Introduction

This book sets out a vision of pervasive IT through intelligent spaces and describes some of the progress that has been made towards its realisation.

The context for intelligent spaces (or iSpaces) is the world where information and communication technology (ICT) disappears as it becomes embedded into physical objects and the spaces in which we live and work. The ultimate vision is that this embedded technology provides us with intelligent and contextually relevant support, augmenting our lives and our experience of the physical world in a benign and non-intrusive manner.

The enormous advances in hardware, system design, and software that are being achieved enable this vision. In particular, the performance advances and cost reductions in hardware components — processors, memory, storage, and communications — are making it possible to embed intelligence and communications ability into lower cost objects. The Internet is a living experiment in building complex, distributed systems on a global scale. In software, there have been solid advances in creating systems that can deal with complexities on the scale required to interact with human activity, in limited domains at least.

The ultimate vision is challenging, and there are many obstacles to its realisation. There are several technical barriers, especially in the creation of intelligent software, but there are also social and economic barriers. We can already see the first deployments of this technology in domains where the benefits are substantial. It is not clear, however, whether there are sufficient value points and benefits to support the fully pervasive and synergistic infrastructure of the iSpace vision.

An iSpace consists essentially of three components:

- the physical world in which users exist, in their relevant context;
- the interface between the digital world and the physical world — this contains embedded sensors to gather parameters, labels to identify objects, actuators to control things/appliances in the physical world, together with support software to facilitate non-intrusive two-way communication across the interface;
- the digital world in which digital knowledge and intelligent systems are available to influence and support actions in the physical world.

This volume opens with three general chapters. Firstly an overview, by the editors, to describe the broader topic, followed by Lyons et al, in Chapter 2, who describe the impact of iSpaces on businesses and the way people will work. This is followed, in Chapter 3, by Thompson and Azvine, who identify what intelligent systems research is needed to prevent users being overwhelmed by the complexity of the systems with which they will be asked to interact.

Physical World — Applications, Benefits, and Concerns

There follows a set of chapters describing several different iSpace application areas. Firstly, Luckett, in Chapter 4, describes the use of such technologies for supply chain

and production improvements, where application has advanced to the stage of commercial trials. Next, Brown et al, in Chapter 5, describe monitoring the well-being of people in need of care in their own home. The first systems for well-being monitoring have also undergone trials, and the chapter describes research on the next generation of more intelligent systems. The following three chapters describe the conversion of the home to an intelligent space (Bull et al in Chapter 6), an intelligent co-operative vehicle highway system (Bilchev et al in Chapter 7), and mixed-reality systems where the real and digital multimedia worlds can be merged to augment user experiences (Bulman et al in Chapter 8). Martinez et al, in Chapter 9 on glacial iSpaces, emphasise that the technology is applicable to hostile environments where humans rarely go but where we want to know what is happening.

These are just a few example application areas selected from the almost limitless possibilities where the technology could have a significant impact.

There are, however, concerns about trust, privacy, and security in these systems. Selezynov et al, in Chapter 10, define realistic models of digital trust that are capable of dealing with the uncertainties inherent in the environment to help engender trust. Then Sopppera and Burbridge, in Chapter 11, describe privacy issues, including legal and technical aspects, and offer a privacy management system for iSpace devices. In Chapter 12, the same authors describe the issues and approaches to satisfying the needs for privacy in the application of radio frequency ID (RFID) technologies, such as those introduced in Chapter 4.

The Interface — Observing Human Activity

In order that the relevant parameters can be gathered to make applications truly beneficial there is a need for a wide range of high-performance and low-cost hardware technology to form the interface between the real and digital worlds. Payne and Macdonald, in Chapter 13, analyse the massive advances and ongoing trends that have occurred in the hardware area, covering silicon, batteries, displays, wireless connectivity, etc. They conclude that there is still some way to go to achieve the full vision, but that enough progress has been made to have real impact in the immediate future. Heatley et al, in Chapter 14, show how large amounts of information can already be gathered from very simple sensors, e.g. attaching a microphone to the water pipe can lead to inferences of many household activities to feed data to a homecare application.

Xu et al, in Chapter 15, tackle the issue of automating visual events detection-and-behaviour analysis for advanced visual surveillance systems. Extracting behaviour from such sensors would considerably empower iSpace technology. The iSpaces can also allow the inference of interests a user might have and hence help retrieve contextually relevant information to support the user. Bamidele et al, in Chapter 16, do this by using a visual attention algorithm to drive content-based image retrieval, while Oyekoya and Stentiford, in Chapter 17, describe how they track eye-gaze direction to infer what a user is interested in, for image retrieval purposes.

Digital Infrastructure — Architectures and Intelligence

The realisation of iSpaces as an application of pervasive ICT will radically increase the number of intelligent, communicating objects in the world. The complex and dynamic nature of these systems will require new approaches to system design and

implementation. For example, the Internet provides the glue for iSpaces, combining wire and radio links, but will it cope with the future scale, dynamics, and heterogeneity? Briscoe, in Chapter 18, concludes that the Internet was well conceived for this sort of usage, but that a number of issues will arise and will need attention. Three further chapters consider aspects of the digital infrastructure. Firstly, Shackleton et al, in Chapter 19, consider self-managing, self-repairing systems that can be easily deployed; secondly, Saffre et al, in Chapter 20, consider the design of scale-free networks; thirdly Ghanea-Hercock et al, in Chapter 21, consider the implementation of a service-oriented architecture in a heterogeneous world.

The networks gather the data from the interface elements and present them for intelligent analysis, according to the requirements of the applications. Some of these aspects are tackled by the final three chapters. Nauck et al, in Chapter 22, describe their development of a system that abstracts required information from an iSpace and provides the data for automatic intelligent data analysis, which is then used for a homecare application. One significant problem is that of inferring users' needs from observations of their behaviour. Allen et al, in Chapter 23, have developed the xAssist framework as a vehicle to experiment with such an inferencing process. Both these chapters seek to create software that explicitly infers intent or needs, whereas Callaghan et al, in the final chapter, discuss a solution based on the use of embedded agents to enable emergent intelligent behaviour by predominantly implicit processes.

Towards the Vision

This book provides an overall vision of intelligent spaces, where they are expected to provide benefits, and what many of the social and technical issues are that must be solved before widespread adoption. However, it is clear that before this vision can be fully realised there are many other technical, social, economic, and business issues to be solved. *En route* to the full vision there are many more constrained visions that can provide valuable benefits to users and useful business opportunities. The technologies are now ready for the development and implementation of such spaces. It is hoped that the content of this book will help readers to imagine and then create a future in which iSpaces become widely implemented.

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The Socio-Economic Impact of Pervasive Computing — Intelligent Spaces and the Organisation of Business

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2.1 Introduction

This chapter is based on work carried out for the Eurescom project P1302 — PROFIT (Potential Profit Opportunities in the Future Ambient Intelligence World). The vision driving iSpaces is described in many different ways, e.g. ubiquitous computing [1], pervasive computing [2], ambient intelligence [3]. Based largely on expected developments in information and communications technology, it has three main aspects:

- pervasive communications;
- ubiquitous sensors and actuators;
- embedded intelligence.

How these capabilities can be exploited for the benefit of both individuals and businesses is the key challenge of the iSpace vision. The different descriptions referred to above emphasise the three characteristic capabilities to varying extents. Ubiquitous computing, as its name implies, concentrates very much on the embedded intelligence of technology. Its emphasis on 'calming' human-centred technology is highly dependent on intelligent systems providing intuitive interfaces and appropriate information to the user in such a way that the underlying technology becomes invisible. Ambient intelligence and iSpaces build on this vision, to include the sensor and actuator networks that enable a continuous interaction between individuals and their environment — and all these visions assume some degree of communication between individual devices, between devices and humans, and between humans.

Thus, an iSpace is an environment that responds and adapts intelligently to the presence of the individuals within it and anticipates requirements, including the need to communicate and interact with other iSpaces. The pervasive communications strand is similar to ideas of seamless, mobile, and broadband communications networks that are seen as the prime enabler of the information society. The concept of an iSpace emphasises an aspect often neglected in discussions of pervasive computing or pervasive ICT — 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. However, a key feature of iSpace technology is its

ability to extend information horizons — potentially to a global level. Like PCs in today's Internet, iSpaces will be interlinked to enable interactions between anyone (or anything) connected to them, regardless of physical location. One challenge for the technology, therefore, will be to protect those spaces from intrusive and unauthorised access by others.

