Sirpa Kolehmainen

Work Organisation in High-Tech IT Firms

Timo Hämäläinen
Sitra

SITRAN JOHDANTOTEKSTI

FOREWORD

This study was carried out as a part of the Research Programme on the Finnish Innovation System financed by Sitra, the Finnish National Fund for Research and Development. The national innovation system is defined as the system of organisations and actors whose interaction shapes the innovativeness of the national economy and society. The main goal of the research programme was to identify the future challenges of the Finnish innovation system. In a rapidly changing techno-economic environment, the Finnish innovation system cannot be expected to repeat its recent successes without continuous and effective development effort.

The research programme included 12 research projects that represented several scientific disciplines: sociology, economics, innovation research, psychology, jurisprudence, etc. The cross-disciplinary approach was chosen to gain many different, but complementary, perspectives on the structure and functioning of the innovation system. The close cooperation of scholars from different disciplines was aimed at creating an innovative research environment for the programme. A particular emphasis was laid on understanding the micro-level innovation processes and innovation networks. The research projects went beyond the traditional organisation- and institution-oriented studies of innovation systems in order to better understand the drivers and context of modern innovation processes. In the changed environment, innovation policies cannot be effective without a deep understanding of these processes and their environment. The results of the whole research programme were synthesized in the programme's final report *Transformation of the Finnish Innovation System: A Network Approach* (Gerd Schienstock and Timo Hämäläinen).

Sitra wants to thank all the researchers, policy makers and distinguished foreign experts that contributed to the success of the research programme. The results of the research programme provide plenty of challenges for further research and future innovation policies.

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ABSTRACT

Along with the growth of the service sector within the information society, the most rapid growth has occurred in business services, including computer and related services. New emerging high-tech business services with increased knowledge intensity of work implicate the changing content of work which both provides and encourages also new and varied forms of work organisation. These new forms have not yet been studied much.

The focus of the study is on describing the typical organisational features of a specific category of knowledge work, which is information system (IS) expert work in specific a category of knowledge-intensive business services, namely high-tech IT service firms. The success of the knowledge-intensive service firms depends to a large extent on their intangible assets, mainly on their human capital. In order to guarantee the innovativeness and competitiveness of their business and the organisational commitment of their employees, it is essential for the firms to pay attention to and invest in the organisation of work and competence.

The data of the study are based on interviews made with the managers and the IS experts within six different private firms operating in the area of high-tech IT business services. As a conceptual framework, the study applies the ideal type of the elements of work organisation. By means of the framework, it is possible to describe the nature and complexity of work, conditions of employment, forms of control as well as patterns of internal and external co-operation needed in work and business. All of these elements together describe work relations, namely what is typically worked on, how the work is performed and in which conditions it is performed. Optimistic theories on the information society support the idea of non-hierarchical, flexible network form of organisation based on enabling technology as well as creative and empowered intelligence.

The results of the report partly support this ideal type of knowledge-intensive work organisation. High-tech business firms are expert organisations in which work is done within continuously changing client projects. While the subject of work is software services, the work of IS experts is characterised by the application of theoretical and technical knowledge. Just as important is, however, the contextual knowledge on business, clients and working methods, for example, developing by the experience. Because project work is based on shared expertise, it also involves rather broad and complicated social, organisational and analytical skills.

Forms of control within knowledge-intensive project work deviates from traditional bureaucratic management-worker conception. The relationships among experts, management and clients are characterised by reciprocal interdependence. Clients are an essential part of the work organisations in high-tech business firms. Knowledge and creativity needed as well as forms and practices of control implemented on the projects are highly dependent on client commissions. However, work is characterised by a combination of indirect and direct input and behavioural and output control.

Employment relations and practices are an essential precondition ensuring that the experts skills, knowledge, attitudes and interests match those of the employing organisation. The IS experts seem to be especially committed to the development of new technological know-how. They respect more intrinsic and social features of their work rather than extrinsic features, such as high status or wages. Then offering challenging, changing and wide-scale work tasks with opportunities to learn within flexible organisations is a challenge for IT service organisations.

The high-tech business services both produce sector-specific knowledge on new technology and distribute it to other industries of the economy. Thus they are important actors within the wider innovation system. This makes the organisation of work, especially the development of appropriate human resources and knowledge management practices to maintain their intellectual capital, as well as education and training in general important policy issues. Instead of either mechanic bureaucracy or totally empowered organisations there exist combinations of many different ways and forms of work organisations behind the innovative services. High-tech IT service firms operate within rapidly developing 'turbulent' markets, which challenges their ability to adapt to the changes and transform along them

Keywords: knowledge work and worker, knowledge-intensive business services and organisations, work organisation, high-tech firm.

1. INTRODUCTION

This report concentrates on work in newly developed and rapidly growing innovative technology-based services supporting the performance and success of the telecommunications industry in Finland. The focus is on the characterisation of typical features of work and its organisation in firms supplying business-to-business services. These services or service products are special in the sense that is that they are highly customised, knowledge-based and produced by experts in technology.

The trend towards the growth of the service sector has continued in within modern societies. The most rapid growth has occurred in the business services sub-sector, especially in the industries, which increasingly depends on theoretical and technological knowledge. Likewise, most of the new jobs were and will be created in knowledge-intensive and professional occupations, but also in service occupations. The trend is characterised by the development and growth of knowledge work and knowledge-intensive organisations, especially within business services. Knowledge-intensive business services (KIBS) are strategically important to the economy because of their strong customer focus on knowledge creation. These services can be seen as bridging institutions that produce intermediated inputs helping to develop customers' knowledge base and knowledge generation for future innovations. (Haukness 1998; Miles 1999.)

