of original research have emerged which explore the pertinent issues.

It is generally acknowledged that a user-centred approach is vital to the success of the Ambient Intelligence vision [1]. But existing AmI scenarios, including those from ISTAG, have been criticised for their unrealistic portrayal of everyday life. There are no technological malfunctions and the technology is mostly accepted without question [1]. User perceptions present societal challenges which may be crucial barriers to the uptake of the Ambient Intelligence vision. Punie's EMTEL report [1], through desk research alone, anticipated some negative user perceptions of Ambient Intelligence devices. The report notes that AmI technologies can easily appear to be controlling the user. Non-independence of AmI devices through business manipulation is also an identified risk of the AmI vision [1]. Finally, AmI networks are noted to need a high degree of robustness and fault tolerance for the user to accept them [1].

The fieldwork element of the Eurescom project sought to explore user perceptions through in-depth interviewing. Two groups were studied - small business owners and the employees of large companies. The literature suggested they may have very different work/home boundaries and contrasting reactions to ubiquitous services and applications. In particular, small business owners are likely to integrate work and home by necessity of having few, if any, staff members; and shared work and home contact details. 47 individuals were interviewed across Norway (11), Finland (3), Hungary (15) and the UK (18). This paper is presented with a number of caveats. It does not suggest that a sample size of 47 is adequate to generalise with certainty for a wider population. However, the extremely uniform repetition of responses across the European fieldwork countries gives a good indication of the socially constructed discourse surrounding Ambient Intelligence at the present time. These may or may not indicate barriers to the

adoption of future AmI devices. People's attitudes and perceptions of technology often change after they have used the technology, or after the technology has been introduced. Bagozzi, Davis and Warshaw [4] note that attitudes towards intending to use technology may be different from those formed after actual use.

2.2. Results

2.2.1. Ubiquity, Work/Home Boundaries and AmI

AmI presents real challenges to work/home boundaries through being ubiquitous and 'always on.' The qualitative fieldwork revealed a number of important work/home boundary concerns which are relevant to the AmI vision. Whilst integrationists are likely to welcome a vision of pervasive and 'always on' AmI, separationists are likely to have special requirements of their AmI devices - and indeed may be more resistant adopters of the technology and ubiquity unless it can support their approach. This section concentrates on the reasons for resisting the blurring of boundaries.

There are some specific sets of people who wish to keep work and home domains quite separate, based on key drivers which are very important to their everyday lives. One of the principal reasons given for separation was that integration led to distractions and fragmentations in either one or both domains. Home and work domains may also be kept separate because people have strong philosophies that this is the way to maintain a certain quality of life. Work and home life is also kept separate as a result of responsibilities at home – people's children and partners. Certain types of employment can also lead to a separation of work and home domains. Mobile phones are forbidden in the health services. Another key reason to keep home and work life separate is to maintain a degree of privacy. This is especially true of small businesses, who both live and work at home. Finally, work and home domains may also be kept relatively separate in order to be able to impose intra-work boundaries. Work and home boundaries may be enforced in terms of ICTs to enable quiet work to take place at home. People for whom these key drivers are important will not want 'always on' AmI devices to break their firmly established boundaries.

It was postulated during the research that those who want to and are able to separate work and home are more likely to be employed by other people. The fieldwork, especially in the UK, Finland and Hungary, showed employees were often more able to separate, and that 'profit maximising' small business owners integrated work and home by necessity. However, the study also revealed the situation of work/home boundaries is more complex than anticipated. In the UK fieldwork, a subset of small businesses, 'lifestyle businesses,' also wish to maintain strict work/home boundaries since their businesses were formed to maintain a certain quality of life and lifestyle rather than profit maximisation. They tend to value demarcated home time as part of achieving a high quality of life.