2.2 Commercial Opportunities

The development of iSpaces will create a system of trillions of interconnected entities, ranging from the most humble object to the most complex. Each entity will have both communications and computing capabilities. They will be able to communicate information, interpret it, and process it. This vision leads us to envisage new ways of creating value and organising businesses.

New business (value creation) opportunities may arise through the development of new infrastructures (such as sensor nets), new operating systems (already a key battleground [4]), and a wide range of applications including intelligent management systems to support both businesses and individuals. A Eurescom survey [5] of iSpace and ambient intelligence scenarios [3, 6, 7] identified a number of key application areas:

- communications/messaging;
- leisure/entertainment;
- collaboration/teleworking;
- e-Government;
- safety-/location-based;
- live independently/health;
- financial security/financial services;
- data across the Web/information services;
- quality of life/monitoring;
- education.

Some specific applications described in the scenarios included:

- 'Digital Me' — a device for controlling access by voice at a particular time, and could decide which calls to ignore;
- identity verification — a device-verifying identity and unifying identity-related information;
- taste and preference adaptor — a device altering things to your own tastes and preferences, e.g. room lighting, news, TV programmes;
- guardian angel — a device to 'look after them', e.g. telling people when they are ill or stressed, remembering where things have been left, stop them when running a bath that is too hot;
- device as 'agent' — a device that acts as an individual's agent, e.g. ordering groceries, looking for and ordering cheaper insurance.

All these applications depend on embedded intelligence and at least local (within a room or house) communication, but the use made of sensors/actuators or global communications varies widely. A crucial concept is 'context-awareness' — the idea that the intelligence within the iSpace is such that it can act (both proactively and reactively) to humans in an appropriate manner, i.e. in a way that reflects the current mood, activity, role, etc, of one or more individuals.

The wide range of potential applications reflects the pervasive nature of the underlying technologies, but will also present problems for companies seeking to exploit the opportunities. As Odlyzko [8] points out, the spread of pervasive computing or iSpace technologies will '... ignite an explosion of innovation that will destroy any stability that might exist'. In this dynamic environment '... new players and new business ideas will be emerging constantly .... no company will be certain of its commercial environment, even in the short-term. If companies are to succeed in the long-term they will need to be constantly innovating' [9]. But eventually, user expectations will start to stabilise and more permanent business forms will emerge.

Although there are many visions of end-user applications, there has been much less attention on the impact of iSpaces on companies. Yet iSpace technologies will have a profound effect, not only on the products and services offered, but also on the way companies are organised and managed. The following sections look at three areas in particular:

- many of the new iSpace applications will be complex services involving several companies working together — this will continue to drive the development of new organisational forms and strategic approaches;
- the rapidly changing market environment and the need for constant innovation will force successful companies to adopt management structures and systems that favour flexibility and adaptiveness;
- the adoption of iSpace technologies by companies will change the way people work — in particular, iSpaces will encourage a merging of home, work, and public spaces.

2.3 New Organisational Forms — The Emerging Value Nets

2.3.1 Value Chains and Value Nets

Following Porter's generic framework [10], 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 iSpace market, neither products nor customer expectations are fixed, posing a challenge to the simple concept of a supplier adding value to a physical component and passing on to the 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 (see Fig. 2.1).

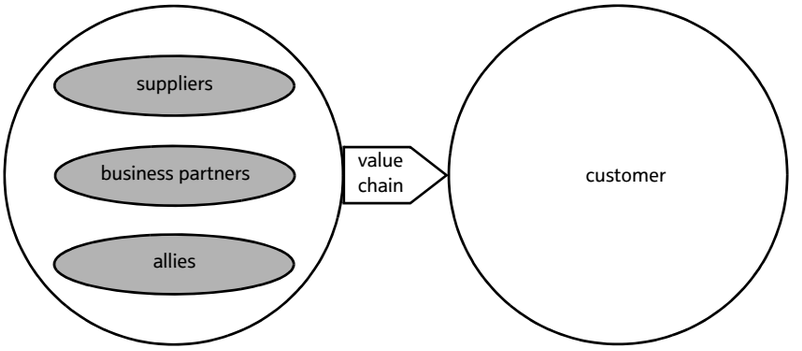

Fig. 2.1 Supplier 'system' allowing the customer to add value.

In many cases the operational boundaries between supplier environment and customer can be thought of in terms of three main components — content, infrastructure, and context. This provides a useful simplification when dealing with virtual value chains [11] — value may be extracted by disaggregating some or all of these components.

A value chain, has three principal 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 the customer (who may also be other businesses).

A value network (Fig. 2.2) 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.

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 an organisational 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. Such value networks will lead to the development of new strategies for competing in emerging iSpace markets.

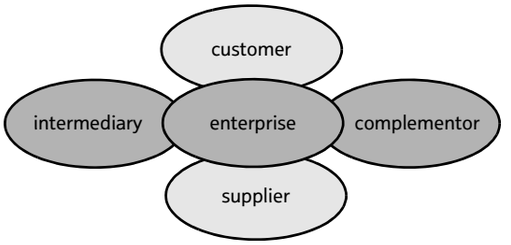

Fig. 2.2 Actors in a typical value net (Tele-Management Forum).

2.3.2 Strategies for Competitive Advantage

The emerging market for iSpace 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;
- 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 [12] captures these three aspects and is helpful in further strategic analysis (see Fig. 2.3) [5, 13]. Porter's models [10] are built on product economics — a best-product concept, which defines differentiation, cost, and focus as shown on the right-hand side of the triangle in Fig. 2.3. But the delta model indicates that competition can also be thought of in terms of two other dimensions:

- customer economics — products 'locked' to customers;
- system economics — products 'locked' to customers and complementors.

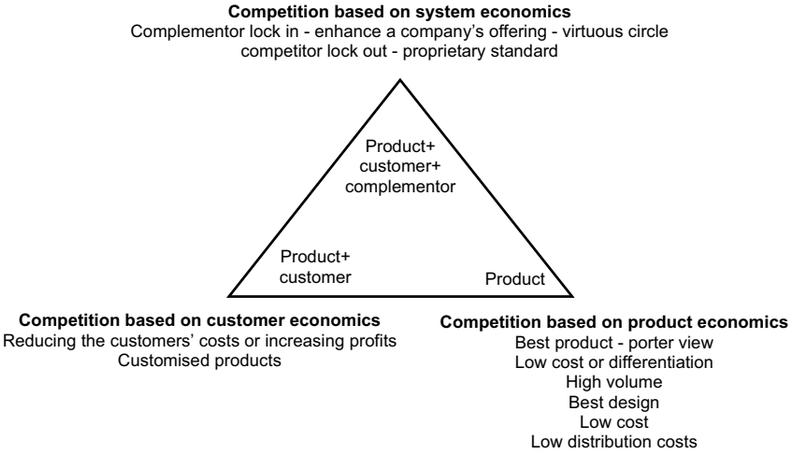

Fig. 2.3 The delta model [12].

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.

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 in Fig. 2.4. 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 McDonalds are termed as 'redefining the customer experience' and positioned on the customer economics/product economics axis.

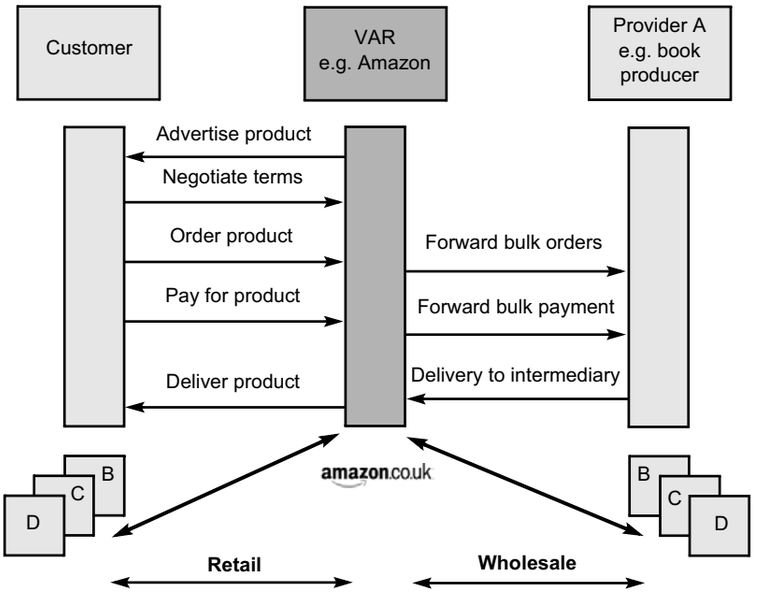

Fig. 2.4 Amazon business model.