In order to distribute strategic knowledge, knowledge-intensive organisations must be innovative and competitive themselves. This, for its part, is dependent on the creation and maintenance in an innovative organisational context, whose structure and patterns support innovation. The organisational context is related to the question of how to attract personnel, the most important resource of knowledge organisation, in a way that they can perform their jobs and deliver service products adequately, and commit themselves to the organisation as well. It is also related to the question of how to attract customers in a way that they can trust the delivery and quality of the expected service product. Organisational structures and processes are thus influenced by the knowledge and tasks to be performed in the organisation as well as by its wider environment. Optimistic theories on information society support the idea of non-hierarchical, flexible network form of organisation based on enabling technology and creative intelligence. (Castells 1996; Sveiby 1996; Tidd et al. 1997; Frenkel et al. 1999.)

New emerging high-tech business services with increased knowledge intensity of work implicate the changing content of work and working, thus providing and encouraging new and varied forms of work organisation. The new features of knowledge work and the new emerging forms of work organisations have been rarely studied, however. The aim of this report is to deal with the following questions. How knowledge-intensive is the work in high-tech business services? How flexible, communication-intensive and empowered is the organisation of work in these services? How does the client orientation of services formulate the organisation of work and working in high-tech services? What are the contributions of high-tech business services for the innovation system in the telecommunications sector?

The question of knowledge work and its organisation is especially relevant in the present market situation of the telecommunications industry and ICT sector as a whole. After the rapid growth of the sector, witnessed dismissals, redundancies, and even bankrupts in the sector have taken place during the year 2001. However, there seems to be a constant lack of competent and experienced labour force, especially in the organisations concentrated on new high-tech IT services. For expert workers instead, there are open labour and wage markets among which they can choose the best options. The means to elicit the integration of expert workers into an organisation is important because they are the most valuable, but at the same time inadequate capital of the organisations in the information industry. Organisations should, then, treat experts as both an asset and a resource, and offer them working conditions that motivate and encourage organisational commitment. The organisational commitment of experts is not necessarily self-evident. One can ask whether they are committed rather to their technological know-how and the hype of the new technology in general, instead of committing to an organisation or even to an occupation or career.

As a conceptual framework in analysing the work and work organisation of high-tech IT firms, the ideal type of the elements of work organisation developed by Frenkel et al. (1999, 23-26) will be applied. This framework makes it possible firstly to describe the nature and complexity of work, and secondly, to describe vertical relations, the conditions of employment, for example, on the one

hand, and control relations between managers and workers on the other. Thirdly, it provides a possibility to understand the lateral relations, including intra-firm co-operation among workers as well as external co-operation especially with clients. All of these elements together describe work relations, namely, what is typically worked on, how the work is performed and in which conditions it is performed.

The data used in the study is based on interviews made with the managers and the expert workers within six (6) private firms operating in the area of high-tech IT business services. The focus is on the typical features of knowledge-intensive expert work and its organisation in the IT service organisations. Thus managers and clerical staff are excluded from the study. In the centre of the analysis of knowledge work and workers, a specific concept of information system experts (IS experts) is used. Naturally, there is a division of labour with various occupations and job titles of the IS expert workers within the sector. Because of concentrating on describing features of work, not much attention is paid to the differences between the case organisations.

The report is divided into five main chapters. After the introduction, Chapter 2 forms the general conceptual framework for the study. It defines and discusses the concepts of knowledge, knowledge work and worker, and knowledge-intensive business services, and presents the framework of the elements of work organisations used in analysis. Chapter 3 specifies the research questions in detail, introduces the data and the case organisations. Chapter 4 is the primary empirical description of the work organisation, based on the presented framework. It illustrates the knowledge, skills and creativity needed in IS expert work, the basis of recruitment and forms of training, careers and rewards as well as patterns of control in the high–tech IT organisations. Further the interrelationships between the expert workers typical of project work as well as inter-organisational collaboration common to the IT service organisations will be described. Chapter 5 is a concluding chapter with policy issues emerged from the empirical data.

2. KNOWLEDGE WORK, KNOWLEDGE ORGANISATIONS AND KNOWLEDGE-INTENSIVE SERVICES

2.1. General features of knowledge work and forms of organisations

Since the 1970s, western societies have experienced a transformation from industrial to post-industrial societies characterised by change in productional paradigm emphasising services over manufacturing, and by overall modernisation of the society. The emerging new society has been defined most commonly by characterisations such as post-modern society, service-society, learning society and especially, information society. Within the information society, knowledge has become the main factor of production instead of land, labour and capital, due to its relative importance as production inputs, as a means within a production process, and as output as well. Along with the decrease in the relative share of industrial production, the focus on what is most commonly worked

on has moved from material to information and knowledge. Knowledge has thus more and more significance both as an autonomous service product and as a part of both manufacturing and service production. (Hautamäki 1996; Spender 1996; Karvonen 2000; Rantanen 2000).

Along with the rising importance of knowledge as the main factor of production, more and more attention has also been paid to the forms and patterns of knowledge as organising principles of different innovative organisations. Related intellectual capital and knowledge capital, for example, are among the commonly analysed concepts for describing organisations intangible assets. Both concepts refer to the patterns of converting knowledge into organisational value. Intellectual capital is composed of human capital and structural capital. Human capital means all the values of the employees, their explicit and implicit knowledge and competence, motivation and commitment. Structural capital means everything that stays at the organisation, such as data, information, industrial property rights and organisation, for example. Furthermore, it includes a company's relationships with its customers (customer capital) and renewal strength as well as the ability to maintain and develop its value-creating process. Knowledge capital can be defined as a company's immaterial assets, human capital and ability to use information and knowledge in continuous production of new ideas and innovations. (Sveiby 1998; Ståhle & Grönroos 1999; Yakhlef and Salzer-Mörling 2000.)