2.2.2. User Perceptions of AmI

The responses to existing AmI scenarios presents crucial data for ICTs businesses in terms of key concerns which will provide barriers to the adoption of AmI devices and services and a challenge to the AmI vision. User perceptions of key elements of the AmI scenarios were surprisingly uniform across the fieldwork countries, with the same responses being repeated across Europe. The user perceptions also confirmed many of the suppositions of the EMTEL report [1]. These key devices and elements, used as concrete examples of AmI for users, and derived from the WWRF and ISTAG scenarios, were: a 'digital me' - a device which could control who accessed individuals by voice at a particular time and which calls would be ignored, a unified identity verification device, the 'guardian angel' system of health monitoring and advice, a vision where AmI devices adapted the environment and data for your tastes and preferences, and devices which acted as your 'agent' - such as Internet 'bots' or smart fridges.

Respondents were concerned that devices will not be independent. For the 'guardian angel' and device as 'agent,' interviewees feared that the advice or results given would be used to encourage sales of particular items, rather than being optimal for their needs. Such AmI devices are constantly monitoring you and gathering data, and questions arise about who owns this data, who can access it, and if it can be sold for marketing purposes. Equally, people felt the wide range of information on the identity verification device may be downloaded in total by firms in order to be used for marketing. The identity verification device raised strong feelings about the need for data privacy, and many would be nervous about what business

and government might do with such data. Related to the privacy issues of data generated and stored on Aml devices, is one of security. When devices contain sensitive data, users will need to feel that such devices are totally secure. Respondents were also concerned that Aml devices led to a loss of control, or were too controlling. They felt they would lose control of how their personal information was used. However, Aml devices were seen as too controlling through their didactic qualities – telling others or their owners what to do. Both the ‘digital me’ and the ‘guardian angel’ share these qualities. The programming of Aml devices will need to make them seem less controlling and more advisory.

Although Ambient Intelligence devices have a form of intelligence where they can act autonomously and predict tastes and preferences based on programmed choices and previous behaviour, interviewees felt they weren’t intelligent enough and never could be. Their tastes could not be defined mechanistically, and the device couldn’t identify an important phone call from an unimportant one. The device could not anticipate their behaviour or moods. Other respondents feared that being surrounded by Aml devices would lead to over-reliance on the technology which would cause tremendous problems if there were systems failures.

3. Business perspectives for Telcos in a Aml environment

In an attempt to answer the question: “is Aml a profitable business for Telcos?” the PROFIT¹ project has analysed the components of profitability, i.e. both the market attractiveness and the competitive advantage in terms of business models and demand, for 2010.

3.1. Methodology

Starting from a set of 14 scenarios [5, 6, 7, 8] describing possible new situations under the light of changing technology, the scenarios were graphically plotted using a competitive web analysis methodology, that rated how the technologies described in each scenario related to the following six different dimensions: 1. Fun, fashion and entertainment, 2. Health and safety, 3. Privacy and confidentiality, 4. Identity issues, 5. Technology ease of use, and 6. Level of technology. This technique allowed a visual map to be made of each scenario and highlighted areas of overlap between scenarios. As a result of this study, the number of chosen scenarios reduced to six as duplicate scenarios were eliminated. Finally, eleven top-level generic services were identified by a process of scenario deconstruction:

- Health Services
- Financial Services
- Messaging Services
- Entertainment Services
- Information Services
- Education Services
- Location Based Services
- Collaboration Services
- Security Services
- Personalisation Services
- Monitoring Services

Typical sub-services were identified for each top level service. In order to reduce the scope of the analysis, it was decided by the project team to focus on services associated with ‘Entertainment’, ‘Collaboration’ and ‘Information’ that ranked higher in terms of profitability, compared to all other services. Personalisation was considered to be a common requirement for all services. As part of the study of the external environment, STEEP² analyses [9] were created as analytical tools, in order to identify key trends, and further integrate key consumer needs and specific services required to meet these needs [10]. According to the STEEP 2 analysis [10] several service categories were ranked as potential high

¹ PROFIT project deliverables are available for download on the SOCQUIT portal http://www.eurescom.de/public/projects/P1300-series/p1302/P1302_portal.asp

² STEEP: Social, Technological, Economic, Environmental and Political.

implementers both in the Norway and UK sections. These categories were then further examined regarding their underpinning driving forces and scrutinised regarding user issues that could be potentially raised as inhibitors according to the findings in section 2. By a combination of qualitative and quantitative techniques, the following ranking was produced of the most profitable services and an estimate of revenue attributable to European Telcos:

1. Communications/Messaging Services
2. Leisure/Entertainment Services
3. Teleworking/Collaboration Services
4. e-Government/Information services
5. Safety/Location Based Services
6. Live independently/Health Services
7. Financial security/Financial Services
8. Data across the web/Information Services
9. Education/e-learning Services
10. Quality of life/Monitoring Services

The output from this examination was used to create the development of a new ‘grounded’³ scenario, more representative of life in 2010, and underpin strategic recommendations.