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 [14, 15] and act as the core enterprise of the value network — this is the highest value space. The keyword is innovation — the existence of network externalities [16] generates a virtuous circle in which users are locked into

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 exploiting system-based competition are eBay and i-mode.

NTT DoCoMo owns the i-mode standard, and this enables 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 (Fig. 2.5). Content providers and customers trade freely between themselves; content providers self-organise, akin to a peer-to-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 telephone calls [17]. The i-mode example is particularly interesting as it begins to demonstrate the characteristics of a complex ecosystem — i-mode exhibits the last vestiges of the 'centralised' model before migrating to peer-to-peer and demonstrates self-organising properties in terms of the behaviour of content providers.

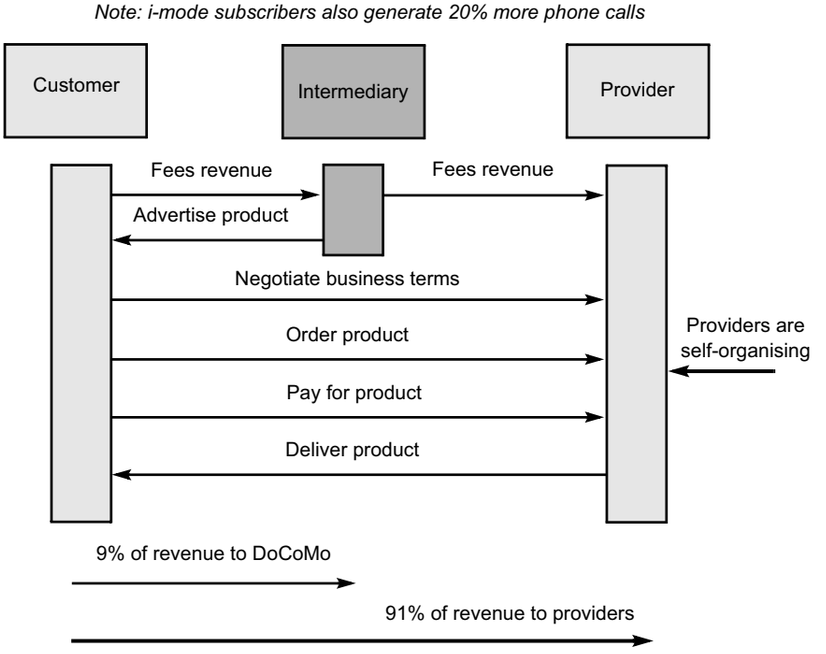

Fig. 2.5 i-mode business model.

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 has

found, this raises questions about the need for regulatory intervention, as it is 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 that appears to have circumvented this is NTT DoCoMo, with the i-mode service. NTT DoCoMo has an extremely powerful advantage, as the company owns the i-mode standard, and owning a proprietary standard enables the company to dictate specifications to providers and operators. In Europe, operators do not control the rights to mobile Internet standards in the same way. From the delta model perspective, rather than competing in terms of system economics, most other wireless carriers are presently moving along the horizontal axis in the direction from product economics towards customer economics.

2.4 Creating the Adaptive Company

The dynamic nature of the future market, and the complex relationships this will generate, imply that the days of mechanistic command and control in business are limited. The enterprise should build relationships with customers, suppliers, and even competitors to create a powerful value net. Often, there will be advantages from co-operating with potential competitors, as joint development plans can lead to bigger returns. Relationships also need to be built with organisations that complement what we do. The most valuable resource today is the combined knowledge of the team. For example, it is advantageous for software and hardware developers to work together, as seen in the case of Microsoft, Intel, and partners. Effective knowledge management will be the key to harnessing the opportunities that complexity brings. The approach for future iSpace business models should be to create networks that respond to the environment and that have the freedom to evolve as self-organising systems.

2.4.1 Controlling the Work or Controlling the Worker?

The need for organisations to be flexible has implications for the way iSpace technologies will be used in future companies. Current ICT systems include enterprise resource planning (ERP), supply chain management (SCM), customer relations management (CRM), and employee relationship management (ERM). The capabilities of these systems will be greatly enhanced by iSpace technologies — much greater information on process performance and status will be gathered in real time, leading to greater control of both processes and service. By taking over much of the routine information transfer and recording, and ensuring process information is delivered to individuals in a timely and controlled way, these systems could both improve efficiency and reduce information overload. However, these same systems will involve the monitoring and storage of far larger amounts of information about

individuals than is currently possible. Used inappropriately, they could give rise to unacceptable levels of monitoring of both consumers and employees, resulting in consumer suspicion and causing stress in employees [18]. Furthermore, if system design emphasises efficiency, then the resultant levels of monitoring and control may work against the need for flexibility and self-organisation, inhibiting the innovation essential for survival in an increasingly competitive environment.

DeTienne, in a largely optimistic article [19], saw the use of ICT systems as a means to provide support and coaching for the users — by monitoring and providing feedback on performance, ICT systems can help both individuals and teams to improve. Monitoring programmes can ensure that successful strategies discovered by one team member can be shared with others. For example, Fastline's fast tracker enables co-workers to monitor each other's Web surfing, helping them to discover the best practices of successful co-workers. Context-sensitive support can ensure appropriate information is delivered to an individual, thus relieving them of the need to remember vast amounts of detail which may only be used occasionally. Work-flow systems can 'talk' employees through complex procedures, thus helping workers to concentrate on key issues. In these examples, the emphasis is on providing support and feedback to individual workers, rather than assessment and control.

Unfortunately, DeTienne [19] contains a number of examples (often in call centre environments) where existing systems were used primarily as means of control, to impose compliance and uniformity on the workforce. Common criticisms of the then-current monitoring systems were that they were only used to speed up work and that there was too much emphasis on quantity of work rather than quality. Ten years later, little seems to have changed. Head [20] suggests that if anything, the situation has worsened — for many workers, the introduction of advanced ICT-based management systems (such as ERP or CRM) has led to a deskilling of the work, strictly enforced work practices, and constant, real-time monitoring of performance.

Given that the emerging ICT and iSpace technologies can be used either to control employees or to support adaptive responses through coaching and appropriate information access, it is worth considering why the trend seems to be so firmly towards control at present. There appear to be four drivers:

- the technology needed to monitor and control is, in general, simpler and largely in place — in contrast, coaching systems require a higher level of intelligence that has yet to be developed;
- the emergence of a 'risk society' [21] in which institutions use surveillance as a means of managing risk — information collected about individuals and their activities is compared with standard profiles (good, bad, trustworthy, untrustworthy) to decide how to deal with those individuals;
- ERP and CRM systems, etc, offer the potential to replace (costly) experts with expert systems and (cheaper) unskilled people [20];
- finally, there is the attitude of managers — '... most business people, without knowing it, see the service world through the lenses of manufacturing goggles ... they are influenced by historical traditions in business training, strategy techniques and organisational theory, all rooted in manufacturing' [22], chief among these traditions being the manufacturing production line and scientific management, with their emphasis on standardised procedures, measurement and control.

A more holistic view of a company's operations may be necessary — rules and procedures tend to grow over time, in response to specific failures, or to meet growing regulatory and legal requirements. The more these are automated, the less freedom individuals have to ignore them. A different view of the workplace [23] described it as a bundle of services, noting that 'employee self-service is an emerging and rapidly evolving set of applications.' If the iOffice and other work-related systems are to live up to the promise of supporting flexible and adaptive organisations by helping and coaching individuals, then the use and control of the key tools must move towards the workers, rather than remain with the employer [24].