The concept of knowledge is very abstract, broad, and difficult to define. The most stable concepts connected to knowledge are data, information, know how, competence and skill, for example. As data is defined simply as symbols and codes, there are clear differences between information and knowledge. According to Nonaka & Takeuchi (1995, 57-59), knowledge unlike information, is firstly about beliefs and commitment, secondly about action, and thirdly about meaning, and thus contextual and relational. While information is a flow of messages, knowledge is created by the flow of information by giving it meanings in social interaction among people. Further, based on Michael Polanyi's ideas, explicit and tacit components of knowledge can be defined. Thus knowledge has two intertwined dimensions: the object of knowledge and tacit knowing as a means of managing the object. Competence is connected to the application of information and knowledge within different social contexts. Thus competence does not mean static knowledge as an end point, but active and dynamic knowing. J.C. Spender (1996) argues that knowledge can be held by an individual or a collective, and presents four types of organisational knowledge: conscious (explicit held by individual); objectified (explicit held by organisation); automatic (preconscious individual), and collective (implicit and social). (Raivola & Vuorensyrjä 1998; Poikela 1999.)

According to Krishan Kumar (1995), knowledge is progressively supposed to affect work in two ways. One is the upgrading of the knowledge content of existing work within every sectors of the economy. The other is the creation and expansion of new work in the knowledge sector in a way that knowledge workers and occupations come to predominate in the economy. In both cases, informatisation of work with the development of information and communication technology affect and create new ways of working and organising work. Changes in the content of work, methods of

working, skills requirements, work arrangements and work organisation are obvious results from these new ways and patterns. The most profound seems to be, however, the supposition according to which work and working are breaking away from their time and place boundaries. All these features also have effects on changes in work cultures.

Knowledge and competence seem to be closely intertwined. All work and working require knowledge and competence. Specialised groups of knowledge (or information) workers are defined by Raimo Blom (1999) to be those wage workers who use information technology at work, whose level of education is high and whose work requires designing and planning as important aspects of work practices. According to the classification of information occupations (On the Road to the Finnish Information Society II 1999), knowledge workers can classified as information producers, information distributors, information users, and information processors. Robert Reich (1992) calls knowledge workers symbolic analysts, whose work, in particular, is related to creative and demanding problem-identifying and problem-solving, and focuses on novel problems and producing novel solutions by manipulating symbols. Winslow and Bramer (1994) define a knowledge worker as someone who interprets and applies information to create and provide value-adding solutions, and to make informed recommendations. They emphasise especially the creation of value-added knowledge and making recommendations instead of completing an assignment from a supervisor and just making decisions.

Knowledge workers may be professionals, but according to William H. Starbuck (1992), compared with knowledge workers, professionals have at least four additional properties: an ethical code, cohesion and collegial enforcement of standards and an autonomy. Further, Frenkel et al. (1999) argue that knowledge workers are employed in organisations whose primary aim is profit-making, whereas professionals rather emphasise professional excellence. According to the authors, characteristics of knowledge work are high-level customisation and creative problem-solving through identification, analysis and resolution which requires close interaction between experts and clients within a longer-lasting customership. By definition, knowledge work can be characterised as abstract, complex, autonomous but as requiring shared expertise as well, and as done by a variety of tools, not physically but intellectually.

Innovative problem-solving and client orientation typical of work in information society implies an increase in the significance and combination of both the theoretical, technical and contextual knowledge. According to Frank Blackler (1995), a recent commentary on knowledge work suggested that, instead of strong reliance on knowledge locating in bodies and routines[1], emphasis is increasingly falling on the knowledge that is located in the brain, dialogue and symbols. According to Blackler's concepts, embrained and encultured knowledges are becoming predominantly important. Embrained knowledge is dependent on conceptual skills and cognitive abilities (knowledge

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[1] Embodied knowledge is action-oriented, only partly explicit (knowledge how), acquired by doing, and rooted in specific context. Embedded knowledge resides in systemic routines, is analysable in systems terms, in the relationships between technologies, roles, formal procedures and emergent routines, for example. Encoded knowledge is information conveyed by signs and symbols. (Blackler 1995, pp 1024-1025.)

that/about). Encultured knowledge refers to the process of achieving shared understandings, socialisation supported by new forms of organisation based on networks, and partnerships of contractual arrangements, for example. Rather than regarding knowledge something that people have, it should be understood as an active process of knowing that is mediated, situated, provisional, pragmatic, and contested. Thus, Blackler's argument is that research on knowledge work should, in particular, draw attention to the action and systems that mediate knowledge.

Work is becoming more and more complex, demanding higher-level competencies but offering increasing independence for workers due to the customer orientation. At the same time, however, organisations have to compete within uncertain product markets in which innovations are the central feature of competitiveness and survival. These combinations of influences encourage the growth of alternative organisational structures. Innovative service products and processes are unlikely to succeed, unless the surrounding organisational context is favourable. An organisation implies, however, more than a structure. It is rather an integrated set of components, which together intensify the innovative environment. Tidd et al. (1997; also Mintzberg 1989) argue that, besides an organisation structure, shared vision and leadership, creative climate, customer focus, and inter-organisational co-operation, the roles played by key individuals, training and development of the staff, how the organisation itself goes about learning and sharing knowledge, and how it is involved in innovation, are some examples of the factors which make for a more or less supporting context.

Organisational structures and processes are influenced by the nature of knowledge and tasks to be performed within the organisation. In essence, the less programmed and the more uncertain tasks and complex knowledge, the greater the need for flexibility around the structuring relationships. In this context, the technological development and ICT technologies in particular have challenged and enabled, and are still challenging and enabling, new ways of working and organising the work. An organisational form is also influenced by its environment. The higher the uncertainty and complexity in the environment, the greater the need for flexible structures and processes to deal with it. Further, organisational design can be seen to vary by industry and by size, age, and company strategy. One view of the structure is that it is an artefact of what the staff believe and how they behave. If the fit is good, the structure will enable and reinforce innovative behaviour. If it is contradictory to the beliefs, for example, restricting communication and/or heavy hierarchy, then it is likely to restrict or even prevent creativity and innovation. (Tidd et al. 1997; McLoughlin 1999; Depickere 1999; Frenkel et al.1999.)