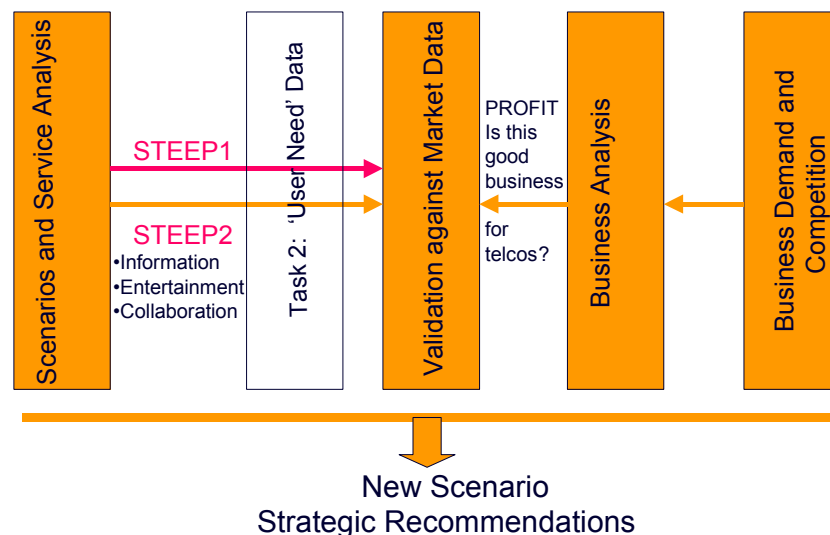


Figure 1 Methodology

3.2. Value Chains and Value Nets

Following Porter’s generic framework [11], much strategic thinking still focuses on the product with competitive strategies being based on cost leadership, product differentiation and focus. The value chain model can be used to analyse the processes in a product delivery from inbound logistics through to sales and marketing. Upstream suppliers provide inputs, add value, and pass down the chain to the next actor, similar to an assembly line metaphor. The aim of the value chain is to promote a best product strategy; a profit margin will result if costs are low. This approach assumes product definitions and customer needs are stable and well understood; strategic effort to increase operational effectiveness is key to this best product paradigm.

However, in the emerging i-Space⁴ market neither products nor customer needs are fixed, posing a challenge to the simple concept of a supplier adding value to a physical component and passing on to the

³ The project’s ‘grounded scenario’ was developed to show where possible Aml-related barriers are and where Aml offers opportunities in the future, to both users and businesses. The term ‘grounded’ is used to denote the fact that the scenario is not just based on a constructed narrative of ideas, but that it is underpinned by both the qualitative and quantitative results of the ‘PROFIT’ study – such as user perceptions and knowledge of the business landscape.

next downstream actor in the chain. In a volatile, competitive environment, strategy is no longer a matter of positioning a fixed set of activities along a physical value chain; the focus is the value creating system itself. This includes not only the suppliers, partners and allies, but also the customers who together co-produce value to allow an ever improving fit between supplier competencies and customer needs. Value occurs in complex value networks rather than in sequential chains.

In many cases the operational boundaries between supplier environment and customer can be thought of in terms of three main components of content, infrastructure and context. This provides a useful simplification when dealing with virtual value chains [12], value may be extracted by disaggregating some or all of these components.

In a value chain, there are three principle roles: the enterprise creating value, the customer and the supplier. The enterprise buys goods and services from its suppliers and assembles them to produce new goods and services to meet the needs of customer (who may also be other businesses).

A value network (figure 2) includes additional actors: intermediaries and complementors. The intermediary performs on behalf of the enterprise a function (typically, sales, fulfilment or information and communication) which is a part of the enterprise's operational requirements. The complementor provides additional products and services to extend the capabilities of the value network.