2.5 Changing the Way We Work

2.5.1 Field Work — the Home–Work Interface

Many of the iSpace scenarios are technology-driven and in most (though not all) cases there is an emphasis on efficiency in terms of using time, interactions with others, etc, as effectively as possible. The interface of personal activities and work activities are a key element of many scenarios. However, some of the visions (e.g. the 'road warriors' travelling the globe, but simultaneously in contact with both work and home) describe a life-style that is alien to many, and one not sought after nor attractive to the majority. The frenetic juggling of multiple interactions described in some scenarios is a marked contrast to the vision of 'calming technology' described by Weiser [1] and a reminder that the way the technology is used depends on a wide range of social, political, and economic factors.

In an attempt to build a more realistic scenario, work has been undertaken to study how ICT supports both the maintenance of work–home boundaries and the integration of these domains, with a view to understanding the likely impact of iSpace technologies [25]. One of the main impacts of ICT has been a marked increase in the number of people working from home for at least part of the time. For example, data from the e-Living project show that in the UK approximately 8% of people use the Internet to work from home, while a further 12% work at home using a PC. Understanding how people use the current generation of ICT to mediate between the home and work roles provides clues as to how iSpaces may be used in the future.

The survey was carried out by means of over 30 interviews with a range of people working both in small businesses and in corporations. The small businesses included a number of 'life-style businesses' where the main driver was quality of life rather than profit maximisation. People had very different views about the extent to which they wanted to merge the work and home roles. Some, particularly small businesses, saw it as part of their service to be available at any time. Other people, more often life-style (hobby) businesses and corporate employees, sought to maintain a clear separation between work and home. Both groups, however, used ICT to control the degree to which work and home activities were integrated. Few people maintained a strict work and home separation; work activities would be done in the home, and home activities could be done at work.

As well as current technologies, interviewees were asked about their feelings towards proposed iSpace applications (see Section 2.2) in order to gain some insight into customer acceptance of these services. Overall, the responses were largely negative. This may in part reflect a suspicion of new technology and bad experiences with existing technology, but the concerns expressed were common to most interviewees across Europe and indicate the issues that need to be solved if the technology is to be widely accepted.

The main advantages of the iSpace technologies were seen to be in automating the mundane (reducing the time spent on routine and trivial activities) and helping people to be more in control of their lives. In fact, the concept of control is central to much of the debate, as most of the perceived problems and disadvantages of the iSpace technologies are also related to issues of control. Negative responses to technology included the following:

- privacy concerns — how to control access to, and the use made of, the (very personal) data gathered by iSpace applications;
- a concern that some of the devices would take over (the device controlling the human rather than vice versa), e.g. the 'guardian angel' might prevent people from undertaking activities it (the device) considered dangerous or the taste and preference adaptor would not recognise changes in taste, thus inhibiting spontaneity;
- a concern that choices made by an agent, or advice provided by the taste and preference adaptor, might not be independent, but influenced by the provider of such services — again this is an issue of who is ultimately in control of the technology;
- there was a concern about the risk of identity theft in an environment where transactions are being made remotely, and possibly without direct intervention by the individual;
- there was considerable scepticism about the ability of the applications to cope with the variability and unpredictability of human behaviour;
- finally, there was a concern about our becoming overly dependent on technology — although a valid concern, it is the one most affected by unfamiliarity, and therefore, as applications become more widespread and are found to be reliable, this concern should fade.

In general, then, the interviews highlighted two areas of concern. One is that of control — who controls the technology, who controls the data or information generated by the technology, and to what extent the user is being controlled by someone or something else. This is not primarily a technology issue, but a result of institutional factors including social and corporate norms, the legal framework, and economic drivers.

A second, related, concern is a scepticism about whether the technology is capable of the level of intelligence needed to filter incoming communications (Digital Me), adapt to changing tastes and preferences, or act as an autonomous agent, for example.

2.5.2 Institutional Issues and Control

In the context of the work–home interface, several issues of control need to be considered:

- the extent to which employees are in control of when and how they work;
- the extent to which the users have control over the data generated within an iSpace, particularly in their own home;
- the extent to which users want to be in direct control of the system, or are willing to trust the system.

Controlling Home–Work Boundaries

Prior to the industrial revolution, most craft workers worked at home, and life and work was an integrated whole. The introduction of factories and, later, office work led to a very clear separation between work and home life, with firm boundaries being set in both time (working hours) and space (work location separated from home). ICT has enabled more workers to re-integrate their work and home lives, leading to a blurring of the work–home boundary. There is no doubt that many people find it advantageous to be able to spend more time at home, working. The greater flexibility in both time and place of work gives individuals the freedom to juggle home and work responsibilities — all the more important in a world where most men and women work, and care of children or elderly relatives has to be shared. Growing use of the Internet for a variety of commercial transactions also enables people to sort out home issues (e.g. purchasing or paying bills) in the work environment.

Flexible working practices can be of benefit to both employees and employers. Thus, a survey within BT found that the ability to work flexibly helped to retain staff. However, the Eurescom survey showed that most people, especially those working for a corporate employer, still wished to maintain a distinction between work and home. An application such as 'Digital Me', which could automatically screen and prioritise calls (a task often achieved currently by the use of CLI or an answerphone), was seen as offering a useful service although there was considerable scepticism over whether such a system could work in practice.

The concern to maintain some distinction between work and home raises issues about who controls the boundaries. For the most part, interviewees were either self-employed or creative knowledge workers — groups that could reasonably exercise some control over these boundaries. Significantly, it was profit-making small businesses that were least inclined to impose a strict separation between home and work. While this was usually expressed as a matter of personal choice, it is also the case that such businesses may feel unable to restrict their work time for fear of damaging reputation and customer relationships.

A consequence of working from home is that the iOffice is extended into the home. As noted in Chapter 1, employees are more acquiescent to corporate 'Big Brother' in the iOffice. However, will this aquiescence extend to extensive monitoring in the home environment? And where are the boundaries drawn when personal and work life merge? Workplace monitoring is already widespread and likely to increase in scope [26–28]. If, for employees, the prime benefit of home working is greater flexibility in when or how they work, then systems that impose

rigid working practices on individuals will undermine both the benefits of, and enthusiasm for, home working.

Within the corporate sphere, the ability to maintain a separation between work and home depends very much on the norms of both the corporation and wider society. In the USA, where a high priority is placed on the demands of the economy, separating home and work life has become problematic for many workers — 'the long arm of the job has reached into employees' homes, their nights, their weekends, and their vacations, as technology designed to make work less onerous has made it more pervasive' [29]. Quoting a book by Jill Andresky Fraser, Beatty [29] describes how work is encroaching into the time people spend at home: 'What Fraser calls "job spill" is the dirty little secret behind many a corporation's thriving bottom line. Half of all households own pagers and half of those who own pagers have been beeped during a vacation' [30]. It is important to recognise that the driver for these trends is not the technology — much of which, as Beatty notes, was developed to make life easier — but the extreme competitiveness of the US commercial environment, which forces firms to find new ways to increase productivity and reduce costs.

It does not have to be like this, but it is important for both companies and employees to have a clear understanding of expectations. For example, Microsoft UK recently introduced advanced technology (smart phones, tablet PCs, and broadband at home). However, a survey conducted with the Work Foundation found strong '... demand for an "agreed etiquette" and "clarity of expectations" from Microsoft's management as to when work ended and their home life began'. Staff felt stressed by the '... ambiguous expectations about how available they should be, ... given that the technology enabled them to work 24 hours a day'. In response, Microsoft '... issued guidance to all its UK staff on when they should turn off their mobile phones and disconnect from the Internet at home, following a six-month trial of the latest mobile technology...' [31] and saw clear benefits from the experiment. After an initial drop, due to a learning curve, the company saw an increase in the productivity of its workers.

Microsoft UK is not the only example of good practice. BT has for many years promoted teleworking, both for its own staff and for its customers. All the authors of this chapter work from home at least part of the time and have benefited from the greater flexibility and productivity offered by teleworking.

Ownership and Control of Information — a Key Issue

There is a widespread concern about the implications of ICT for the privacy of consumers [26] that is thought to be slowing the development of eCommerce. Concern is likely to increase in the future — an announcement that Benetton intended to sew RFID tags into its clothing range caused a deluge of complaints by customers and the project's being postponed [32]. The development of iSpaces greatly increases the extent of monitoring and surveillance. 'This will be possible not only because this intelligent environment will be able to detect what people are doing in their everyday lives ... but also because it will connect and search isolated databases containing personal information' [33]. Thus it will be increasingly difficult for people to find a space where they have 'the right to be left alone' — one of the earliest definitions of privacy. The issue is not monitoring *per se*, but rather the use made of the monitoring taking place, by whom and the extent to which an individual can control this monitoring. But such monitoring is an integral part of

iSpaces, without which the vision of an intelligent, responsive, and adaptive environment is not feasible.