Instead of a mechanic division of labour and bureaucratic control, innovative knowledge creation and learning requires a more dynamic, non-hierarchical and flexible organisation which has mainly been characterised by forms of the organisation archetype of adhocracy developed by Henry Minzberg (1989). The structure of adhocracy is fluid, organic, and selectively centralised. Functional experts are deployed in multidisciplinary teams of staff to carry out innovative projects. Co-ordination is based on mutual adjustment encouraged by the liaison personnel, integrating managers and matrix structure. The environment of adhocracy is complex and dynamic, including high technology and

temporary projects, and the form is common in young industries. There exist two basic types, operating adhocracy for contract project work and administrative adhocracy for one's own project work. According to Tidd et al. (1997), the strengths of this project type of organisation model are its ability to cope with high-level uncertainty and its creativity, whereas weaknesses include the lack of control due to the lack of formal structures and standards. Ståhle and Grönroos (1999) emphasise the interrelationship and interplay of mechanic, organic, and dynamic organisational functions within an innovative organisation. They also point out the three intertwined factors on the basis of innovative organisation form: the intensity and openness of information flow, competence and dynamic knowledge creation, and varied internal and external relationships as important building material for organisational knowledge capital. Also, according to the contingency model, there is no single 'best' structure, but successful organisations tend to be the ones that develop the most suitable 'fit' between the structure and operating contingencies. (Tidd et al. 1997; Depickere 1999.)

According to Blackler (1995; also Lam 1998), organisations are dominated by one knowledge type. Thus, the dominant knowledge type and the structural form of the organisation correspond to each other and also affect the differences in learning and innovation in an organisation. Emphasis in the information economy is turning from embodied and embedded knowledge focusing on familiar problems to embrained and encultured knowledge focusing on novel problems. This also means a shifting trend away from expert-centred, professional bureaucracy organisations that depend on embodied knowledge (such as hospitals) and from knowledge-routinised machine bureaucracy organisations (traditional factories) that depend on embedded knowledge. Instead, there emerge both symbolic-analyst-dependent organisations with embrained knowledge, such as knowledge-intensive firms (IT services) and communication-intensive organisations with encultured knowledge, such as adhocracy and innovation-mediated production.

Alice Lam's (1998) typology of relationships between the different knowledge types and organisational forms deviates from Blackler's typology. Lam combines operating adhocracy from Mintzberg with embodied knowledge, for example. According to her, in addition to formal knowledge of workers, diverse know-how and practical problem-solving skills embodied in individual experts are important. This is a highly organic form of an organisation with little standardisation of knowledge or the work process. An organisation engaged in providing non-standard creative and problem-solving services the clients directly. The knowledge structure within this organisational form is individualistic but collaborative. Learning occurs as experts of diverse backgrounds jointly solve problems for clients. These organisations' knowledge base is diverse, varied and organic, thus enabling innovation and creative problem-solving. As an example of operating adhocracy with embodied knowledge, Lam highlights, in particular, knowledge-intensive firms (by Starbuck 1992).

2.2. Definition of KIBS

Along with the growth of services, the increasing knowledge-intensity of economies and the development of information society, special attention has been paid to a significantly growing part of the service sector producing high value, namely knowledge-intensive services (KIS), and even more importantly, the knowledge-intensive business services (KIBS). The term knowledge-intensive imitates the economists' labeling of industries according to the factors of production as capital-intensive or labour-intensive. These divisions describe the relative importance of capital, labour or knowledge as production inputs. In knowledge-intensive services, knowledge has more importance than other inputs. Further knowledge and competence are nowadays important parts of different production processes within different industrial sectors, both as inputs or raw material, means and act of work and outputs as well. Thus, according to Miles et al. (1995), while knowledge-intensive activities are so manifold, the definition on knowledge-intensive services is a relative affair. (Starbuck 1992; Løvendahl 1997; Strambach 1997; Kasanko & Tiilikka 1999.)

Knowledge intensity is hard to define and ever harder to measure. Kasanko & Tiilikka (1999) stated that the analysis of knowledge intensity of an industry or an organisation requires a multi-level and multi–method approach. Especially on the organisation level, there is a need for qualitative methods in analysing knowledge creation and know-how processes. Knowledge intensity of an industry, instead, can be analysed by means of some statistical indicators. In their study on the development of the knowledge-intensive service sector in Finland, Kasanko & Tiilikka use the following typical indicators: employees' education levels; average annual income level within an industry; the share of white-collar employees (especially white-collar employees with higher education in the labour force of an industry); formal research and development (R&D) costs; and the number of organisations with innovation activity from all organisations in an industry. They divide service industries into three categories by education and income levels: knowledge-intensive core industries (business services for finance and insurance, computer and related IT services, R&D, technical engineering services and higher education); knowledge-intensive-associated and related services (information services, basic services, logistic); and skill-intensive services (wholesale and retail, transportation, real estate, tourism and restaurants, cleaning, entertainment, social services, etc.).

For Haukness (1996; 1998), knowledge intensity reflects the integration with a service-specific science and technology base. Thus, it can be seen as a combination of knowledge embedded in new equipment, personnel, and R&D intensity. Miles et al. (1995) associate knowledge intensity with the process of application of knowledge within a particular sector. Many services are knowledge-intensive in such indicators as the large number of professional and technical personnel and high level of investment in the new information and communication technology. This does, however, not mean that they are contributing to knowledge formation in the economy more generally. As services are important users of new technology, some services are also agents of transfer of new technology. Besides that, some services are integral producers of new technology: laboratory, design, engineering and related services, for example, when they are important for the dynamism of service industries themselves but also across the whole economy. The current interest in KIS relates particularly to

the various new business services connected with technology, and with the production and transfer of knowledge about new technology.