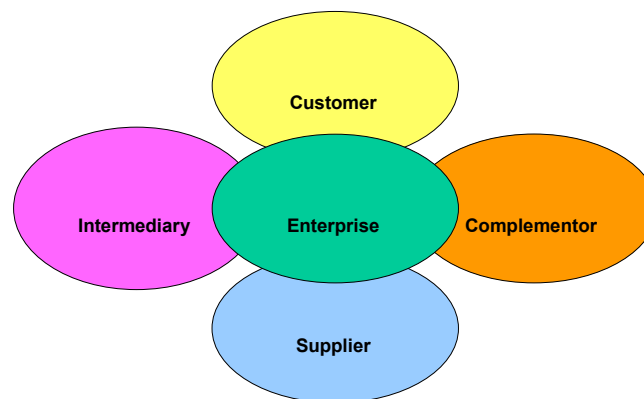


Figure 2 Actors in a typical value net (tele-management forum)

Moving towards a more holistic view, the value network must operate with the efficiency of a self-contained enterprise, which requires managing the network on a process rather than on an organizational basis. This places great importance on the core enterprise, which is no longer just one actor in a chain but the central point of execution and responsible for the whole value network. This includes the operational platform and infrastructure by which the other business partners can collaborate to deliver goods and services.

3.3. Strategies for Competitive Advantage

The emerging market for i-Space applications is characterised by:

- the constant innovation of new products and services,
- rapidly evolving customer needs, often as a response to new products and service offerings;

⁴ i-Spaces (intelligent spaces): The intelligent environments created by AmI. These respond and adapt intelligently to the presence of the individuals within, and anticipate needs including the need to communicate and interact with other i-Spaces. Although in many contexts, the terms AmI and i-Space are interchangeable, the concept of an i-Space emphasises an aspect often neglected in discussions of AmI –the notion of boundaries. Spaces are bounded both physically and logically; access to these spaces may be restricted to particular people, or at particular times.

- complex supply systems (value nets) that involve several companies working together to deliver the end-user application.

The delta model developed by Hax and Wilde [13] captures these three aspects and is helpful in further strategic analysis (figure 3). Porter's [11] models are built on a best product concept, which defines differentiation, cost and focus shown on the right hand side of the triangle. But the delta model indicates that competition can also be thought of in terms of two other dimensions: (i) customer solutions (products 'locked' to customers) and (ii) system economics (products 'locked' to customers and complementors).

The 'best product' value chain approach concentrates on the internal operation of the firm and its operational efficiency. The concept of a value net is more outward looking, bringing in the concepts of external actors and co-operation. A degree of lock-in between products, customers and complementors, not seen in the best product paradigm, is a characteristic of the value net.

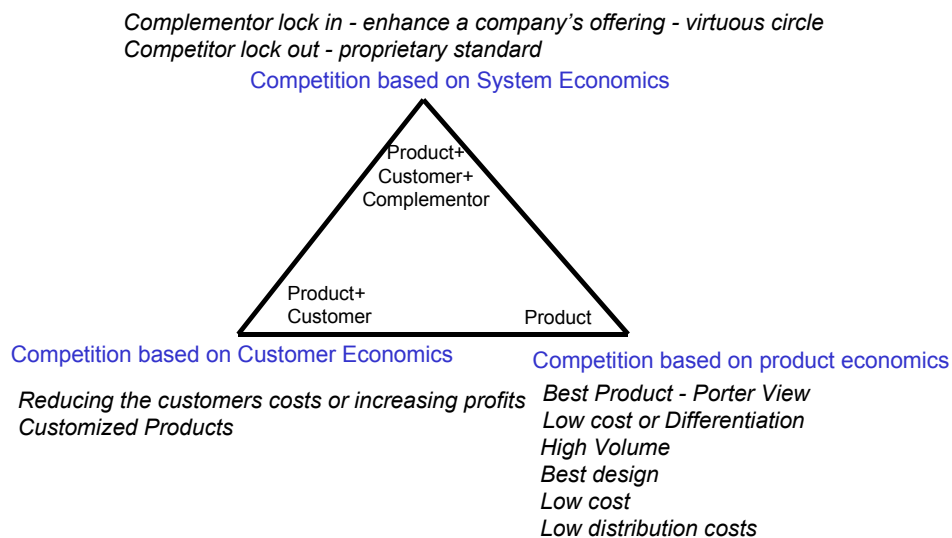


Figure 3 Macro perspective: the delta model Hax and Wilde, (1999)