Fortunately, the same technology that is reducing the cost of data gathering and collection also offers greater control of information by the individual. Agent-based approaches are being developed such as the P3P [34], which enables an individual's computer agents to seek Web sites for business, having specified what types of privacy policy are acceptable, or should be avoided. Such systems enable individuals to establish an optimal level of privacy at minimal cost in terms of time and money — a clear case of 'automating the mundane'. They will also be able to monitor and track the usage of personal information by those gathering it. This transparency in usage also acts as a check on abuse of privacy [35].

Control of Services

Interviewees were very concerned that the advice and actions taken by intelligent systems should be independent of any third party. This was particularly the case for services offering medical or health support and advice. There is clearly an issue of trust here — many of the iSpace systems are designed to learn individual preferences and will, after an initial period, act in the interests of their user. However, those users must feel confident that the device is not being manipulated by other organisations, and providers of intelligent devices and services need to be sensitive to customer expectations. Failure to do so can have serious consequences, as TiVo discovered. TiVo is a personal video recorder (PVR) that will automatically scan programme listings and record on to a hard disk everything for which it is programmed.

This is another example of technology 'automating the mundane' and PVRs have been sold on the basis that customers have control over what they watch and when they watch it. The machines can also be used to monitor viewing habits. This latter facility could be useful in letting the machine learn users' tastes and suggest other programmes they may be interested in.

However, the machines can also be remotely set to record specific programmes. In 2002, this facility was used to record for all subscribers a BBC sitcom 'Dossa and Joe'. The idea was to try using the machines to market new TV programmes; no one was forced to watch the programme, but some people might be tempted to try it. The response from TiVo subscribers was fury, much of it related to the fact that they were not given any option over whether or not to record the programme [36]; viewers perceived it as an invasion of privacy.

2.6 Summary

The development of iSpace technologies will have a radical impact on the commercial relationships between companies and the way individuals interact with these companies, both as consumers and as employees. Successful companies will exploit not only the new commercial opportunities offered by iSpaces, but also the technology within their own organisation.

The dynamic market-place created by emerging technologies will have an impact on the way companies are structured, with a shift from a linear value chain of suppliers and customers to more complex value nets that incorporate complementors

and aggregators. Commercial relationships will become more complex and dynamic, requiring companies to move away from a command and control approach towards one that emphasises flexibility and adaptiveness. iSpace technologies will be adopted in the workplace; they offer greater flexibility both in where people work and in how they work. Where individuals have retained overall control of the technology (as at Microsoft), such flexibility has been shown to improve productivity and can improve employee retention.

Although individuals can see potential benefits from proposed iSpace services, there is considerable concern about privacy issues and the question of who is in control of the technology. Intelligent systems can help with both the privacy and control issues, but this depends very much on the trust people place in their suppliers. Service providers will need to be sensitive to these concerns and ensure their actions do not breach customer expectations. A key issue is the question of control — some degree of end-user control over the way the systems use information and interact with individuals will be essential if iSpaces are to be accepted both in the home and at work.

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2

The Socio-Economic Impact of Pervasive Computing — Intelligent Spaces and the Organisation of Business

M H Lyons, R Ellis, J M M Potter, D A M Holm, and R Venousiou

2.1 Introduction

This chapter is based on work carried out for the Eurescom project P1302 — PROFIT (Potential Profit Opportunities in the Future Ambient Intelligence World). The vision driving iSpaces is described in many different ways, e.g. ubiquitous computing [1], pervasive computing [2], ambient intelligence [3]. Based largely on expected developments in information and communications technology, it has three main aspects:

- pervasive communications;
- ubiquitous sensors and actuators;
- embedded intelligence.

How these capabilities can be exploited for the benefit of both individuals and businesses is the key challenge of the iSpace vision. The different descriptions referred to above emphasise the three characteristic capabilities to varying extents. Ubiquitous computing, as its name implies, concentrates very much on the embedded intelligence of technology. Its emphasis on 'calming' human-centred technology is highly dependent on intelligent systems providing intuitive interfaces and appropriate information to the user in such a way that the underlying technology becomes invisible. Ambient intelligence and iSpaces build on this vision, to include the sensor and actuator networks that enable a continuous interaction between individuals and their environment — and all these visions assume some degree of communication between individual devices, between devices and humans, and between humans.

Thus, an iSpace is an environment that responds and adapts intelligently to the presence of the individuals within it and anticipates requirements, including the need to communicate and interact with other iSpaces. The pervasive communications strand is similar to ideas of seamless, mobile, and broadband communications networks that are seen as the prime enabler of the information society. The concept of an iSpace emphasises an aspect often neglected in discussions of pervasive computing or pervasive ICT — 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. However, a key feature of iSpace technology is its

ability to extend information horizons — potentially to a global level. Like PCs in today's Internet, iSpaces will be interlinked to enable interactions between anyone (or anything) connected to them, regardless of physical location. One challenge for the technology, therefore, will be to protect those spaces from intrusive and unauthorised access by others.

2.2 Commercial Opportunities

The development of iSpaces will create a system of trillions of interconnected entities, ranging from the most humble object to the most complex. Each entity will have both communications and computing capabilities. They will be able to communicate information, interpret it, and process it. This vision leads us to envisage new ways of creating value and organising businesses.

New business (value creation) opportunities may arise through the development of new infrastructures (such as sensor nets), new operating systems (already a key battleground [4]), and a wide range of applications including intelligent management systems to support both businesses and individuals. A Eurescom survey [5] of iSpace and ambient intelligence scenarios [3, 6, 7] identified a number of key application areas:

- communications/messaging;
- leisure/entertainment;
- collaboration/teleworking;
- e-Government;
- safety-/location-based;
- live independently/health;
- financial security/financial services;
- data across the Web/information services;
- quality of life/monitoring;
- education.

Some specific applications described in the scenarios included:

- 'Digital Me' — a device for controlling access by voice at a particular time, and could decide which calls to ignore;
- identity verification — a device-verifying identity and unifying identity-related information;
- taste and preference adaptor — a device altering things to your own tastes and preferences, e.g. room lighting, news, TV programmes;
- guardian angel — a device to 'look after them', e.g. telling people when they are ill or stressed, remembering where things have been left, stop them when running a bath that is too hot;
- device as 'agent' — a device that acts as an individual's agent, e.g. ordering groceries, looking for and ordering cheaper insurance.

All these applications depend on embedded intelligence and at least local (within a room or house) communication, but the use made of sensors/actuators or global communications varies widely. A crucial concept is 'context-awareness' — the idea that the intelligence within the iSpace is such that it can act (both proactively and reactively) to humans in an appropriate manner, i.e. in a way that reflects the current mood, activity, role, etc, of one or more individuals.

The wide range of potential applications reflects the pervasive nature of the underlying technologies, but will also present problems for companies seeking to exploit the opportunities. As Odlyzko [8] points out, the spread of pervasive computing or iSpace technologies will '... ignite an explosion of innovation that will destroy any stability that might exist'. In this dynamic environment '... new players and new business ideas will be emerging constantly .... no company will be certain of its commercial environment, even in the short-term. If companies are to succeed in the long-term they will need to be constantly innovating' [9]. But eventually, user expectations will start to stabilise and more permanent business forms will emerge.

Although there are many visions of end-user applications, there has been much less attention on the impact of iSpaces on companies. Yet iSpace technologies will have a profound effect, not only on the products and services offered, but also on the way companies are organised and managed. The following sections look at three areas in particular:

- many of the new iSpace applications will be complex services involving several companies working together — this will continue to drive the development of new organisational forms and strategic approaches;
- the rapidly changing market environment and the need for constant innovation will force successful companies to adopt management structures and systems that favour flexibility and adaptiveness;
- the adoption of iSpace technologies by companies will change the way people work — in particular, iSpaces will encourage a merging of home, work, and public spaces.

2.3 New Organisational Forms — The Emerging Value Nets

2.3.1 Value Chains and Value Nets

Following Porter's generic framework [10], 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 iSpace market, neither products nor customer expectations are fixed, posing a challenge to the simple concept of a supplier adding value to a physical component and passing on to the 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 (see Fig. 2.1).