The definition of knowledge-intensive business services (KIBS) differs from one theoretician to another. Usually, KIBS are defined (Miles et al. 1995; Haukness 1998; Kautonen et al. 1998) as follows:

- They rely on specialised expertise, usually integrated with professional knowledge and linked to scientific knowledge development. The employment structure is generally expected to have a large share of highly skilled personnel with academic or tertiary education. Experts in KIBS also tend to be leading users of information and communication technology (ICT) to support their activities.

- They supply dominantly intermediate inputs rather than output for final consumption. The service products may both be bundled with or supplied independently of other tangible or intangible input factors.

- On the one hand, their service products may themselves be primary sources of information and knowledge to their users (e.g. reports, training, consultancy).

- On the other hand, the service products are intended intermediate inputs into clients' knowledge generating and information processing activities (communication and computer services) for internal use or supplied to yet other users in turn.

- Services are knowledge-intensive both in terms of the factors of the production process of these services and in terms of required capabilities to interpret and use these service products.

- They have as their main clients other businesses, including the private and public sectors, and the self-employed.

One can further add to the list that KIBS are situated in private sector, being mainly private companies. (e.g. Bilderbeek et al. 1998). Besides private companies, KIBS can also be public or semi-public organisations, or even functional parts of manufacturing companies. From the functional point of view, when they are produced and used in-house, KIBS do not follow any standard industrial classification. The range of industries that may involve considerable KIBS elements is wide. Because it is nearly impossible to map all knowledge-intensive service functions of the economy, the analysis of KIBS has mainly focused on the industry and firm levels. According to these studies, the dominant modes of KIBS functions seem to be within the industrial category of business services (NACE-code 72, 73, 74). However, different studies on KIBS have classified these services in a slightly different way. In these statistical studies, KIBS organisations are understood as private (often very small) service firms. This means that publicly organised business services as well as the service-oriented functional departments of manufacturing companies are excluded. Services organised in that way can play a great role for their customers, however. (Haukness 1998; Hales 1998; Kautonen 1998; Kasanko and Tiilikka 1999; Kautonen et al. 2000; Kautonen & Tiainen 2000; Toivonen 2001.)

KIBS cover a wide range of services, although in addition to being knowledge-intensive, services can also be labour- or capital-intensive. Furthermore, considerable KIBS functions may be comprised in services as well as in manufacturing industries. Bente Løvendahl (1997), for example, divided knowledge-intensive organisations into three, namely professional services (e.g. consulting, legal services, accounting), non-professional services (e.g. gourmet restaurants, schools, welfare services), and producers of knowledge-intensive service products (e.g. computer software). She refers, however, to the fact that the division is a fundamental simplification on reality and based mainly on the characteristics of the service delivered. Factors that differentiate professional services from other KIBS involve an especially high degree of customisation, substantial interaction with the customer as well as professional norms constraining the service delivery. (Empson 2000.)

In developing new services within KIBS, co-development and interaction with clients are especially important. However, the degree of the customisation of service may somewhat vary among KIBS. There are two interrelated tendencies in KIBS: commoditisation and modularisation. After having solved client-specific problems, the service provider can generalise the solution and sell it to other clients. Or the solutions to clients' problems, or new innovations, are created by splitting service products into component elements and by combining these elements in novel ways. Professional organisations instead, according to Empson (2000), tailor each solution to the unique requirements of an individual client. (Miles et al. 1995; Løvendahl 1997; Bilderbeek et al. 1998; Innovaatiotutkimus 1996; Sundbo 1998; Piirainen et al. 2000.)

Mainly by industrial classification, Miles et al. (1995) and Bilderbeek et al. (1998) have distinguished between traditional professional services and new technology-based KIBS (T-KIBS). Furthermore, they have given examples also of non-KIBS services. The traditional professional services are not always business-related but provide services also for individual people. According to Miles et al. (1995), traditional professional services that probably are intensive users of new technology are accounting and bookkeeping, management consultancy, specific building services, legal services, some financial services, marketing/advertising and training, office services, and designing, for example.

The focus of attention in previous studies of KIBS, however, has been on those services that derive their intermediate function primarily from the production and transfer of technology-related knowledge. The focus is thus on the category of service activities, which are often highly innovative in their own right as well as facilitate innovation in other economic sectors, and therefore contribute significantly to economic competitiveness. According to Bilderbeek et al. (1998), definite T-KIBS based on NACE-codes are:

T-KIBS categories:	NACE-code
Hardware consultancy services	7210
Software consultancy and supply services	7220
• *Data processing services*	7230
• *Database activities*	7240
Maintenance and repair of office	7250

Other computer-related activities	7260
Computer and related IT services	72
Research & (experimental) Development	73
• *R&D on natural sciences and engineering*	7310
• *R& experimental D in social sciences and humanities*	7320
• *Architectural and engineering activities and related technical services*	742
• *Technical testing and analysis*	743

Most of the statistical categories listed above have a rather clear-cut relationship with technological innovation. Since information and communication is of major importance for service innovation, computer and related IT-service industry can attributed to be a main component of T-KIBS. Bilderbeek et al. (1998) included in T-KIBS a more tentative T-KIBS category consisting of industries which may be 'hidden' within a broader statistical category, or whose role in producing and/or distributing knowledge resources is difficult to assess on the basis of the available information. Potential T-KIBS categories they suggest are technology-related publishing, wholesale in machinery, equipment, etc., logistic services and related transport services, T-KIBS in telecommunications, patent bureaux, technology-related market research, technology-related economic and management consultancy, technology-related labour recruitment and technology-related training.

Miles et al. (1995) have defined the services not included in KIBS. Many of those, however, feature professional services but also emerging activities which may be regarded as KIBS. For example, health care is a sector where there are highly qualified professional staff, many laboratories and specialised researchers, and a high rate of development and use of new technology and techniques.