3.4. Competition based on Customer Economics - Customer Targeting

If operational efficiency was the keyword of the best product paradigm, then customer targeting is the keyword here. As an example the amazon.com business model is shown below in figure 4. Amazon relies on the centralised or intermediate server acting as a hub for transactions. The actors in this case are simply a supplier, a customer and the centralised Amazon portal. The portal intercepts the business processes between provider and customer. In the parlance of the Delta model, Amazon comes under the category of 'horizontal breadth', and is positioned on the customer economics-system economics axis. Examples such as Disney and Macdonalds are termed as 're-defining the customer experience', and positioned on the customer economics-product economics axis.

3.5. Competition Based on System Economics – Innovation

The key characteristic in this space is that companies claim to be the de-facto standard in the industry and act as the core enterprise of the value network: this is the highest value space. The keyword here is innovation: the existence of network externalities [14] generates a virtuous circle in which users are locked-in to the dominant system. Complementors are locked to products, which in turn are locked to customers. Microsoft, Intel and partners are classic examples of system based economics. Microsoft has dominated the desktop market for years. The high user base of Microsoft products and the advantages of portability this gives users, have effectively locked competitors out. Other notable examples of business models of system based competition are eBay and i-mode.

NTT DoCoMo own the i-mode standard, and this alone provides the uniqueness to enable competition based on system economics. In the i-mode model, DoCoMo advertises the service in return for a 9% commission for deals negotiated using the i-mode platform. There is very little for the central server to do other than vet content from providers (figure 5). Content providers and customers trade freely between themselves; content providers self-organise, akin to a peer-peer model. Thus, Japanese banks self-organised to provide a coherent customer service. No trading agreements are in place between the content providers and DoCoMo, yet the existence of the content providers itself generates up to 20% more phone calls [15]. The i-mode example is particularly interesting as it begins to demonstrate the characteristics of a complex ecosystem: i-mode exhibits the last vestige of the 'centralised' model before migrating to peer-peer, and demonstrates self-organising properties in terms of the behaviour of content providers.