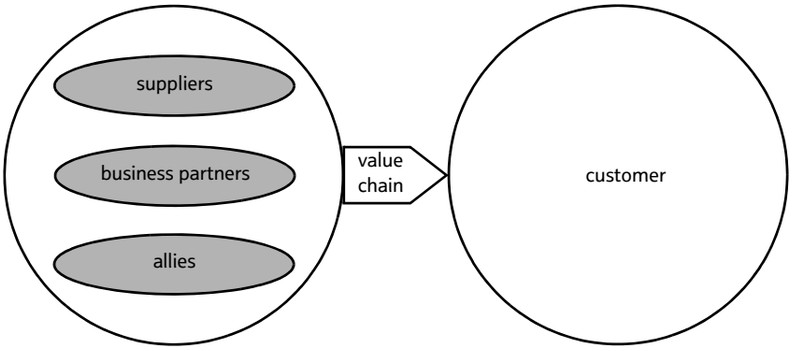

Fig. 2.1 Supplier 'system' allowing the customer to add value.

In many cases the operational boundaries between supplier environment and customer can be thought of in terms of three main components — content, infrastructure, and context. This provides a useful simplification when dealing with virtual value chains [11] — value may be extracted by disaggregating some or all of these components.

A value chain, has three principal 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 the customer (who may also be other businesses).

A value network (Fig. 2.2) 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.

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 an organisational 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. Such value networks will lead to the development of new strategies for competing in emerging iSpace markets.

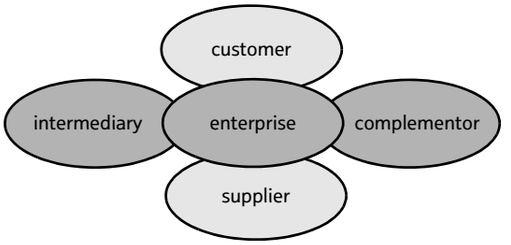

Fig. 2.2 Actors in a typical value net (Tele-Management Forum).

2.3.2 Strategies for Competitive Advantage

The emerging market for iSpace 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;
- 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 [12] captures these three aspects and is helpful in further strategic analysis (see Fig. 2.3) [5, 13]. Porter's models [10] are built on product economics — a best-product concept, which defines differentiation, cost, and focus as shown on the right-hand side of the triangle in Fig. 2.3. But the delta model indicates that competition can also be thought of in terms of two other dimensions:

- customer economics — products 'locked' to customers;
- system economics — products 'locked' to customers and complementors.

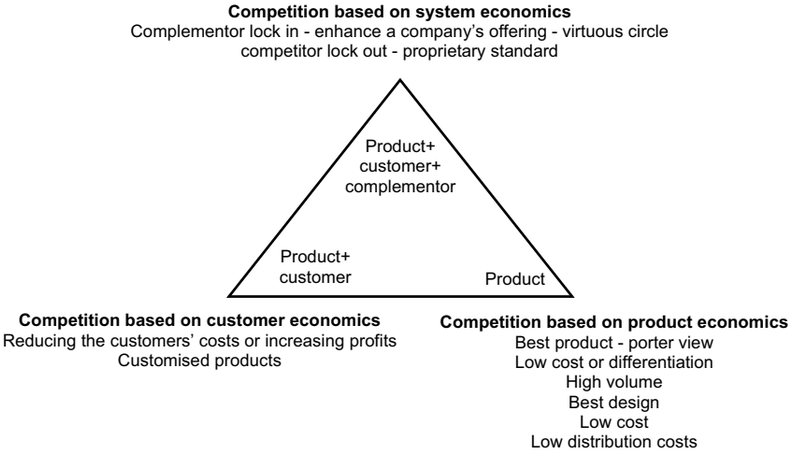

Fig. 2.3 The delta model [12].

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.

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 in Fig. 2.4. 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 McDonalds are termed as 'redefining the customer experience' and positioned on the customer economics/product economics axis.

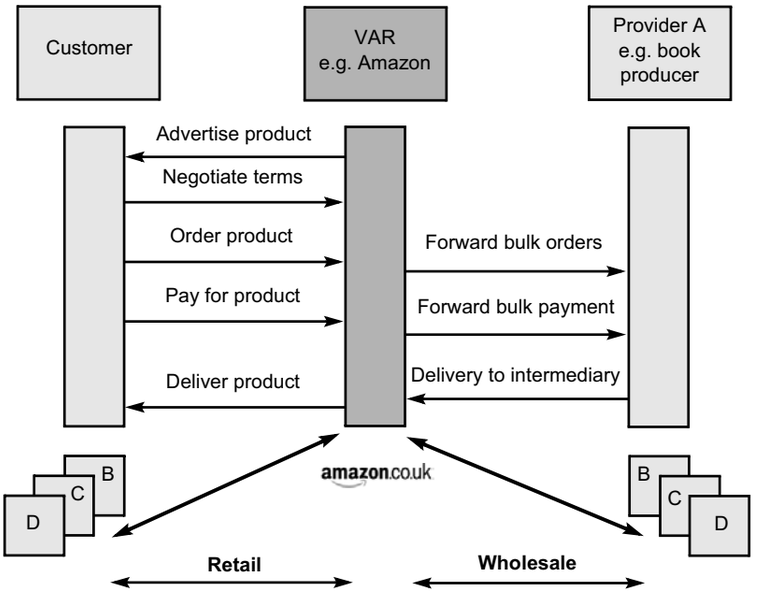

Fig. 2.4 Amazon business model.

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 [14, 15] and act as the core enterprise of the value network — this is the highest value space. The keyword is innovation — the existence of network externalities [16] generates a virtuous circle in which users are locked into

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 exploiting system-based competition are eBay and i-mode.

NTT DoCoMo owns the i-mode standard, and this enables 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 (Fig. 2.5). Content providers and customers trade freely between themselves; content providers self-organise, akin to a peer-to-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 telephone calls [17]. The i-mode example is particularly interesting as it begins to demonstrate the characteristics of a complex ecosystem — i-mode exhibits the last vestiges of the 'centralised' model before migrating to peer-to-peer and demonstrates self-organising properties in terms of the behaviour of content providers.

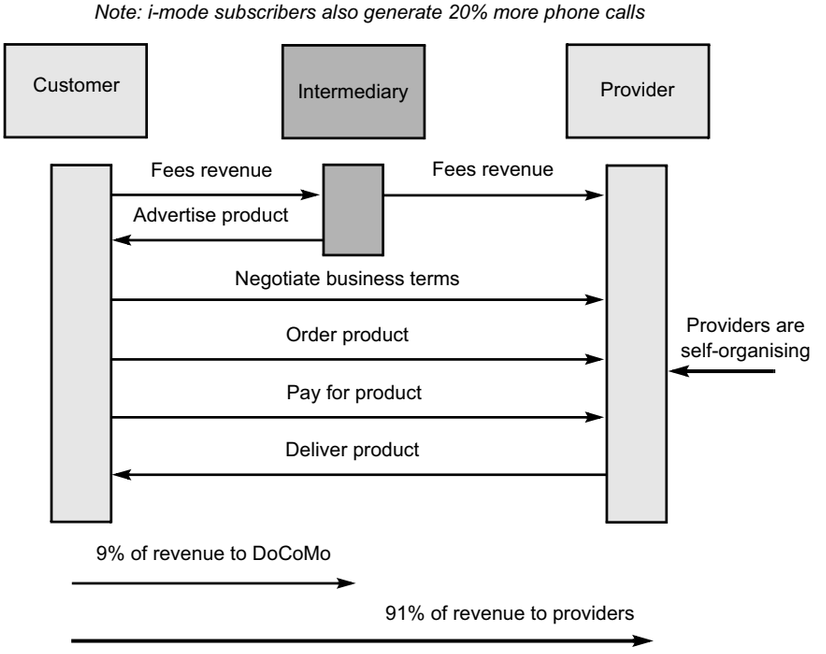

Fig. 2.5 i-mode business model.