Non-KIBS services are:

• Health/medical services
• Post, transport and distribution
• Consumer financial and real estate services
• Education
• Broadcast and other mass media
• Public administration
• Repair/maintenance
• Retail and wholesale
• Social welfare
• Leisure and tourism, hotels and catering
• Personal consumer services
• Entertainment

As can be found out from previous definitions, it is difficult to decide whether or not a service is knowledge-intensive. In addition, there is a general tendency in all the economic sectors towards

knowledge intensity. Nevertheless, among business services, we can find the core industries that can be classified as knowledge-intensive. (Kasanko & Tiilikka 1999).

The rise of KIBS

Knowledge-intensive business services can be produced both in specialised functional departments within larger companies and in specialised (independent) firms (or organisations). However, there are tendencies that support the notion of a growing number of specialised firms within the knowledge-intensive service sector. In Finland, there has been a clear growth trend in business services both in number of firms and in employment and productivity. There is a great deal of literature on the theme "where do KIBS come from". The answers found to that question are, according to Miles et al. (1995; also Bilderbeek et al. 1998), for example, the following:

- Many KIBS are spin-offs from firms in other sectors;
- Often structural changes in industry (downsizing, outsourcing, concentration on core activities) have led to externalisation of activities;
- Similar contracting-out of services has been undertaken by public sector bodies;
- "Re-regulation" has had impacts on sectors such as financial and telecommunications services, in which new products and strategies are common;
- Some services are too complex or expensive to maintain in-house;
- Start-ups, including many self-employed professionals, have established themselves as small suppliers from service firms; and
- Other sources, companies engaged in manufacturing or other lines of business, for example, may reorient themselves towards being KIBS.

Most of these explanations share the idea of the emergence of small KIBS enterprises after the manufacturing firms have externalised some functions. Undoubtedly, that is a very important reason for the increase in the number of KIBS organisations, but the growth and origins of KIBS is not that deterministic and straightforward. The industrial structure of KIBS is outstandingly dynamic. Entry and exit rates are very high because of the dynamic changes and growth in demand for more specialised and new services, on the one hand, as is the concentration of KIBS organisations themselves into core activities and outsourcing the less important supportive activities on the other. Furthermore, Finnish science and technology policy by means of science park and technology centre operations and centre of expertise programmes is concerned with and encourages the birth and build-up of innovative KIBS organisations. (Bilderbeek et al. 1998; An operative network… 1999; Tampereen seudun osaamiskeskusohjelma 1999-2006.)

A general pattern in the emergence of KIBS is that there is a high regional concentration (especially T-KIBS) in urban centres, mainly because the business is very dependent on the information and contact networks that are linked up in these centres. These networks play an important role in the interaction with clients. Agglomeration centres also provide a large and diverse market as well as

high-quality transportation and information infrastructure for KIBS. Furthermore, as KIBS rely on technical and scientific professional knowledge, urban agglomeration areas are able to supply expert and professional labour because higher education institutions are also concentrated in bigger cities. (Strambach 1997; Bilderbeek et al. 1998.)

One general explanation for the growth of KIBS, and especially technology-based KIBS industries, is the rapid development of information and communication technologies (ICTs) and their use in modern economies. In addition to ICTs, there are needs connected with other new technologies, biotechnology, for example, and with environmental pressures for technological change. The expansion of KIBS can also be seen in the context of general restructuring process in the industrial system. In this process of vertical disintegration, flexible specialisation and increased social division of labour, the manufacturing and service sectors (both public and private) may outsource many of their service functions for external providers rather than include them in the company infrastructure. Outsourced business services lead to the development of highly specialised service firms delivering such (knowledge) services to an increasing number of buying customers. Then, it is also more and more a strategic decision for the customer company whether to buy novel, complement or even similar services or service products from external KIBS providers. The increasing level of specialisation and expertise required in different areas of knowledge-intensive economies suggest that it is not possible to develop and utilise all necessary expertise in-house. That is why the growth of technology-based and other business services will probably continue in the future. (Løvendahl 1997; Bilderbeek et al. 1998.)

T-KIBS and the core of telecommunications

From the technological point of view, in the core of the knowledge-based economy lies the development of the sectoral cluster of information and communication industries. The main functional elements of this sector, on the general level, are the information technology industry, telecommunications hardware and services, and the content industry. The broad service sector of ICT consists of software industry and services, and ICT integration consultancy as well as maintenance services, which can often be an integral part of hardware, software and ICT consultancy services. Further, in the ICT sector, there have emerged a growing number of small and new innovative organisations that fall into the indefinable and blurred category of the new media industry. Some of these organisations are close to the media and content providers, some of them operate near the ICT equipment and network manufacturing or the software industry, or in close interaction with ICT services, for example. Overall, due to the convergence of information industries, and at the same time, due to decentralisation, specialisation and integration on the organisational level, boundaries between the main functions of these sectors on the practical level are somewhat blurred. For example, an ICT consultancy firm, in addition to its integration service function, may contribute to software development as well as be dealing hardware.

The information industry can be seen as an example of a cluster-based network economy that is organised on the basis of the combination of at least technological, horizontal and lateral dimensions of clusterisation. In the analysis of telecommunications, ICT or communications clusters, or added value chains in production or services within information sector (Mannermaa & Ahlqvist 1998; Mäenpää & Luukkainen 1994; Lahti & Stenlund 1998; Ali-Yrkkö et al. 2000; Visioista osaamistarpeisiin 2000), the most important functional actors mentioned above are usually present. Knowledge intensity within all these functional sectors is very high as well as organisations within all of these sectors all bear features common to knowledge-intensive business services. Besides manufacturing tangible products (computers, mobile phones, software programs, games, etc.) for consumption and end-users, organisations within any of these functional sectors may at the same time provide services which are integral service inputs to the production or service development of organisations situated within other functional sectors of information industry. For example, KIBS-client roles are dynamic and changing according to the business situation, nature and aim of networking.