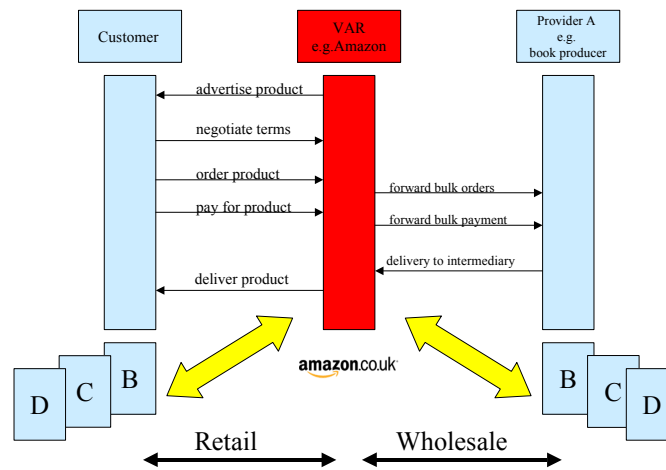


Figure 4 Amazon model

Note: i-mode subscribers also generate 20% more phone calls

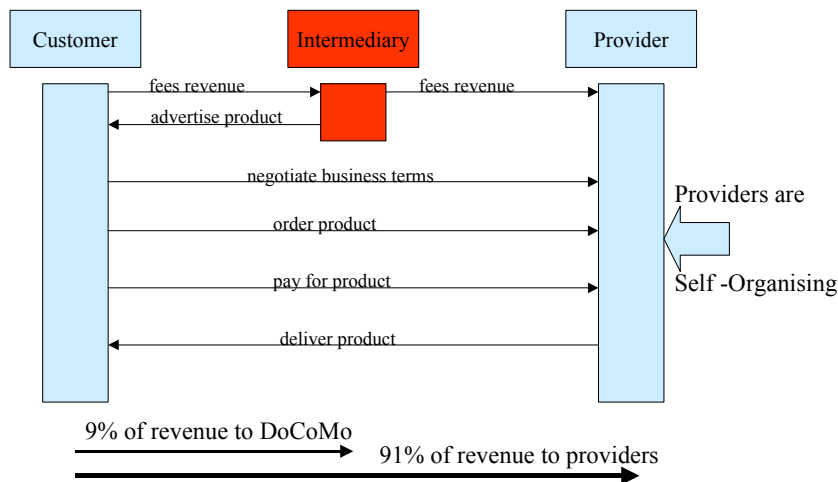


Figure 5 i-mode business model

3.6. Regulation

A feature of system economics is that the virtuous circle created by network externalities can result in one company dominating the market. As Microsoft have found, this raises questions about the need for regulatory intervention, as it assumed that market dominance will encourage anti-competitive practices. Active regulation can serve as a barrier to competition based on 'system lock-in'. This will be one of the most difficult issues that Telcos will face in the new economy, if they seek to compete by controlling a key part of the system. Yet, such control may be necessary to justify the potentially enormous capital investments required in providing high bandwidth fibre services on a ubiquitous basis. This regulatory

limit on the nature of competition will serve to limit the profitability of Telcos. The only telco which appears to have avoided this is NTT DoCoMo, with the i-mode service. NTT DoCoMo has an extremely powerful position, being able to dictate specifications to operators. In Europe, operators do not control the rights to Wireless Internet standards in the same way that NTT DoCoMo owns the i-mode standard.

At present there is a regulatory barrier, which serves to attempt to increase competition, by taking power from those players deemed to have ‘SMP’ (Significant Market Power). Willman et al. [16] suggest that in order to cross the regulatory barrier, alliances should be built in collaboration with industry, regulators, and government, focusing on encouraging a higher level of co-operation. In the UK the Telecommunications Strategic Review is taking place by the current Regulator Ofcom. This will have composed three phases of consultation with over 100 stakeholders in the UK, before it is due to report around mid 2005 with a new package of regulation to suit the emerging networked economy.

3.7. Market Dynamics (Figure 6)

At present, some of the new generation of business models have exposed the most profitable elements of value chain to attack, which can lead to commoditisation and the destruction of the value chain. This can be seen in respect of disruptive technologies, for example WiFi could disrupt the adoption of 3G, startup airlines have disrupted the main carriers, Linux software, and the threat VoIP poses to existing PSTN revenues.

The customer plays a key role in the de-commoditisation process. Understanding shifts in customer behaviour is crucial to the innovation and re-bundling process. The studies in the PROFIT project have highlighted key areas of requirement and concern by real customers. These must be taken into account when service re-bundling takes place.

The stable ecosystem, employing a network of integrators, complementors, customers and suppliers surrounding the enterprise will enable a more sustainable model to be built. The key enablers of the System Economics model are lock-in and co-operation.