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 has

found, this raises questions about the need for regulatory intervention, as it is 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 that appears to have circumvented this is NTT DoCoMo, with the i-mode service. NTT DoCoMo has an extremely powerful advantage, as the company owns the i-mode standard, and owning a proprietary standard enables the company to dictate specifications to providers and operators. In Europe, operators do not control the rights to mobile Internet standards in the same way. From the delta model perspective, rather than competing in terms of system economics, most other wireless carriers are presently moving along the horizontal axis in the direction from product economics towards customer economics.

2.4 Creating the Adaptive Company

The dynamic nature of the future market, and the complex relationships this will generate, imply that the days of mechanistic command and control in business are limited. The enterprise should build relationships with customers, suppliers, and even competitors to create a powerful value net. Often, there will be advantages from co-operating with potential competitors, as joint development plans can lead to bigger returns. Relationships also need to be built with organisations that complement what we do. The most valuable resource today is the combined knowledge of the team. For example, it is advantageous for software and hardware developers to work together, as seen in the case of Microsoft, Intel, and partners. Effective knowledge management will be the key to harnessing the opportunities that complexity brings. The approach for future iSpace business models should be to create networks that respond to the environment and that have the freedom to evolve as self-organising systems.

2.4.1 Controlling the Work or Controlling the Worker?

The need for organisations to be flexible has implications for the way iSpace technologies will be used in future companies. Current ICT systems include enterprise resource planning (ERP), supply chain management (SCM), customer relations management (CRM), and employee relationship management (ERM). The capabilities of these systems will be greatly enhanced by iSpace technologies — much greater information on process performance and status will be gathered in real time, leading to greater control of both processes and service. By taking over much of the routine information transfer and recording, and ensuring process information is delivered to individuals in a timely and controlled way, these systems could both improve efficiency and reduce information overload. However, these same systems will involve the monitoring and storage of far larger amounts of information about

individuals than is currently possible. Used inappropriately, they could give rise to unacceptable levels of monitoring of both consumers and employees, resulting in consumer suspicion and causing stress in employees [18]. Furthermore, if system design emphasises efficiency, then the resultant levels of monitoring and control may work against the need for flexibility and self-organisation, inhibiting the innovation essential for survival in an increasingly competitive environment.

DeTienne, in a largely optimistic article [19], saw the use of ICT systems as a means to provide support and coaching for the users — by monitoring and providing feedback on performance, ICT systems can help both individuals and teams to improve. Monitoring programmes can ensure that successful strategies discovered by one team member can be shared with others. For example, Fastline's fast tracker enables co-workers to monitor each other's Web surfing, helping them to discover the best practices of successful co-workers. Context-sensitive support can ensure appropriate information is delivered to an individual, thus relieving them of the need to remember vast amounts of detail which may only be used occasionally. Work-flow systems can 'talk' employees through complex procedures, thus helping workers to concentrate on key issues. In these examples, the emphasis is on providing support and feedback to individual workers, rather than assessment and control.

Unfortunately, DeTienne [19] contains a number of examples (often in call centre environments) where existing systems were used primarily as means of control, to impose compliance and uniformity on the workforce. Common criticisms of the then-current monitoring systems were that they were only used to speed up work and that there was too much emphasis on quantity of work rather than quality. Ten years later, little seems to have changed. Head [20] suggests that if anything, the situation has worsened — for many workers, the introduction of advanced ICT-based management systems (such as ERP or CRM) has led to a deskilling of the work, strictly enforced work practices, and constant, real-time monitoring of performance.

Given that the emerging ICT and iSpace technologies can be used either to control employees or to support adaptive responses through coaching and appropriate information access, it is worth considering why the trend seems to be so firmly towards control at present. There appear to be four drivers:

- the technology needed to monitor and control is, in general, simpler and largely in place — in contrast, coaching systems require a higher level of intelligence that has yet to be developed;
- the emergence of a 'risk society' [21] in which institutions use surveillance as a means of managing risk — information collected about individuals and their activities is compared with standard profiles (good, bad, trustworthy, untrustworthy) to decide how to deal with those individuals;
- ERP and CRM systems, etc, offer the potential to replace (costly) experts with expert systems and (cheaper) unskilled people [20];
- finally, there is the attitude of managers — '... most business people, without knowing it, see the service world through the lenses of manufacturing goggles ... they are influenced by historical traditions in business training, strategy techniques and organisational theory, all rooted in manufacturing' [22], chief among these traditions being the manufacturing production line and scientific management, with their emphasis on standardised procedures, measurement and control.

A more holistic view of a company's operations may be necessary — rules and procedures tend to grow over time, in response to specific failures, or to meet growing regulatory and legal requirements. The more these are automated, the less freedom individuals have to ignore them. A different view of the workplace [23] described it as a bundle of services, noting that 'employee self-service is an emerging and rapidly evolving set of applications.' If the iOffice and other work-related systems are to live up to the promise of supporting flexible and adaptive organisations by helping and coaching individuals, then the use and control of the key tools must move towards the workers, rather than remain with the employer [24].

2.5 Changing the Way We Work

2.5.1 Field Work — the Home–Work Interface

Many of the iSpace scenarios are technology-driven and in most (though not all) cases there is an emphasis on efficiency in terms of using time, interactions with others, etc, as effectively as possible. The interface of personal activities and work activities are a key element of many scenarios. However, some of the visions (e.g. the 'road warriors' travelling the globe, but simultaneously in contact with both work and home) describe a life-style that is alien to many, and one not sought after nor attractive to the majority. The frenetic juggling of multiple interactions described in some scenarios is a marked contrast to the vision of 'calming technology' described by Weiser [1] and a reminder that the way the technology is used depends on a wide range of social, political, and economic factors.

In an attempt to build a more realistic scenario, work has been undertaken to study how ICT supports both the maintenance of work–home boundaries and the integration of these domains, with a view to understanding the likely impact of iSpace technologies [25]. One of the main impacts of ICT has been a marked increase in the number of people working from home for at least part of the time. For example, data from the e-Living project show that in the UK approximately 8% of people use the Internet to work from home, while a further 12% work at home using a PC. Understanding how people use the current generation of ICT to mediate between the home and work roles provides clues as to how iSpaces may be used in the future.

The survey was carried out by means of over 30 interviews with a range of people working both in small businesses and in corporations. The small businesses included a number of 'life-style businesses' where the main driver was quality of life rather than profit maximisation. People had very different views about the extent to which they wanted to merge the work and home roles. Some, particularly small businesses, saw it as part of their service to be available at any time. Other people, more often life-style (hobby) businesses and corporate employees, sought to maintain a clear separation between work and home. Both groups, however, used ICT to control the degree to which work and home activities were integrated. Few people maintained a strict work and home separation; work activities would be done in the home, and home activities could be done at work.

As well as current technologies, interviewees were asked about their feelings towards proposed iSpace applications (see Section 2.2) in order to gain some insight into customer acceptance of these services. Overall, the responses were largely negative. This may in part reflect a suspicion of new technology and bad experiences with existing technology, but the concerns expressed were common to most interviewees across Europe and indicate the issues that need to be solved if the technology is to be widely accepted.

The main advantages of the iSpace technologies were seen to be in automating the mundane (reducing the time spent on routine and trivial activities) and helping people to be more in control of their lives. In fact, the concept of control is central to much of the debate, as most of the perceived problems and disadvantages of the iSpace technologies are also related to issues of control. Negative responses to technology included the following:

- privacy concerns — how to control access to, and the use made of, the (very personal) data gathered by iSpace applications;
- a concern that some of the devices would take over (the device controlling the human rather than vice versa), e.g. the 'guardian angel' might prevent people from undertaking activities it (the device) considered dangerous or the taste and preference adaptor would not recognise changes in taste, thus inhibiting spontaneity;
- a concern that choices made by an agent, or advice provided by the taste and preference adaptor, might not be independent, but influenced by the provider of such services — again this is an issue of who is ultimately in control of the technology;
- there was a concern about the risk of identity theft in an environment where transactions are being made remotely, and possibly without direct intervention by the individual;
- there was considerable scepticism about the ability of the applications to cope with the variability and unpredictability of human behaviour;
- finally, there was a concern about our becoming overly dependent on technology — although a valid concern, it is the one most affected by unfamiliarity, and therefore, as applications become more widespread and are found to be reliable, this concern should fade.

In general, then, the interviews highlighted two areas of concern. One is that of control — who controls the technology, who controls the data or information generated by the technology, and to what extent the user is being controlled by someone or something else. This is not primarily a technology issue, but a result of institutional factors including social and corporate norms, the legal framework, and economic drivers.