Because of the established and interrelated but complex nature of the interaction and networking in the information sector, mapping the spectrum of KIBS functions and actors is not very relevant. The trends affecting the development of information sector (more specifically ICT) are connected with digitalisation, with the Internet and wireless information transmission, and especially with the integration of digital networks, communication equipment and services. The focus of added value production within the sector is moving from production development of electronics and electro-technical manufacturing towards production development of software productions and software applications and services. The most important KIBS organisations within ICT can then be seen as locating within the functional sectors of software industry, the blurred area of the new media industry and IT service providers concentrating on application integration. KIBS within these functional sectors represent more prominent technology-intensive and innovative KIBS (T-KIBS) distinct from more traditional professional KIBS, accounting, legal services, and management consultancy, for example (Bilderbeek et al. 1998). Associated with these, the most important services for the ICT sector include venture capital and training as well marketing functions.

2.3. Framework for analysing knowledge-intensive work organisation

The concept of work organisation has usually been taken for granted as a central forum that mediates and shapes up the content of work and working. But what the work organisation actually is, or means, is not properly conceptualised. The space of work organisation has been analysed, for example, on the organisational level, workplace level and even on the level of concrete work activity. However, the division of labour between employees, control of work and different kinds of interrelationships can be mentioned as central social dimensions of work organisation. The organisation of work concerns both intra-organisational and inter-organisational forms of action. It is about how human resources, tools, the subject of work, clients, and other partners are co-ordinated

with the organisation and technologies supporting effective, appropriate and adaptable production. (Julkunen 1987; Korvajärvi 1990; Tietoyhteiskunnasta osaamisyhteiskuntaan 2000.)

Steve Frenkel et al (1995; 1999) in their study on front line work and transformation of work organisations concentrate specifically on identifying and implementing new models of work organisations in information economies. According to them (1999, pp 23; also Ståhle & Grönroos 1999), a work organisation should be seen as a dynamic system operating within the workplace and comprising various elements that are related to the organisation and society in which the work organisation is embedded. A set of key issues they brought up from the overview of work organisation theory includes variations in employment and control relations; management, worker and customer dynamics; work and learning processes; and differences and changes in work organisation, including their consequences. As a future view, some organisation theorists emphasise the convergence on the empowered, network form of a work organisation, arguing that the mechanical, controlled bureaucracy is in the stage of decline. While, in comparison, some theorists support a continuity view according to which changes in a work organisation are variants of the regimented bureaucratic form. There are also some that argue that elements of work organisation combine many different ways and forms or even ways that are not yet predictable.

In their analysis on work and its organisation, Frenkel et al (1999) apply structuration theory following Anthony Giddens' idea that a social organisation is a product of meaningful action within a context, a wider social structure, for example, that is both constraining and facilitating in ways that may not be evident to actors. According to Giddens (1984), the structural properties of a social system (an organisation) are chronically implicated in its production and reproduction. Thus, structural properties do not exist outside the action. This means an emphasis on day-to-day life in the analysis of the reproduction of institutionalised practices. (Rantalaiho et al. 1997.)

In applying structuration theory to work organisation, Frenkel et al. (1999) place the conduct of work, work relations as they call it, in the centre of the analysis. While studying work and its organisation, organisations or workplaces are usually the main units of analysis. Both of these structures, however, include multiple forms of work organisations. Their size and complexity thus makes it problematic to understand social action within the organisations. Therefore, Frenkel et al. (1999, 36) used the workflow as a main unit of analysis in their research on work organisations. By workflow the researchers mean a structured set of tasks (work) leading to a specific output oriented towards a particular market. As an analytical framework, Frenkel et al. (1999) present the elements of a work organisation, in which they include work relations, vertical relations, and lateral relations.

Vertical relations

Management

Employment and
control relations

Customers — Work relations
Nature and
complexity of
work
— Workers — Lateral relations

Inter-organisational ralations

Intra-organisational relations

Workers

Figure 1. The elements of work organisation.
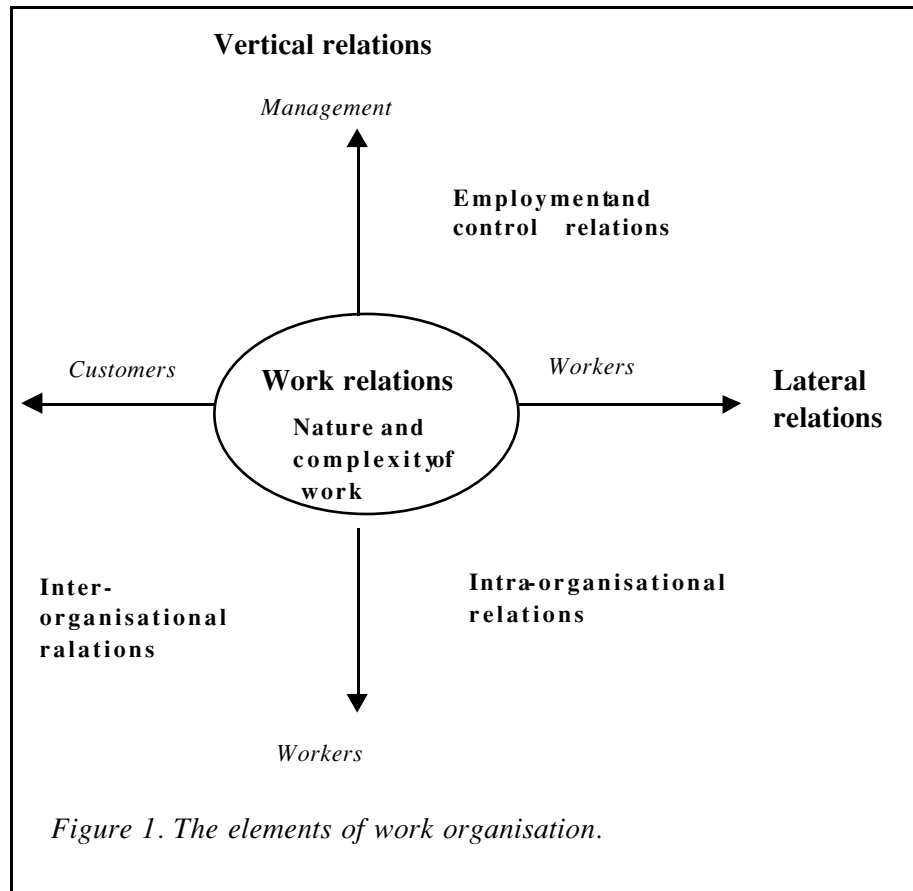
Work relations describe the constituents of work and a worker, that is, the nature and complexity of work, the basis of work roles, and competencies needed. Frenkel et al. (1999, pp. 24, 61-65) illustrate the key features of work by means of two concepts: the medium of work and the act of work. The medium of work refers to what is typically worked on in the course of completing tasks. This includes materials, persons, information (technology), or knowledge. The act of work refers to the process whereby various media, knowledge, creativity, and skills are employed to complete the task. The three components of the act of work are knowledge (scientific, technological, codified, or contextual and tacit), skills (required to execute typical tasks in a job or in an occupation) and creativity (a process of original problem-solving).