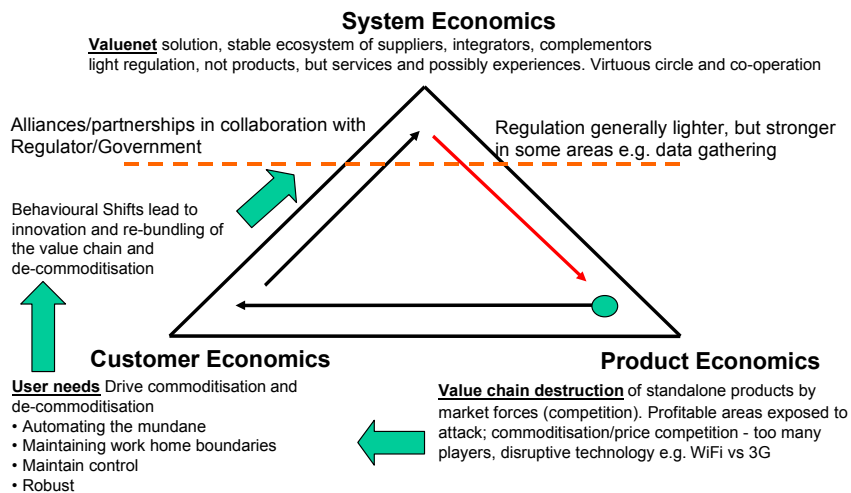


Figure 6 Market dynamics; moving towards a pervasive ICT environment

As the market for AmI develops, Telcos face the risk of being relegated to a minor role as the provider of commoditised connectivity. However, connectivity is also a key enabler of the visions – Telcos also have the opportunity to use this key role as a lever to position themselves as major providers of AmI services and applications. To do so, they need to understand the implications of both customer and systems economics.

Key markets and applications have been listed above. However, the descriptions are very generic at this stage. It will be essential for Telcos to engage with customers, seeking feedback and adapting service offering to match developing customer requirements. Telcos will need to develop a relationship, and

possibly even a partnership with key customers or customer groups, with whom they co-develop new products. Successful AmI providers will actively respond to customer concerns about privacy, security, reliability and control and seek to resolve these issues.

4. Conclusions

This paper has examined the socio-economic dimensions of AmI, and a number of conclusions can be reached from both the user and business perspectives. Qualitative fieldwork firstly revealed that ubiquitous services, applications and devices are not seen as a user need or beneficial in all circumstances or to all users. Maintaining work/ home boundaries are important to people with certain philosophies, work and home situations. Ubiquitous services, applications and devices must be developed to accommodate sophisticated forms of 'switching off' which allow the maintenance of work/ home boundaries in the multiple ways users require. Secondly, the presentation of existing AmI scenarios to users across Norway, Finland, Hungary and the UK revealed very similar negative discourses surrounding the worked through examples of AmI devices and services – the 'digital me,' unified identity verification device, 'guardian angel,' taste and preference adaptor and 'device as agent.' The development of future AmI devices and services will need to take into account concerns about non-independence, loss of control, security, privacy and systems failures. These will need to be addressed if AmI is to experience widespread adoption. AmI is associated with some positive aspects such as automating the mundane, helping people to be more in control of their lives and its environmental benefits in monitoring and intelligently switching off. These positive aspects must be emphasised in future marketing and the creation of new AmI scenarios.

Governments and regulators have a key role in encouraging the development of AmI. As well as funding seed research, they will need to ensure there are appropriate incentives for companies to invest in AmI. This means taking on board the implications of system economics, particularly the fact that these are often subject to network effects and positive returns to scale that encourage near monopoly. It is likely that customer or user concerns will lead to tighter regulation on 'intelligent' data gathering and on what information businesses or government can hold on an individual and their behaviour. This is particularly important where the application is dependent on collecting personal data e.g. an intelligent home agent like the guardian angel. The role of the regulator is also important in reassuring the customer that the recommendations that AmI devices make are in the users' best interests rather than in businesses' best interests – for example that health related devices do not advise the use of expensive medical products rather than what is best in the situation. Telcos and other AmI suppliers will need to work with regulators to ensure a regulatory regime that both meets the concerns of users and the commercial needs of business.

Since the delivery of AmI services will generally involve a number of suppliers, Telcos will need to understand the system economics and should try to act as the core enterprise of the associated value network. This will mean actively working with partner companies to ensure customer needs and concerns are dealt with. In developing a value network (or value system) Telcos will not only need to identify potential partners with whom to collaborate, but also have a very clear view of their role within the network. In particular, Telcos will need to ensure their contribution to the system is both unique (cannot be readily replaced or copied) and core to the application, otherwise the system is likely to be unstable. In order to sustain the system, Telcos will need to actively manage the relationships with their partners, as well as governments and regulatory bodies.

AmI involves thinking beyond notions of ubiquitous services and applications to the convergence of three technologies: ubiquitous computing, ubiquitous communication, and intelligent user-friendly interfaces. AmI presents some tremendous business opportunities and challenges to telecommunications operators and service providers, with the need to consider value chains, market dynamics and how AmI devices can be usefully incorporated into people's life worlds. Never has it been so pertinent to explore these opportunities and challenges, and to produce 'grounded scenarios' which better reflect the emerging business landscape and user acceptance issues.

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