A second, related, concern is a scepticism about whether the technology is capable of the level of intelligence needed to filter incoming communications (Digital Me), adapt to changing tastes and preferences, or act as an autonomous agent, for example.

2.5.2 Institutional Issues and Control

In the context of the work–home interface, several issues of control need to be considered:

- the extent to which employees are in control of when and how they work;
- the extent to which the users have control over the data generated within an iSpace, particularly in their own home;
- the extent to which users want to be in direct control of the system, or are willing to trust the system.

Controlling Home–Work Boundaries

Prior to the industrial revolution, most craft workers worked at home, and life and work was an integrated whole. The introduction of factories and, later, office work led to a very clear separation between work and home life, with firm boundaries being set in both time (working hours) and space (work location separated from home). ICT has enabled more workers to re-integrate their work and home lives, leading to a blurring of the work–home boundary. There is no doubt that many people find it advantageous to be able to spend more time at home, working. The greater flexibility in both time and place of work gives individuals the freedom to juggle home and work responsibilities — all the more important in a world where most men and women work, and care of children or elderly relatives has to be shared. Growing use of the Internet for a variety of commercial transactions also enables people to sort out home issues (e.g. purchasing or paying bills) in the work environment.

Flexible working practices can be of benefit to both employees and employers. Thus, a survey within BT found that the ability to work flexibly helped to retain staff. However, the Eurescom survey showed that most people, especially those working for a corporate employer, still wished to maintain a distinction between work and home. An application such as 'Digital Me', which could automatically screen and prioritise calls (a task often achieved currently by the use of CLI or an answerphone), was seen as offering a useful service although there was considerable scepticism over whether such a system could work in practice.

The concern to maintain some distinction between work and home raises issues about who controls the boundaries. For the most part, interviewees were either self-employed or creative knowledge workers — groups that could reasonably exercise some control over these boundaries. Significantly, it was profit-making small businesses that were least inclined to impose a strict separation between home and work. While this was usually expressed as a matter of personal choice, it is also the case that such businesses may feel unable to restrict their work time for fear of damaging reputation and customer relationships.

A consequence of working from home is that the iOffice is extended into the home. As noted in Chapter 1, employees are more acquiescent to corporate 'Big Brother' in the iOffice. However, will this aquiescence extend to extensive monitoring in the home environment? And where are the boundaries drawn when personal and work life merge? Workplace monitoring is already widespread and likely to increase in scope [26–28]. If, for employees, the prime benefit of home working is greater flexibility in when or how they work, then systems that impose

rigid working practices on individuals will undermine both the benefits of, and enthusiasm for, home working.

Within the corporate sphere, the ability to maintain a separation between work and home depends very much on the norms of both the corporation and wider society. In the USA, where a high priority is placed on the demands of the economy, separating home and work life has become problematic for many workers — 'the long arm of the job has reached into employees' homes, their nights, their weekends, and their vacations, as technology designed to make work less onerous has made it more pervasive' [29]. Quoting a book by Jill Andresky Fraser, Beatty [29] describes how work is encroaching into the time people spend at home: 'What Fraser calls "job spill" is the dirty little secret behind many a corporation's thriving bottom line. Half of all households own pagers and half of those who own pagers have been beeped during a vacation' [30]. It is important to recognise that the driver for these trends is not the technology — much of which, as Beatty notes, was developed to make life easier — but the extreme competitiveness of the US commercial environment, which forces firms to find new ways to increase productivity and reduce costs.

It does not have to be like this, but it is important for both companies and employees to have a clear understanding of expectations. For example, Microsoft UK recently introduced advanced technology (smart phones, tablet PCs, and broadband at home). However, a survey conducted with the Work Foundation found strong '... demand for an "agreed etiquette" and "clarity of expectations" from Microsoft's management as to when work ended and their home life began'. Staff felt stressed by the '... ambiguous expectations about how available they should be, ... given that the technology enabled them to work 24 hours a day'. In response, Microsoft '... issued guidance to all its UK staff on when they should turn off their mobile phones and disconnect from the Internet at home, following a six-month trial of the latest mobile technology...' [31] and saw clear benefits from the experiment. After an initial drop, due to a learning curve, the company saw an increase in the productivity of its workers.

Microsoft UK is not the only example of good practice. BT has for many years promoted teleworking, both for its own staff and for its customers. All the authors of this chapter work from home at least part of the time and have benefited from the greater flexibility and productivity offered by teleworking.

Ownership and Control of Information — a Key Issue

There is a widespread concern about the implications of ICT for the privacy of consumers [26] that is thought to be slowing the development of eCommerce. Concern is likely to increase in the future — an announcement that Benetton intended to sew RFID tags into its clothing range caused a deluge of complaints by customers and the project's being postponed [32]. The development of iSpaces greatly increases the extent of monitoring and surveillance. 'This will be possible not only because this intelligent environment will be able to detect what people are doing in their everyday lives ... but also because it will connect and search isolated databases containing personal information' [33]. Thus it will be increasingly difficult for people to find a space where they have 'the right to be left alone' — one of the earliest definitions of privacy. The issue is not monitoring *per se*, but rather the use made of the monitoring taking place, by whom and the extent to which an individual can control this monitoring. But such monitoring is an integral part of

iSpaces, without which the vision of an intelligent, responsive, and adaptive environment is not feasible.

Fortunately, the same technology that is reducing the cost of data gathering and collection also offers greater control of information by the individual. Agent-based approaches are being developed such as the P3P [34], which enables an individual's computer agents to seek Web sites for business, having specified what types of privacy policy are acceptable, or should be avoided. Such systems enable individuals to establish an optimal level of privacy at minimal cost in terms of time and money — a clear case of 'automating the mundane'. They will also be able to monitor and track the usage of personal information by those gathering it. This transparency in usage also acts as a check on abuse of privacy [35].

Control of Services

Interviewees were very concerned that the advice and actions taken by intelligent systems should be independent of any third party. This was particularly the case for services offering medical or health support and advice. There is clearly an issue of trust here — many of the iSpace systems are designed to learn individual preferences and will, after an initial period, act in the interests of their user. However, those users must feel confident that the device is not being manipulated by other organisations, and providers of intelligent devices and services need to be sensitive to customer expectations. Failure to do so can have serious consequences, as TiVo discovered. TiVo is a personal video recorder (PVR) that will automatically scan programme listings and record on to a hard disk everything for which it is programmed.

This is another example of technology 'automating the mundane' and PVRs have been sold on the basis that customers have control over what they watch and when they watch it. The machines can also be used to monitor viewing habits. This latter facility could be useful in letting the machine learn users' tastes and suggest other programmes they may be interested in.

However, the machines can also be remotely set to record specific programmes. In 2002, this facility was used to record for all subscribers a BBC sitcom 'Dossa and Joe'. The idea was to try using the machines to market new TV programmes; no one was forced to watch the programme, but some people might be tempted to try it. The response from TiVo subscribers was fury, much of it related to the fact that they were not given any option over whether or not to record the programme [36]; viewers perceived it as an invasion of privacy.

2.6 Summary

The development of iSpace technologies will have a radical impact on the commercial relationships between companies and the way individuals interact with these companies, both as consumers and as employees. Successful companies will exploit not only the new commercial opportunities offered by iSpaces, but also the technology within their own organisation.

The dynamic market-place created by emerging technologies will have an impact on the way companies are structured, with a shift from a linear value chain of suppliers and customers to more complex value nets that incorporate complementors

and aggregators. Commercial relationships will become more complex and dynamic, requiring companies to move away from a command and control approach towards one that emphasises flexibility and adaptiveness. iSpace technologies will be adopted in the workplace; they offer greater flexibility both in where people work and in how they work. Where individuals have retained overall control of the technology (as at Microsoft), such flexibility has been shown to improve productivity and can improve employee retention.

Although individuals can see potential benefits from proposed iSpace services, there is considerable concern about privacy issues and the question of who is in control of the technology. Intelligent systems can help with both the privacy and control issues, but this depends very much on the trust people place in their suppliers. Service providers will need to be sensitive to these concerns and ensure their actions do not breach customer expectations. A key issue is the question of control — some degree of end-user control over the way the systems use information and interact with individuals will be essential if iSpaces are to be accepted both in the home and at work.

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