Vertical relations emphasise the hierarchical division of labour within an organisation and refer to two aspects of hierarchical power, namely employment relations and control relations. Employment relations describe the conditions of employment, recruitment, working time, training, career structures, and reward systems, for example. They are partly dependent on the national law, social customs and economic circumstances, and constitute a general form of control. Recruitment includes the skills and knowledge required of the employees and the characteristics of the hiring process, especially where the employees come from and the criteria used in hiring, as well as the nature and basis of employment contracts. Training issues concern the predominant sources (i.e. whether training is external or internal to the organisation) and the nature of training. Career issues point to employment security, to the existence of career opportunities and to whether the opportunities

exist inside or outside the organisation. Reward issues concern features of payment and other possible incentive systems. (Frenkel et al. 1999.)

Control relations refer to the means by which managers exercise direct power over workers, on the one hand, and to the extent and patterns of worker participation in decision-making on the other. The existing form of control in an organisation is related firstly to management's knowledge of the labour process, and secondly to management's ability to measure output. Direct control includes formal behavioural control and supervision over those who perform tasks, quality control, designation of authorisation responsibilities, standard operating procedures, rules as well as budget and expenditure guidelines. Direct behavioural top-down control may be appropriate when desired behaviours and outcomes are easily defined. However, in cases of more complex and unanalysable tasks, output control is more appropriate than behavioural control. Output control has potential for providing professional experts with discretion to exercise judgement and be creative, but it also passes a great deal of responsibility on to the experts who might be reluctant to take all that responsibility. This form of control is related to new management concepts like empowerment, coaching, and entrepreneurship. These principles require the building of a strong commitment among experts to the organisation by means of flexible work arrangements, for example. (Adami 1999; Depickere 1999; Frenkel et al. 1999.)

Indirect control includes job description, culture, performance appraisals, career advancement, incentives, compensation and remuneration as well as training and skill development, for instance. One form of indirect control is called input control, which regulates mainly antecedent conditions of performance. Some of these indirect forms of control will be approached as part of employment relations. Furthermore, by developing group- and team-based work arrangements, organisations can encourage the development of forms of social control, derived from mutual commitments of group members to each other and to the shared ideas and values of members. Frenkel et al. (1999) emphasise this kind of socio-normative or clan control as common within project-based knowledge work. In addition, the role of clients both as sources of information for control and as direct controllers has to be taken into account. Some combination of behaviour, output and input control is present in most organisations. The organisations that rely on experienced and professional experts to complete novel and complex tasks are most likely to have a balance between output and input controls. (Adami 1999.)

By lateral relations Frenkel et al. (1999) mean the functional or horizontal division of labour within an organisation. Firstly, they focus on co-worker relations, the ties between workers and their colleagues, for example. Secondly, they focus on customer interface, the relationships between workers and customers, for example, which often are structured by management. Co-worker relations includes such features as working alone, in groups or teams, the extent and nature of co-operation among immediate co-workers, between different competence areas and between different functional sections of the organisation, and lateral communication. These features were analysed particularly from the standpoint of task interdependency and learning interdependency, integration

of informal relations, and forms of teamwork. The extent and nature of collaboration among co-workers vary according to work complexity, business concept, organisation's human resources (HR) strategy and organisational culture, for example.

In customer interface, Frenkel et al. (1999) emphasise workers' role, and especially worker-customer-management interdependency. Within this triangle, the parties may have conflicting or complementary interests and then several potential alliances. While the interrelationship between IS experts, their managers and clients will be somewhat discussed in connection with other chapters of this report, client relations will be analysed on the organisational level; that is, from the standpoint of the role of case organisations for clients' business and vice versa.

The current interest in knowledge-intensive services in particular relates to the growth of various new business organisations connected with information technology, and with the production and transfer of knowledge about new technology. KIBS organisations bind more general scientific and technological information and knowledge with the more localised requirements and competence, including more tacit knowledge located in the daily practices of the clients and sectors they service. By identifying, generating and diffusing innovations and information about them through economic sectors, they contribute to overall innovation system and economic competitiveness. (Bilderbeek et al. 1998; Haukness 1998).

According to Simone Strambach (1997), the contribution of KIBS in innovation systems can be divided into direct effects and indirect effects. The direct effects emerge as a result of the supplier's own innovative activities, such as product innovations, process innovation or social, organisational and delivery innovations. The indirect effects emerge on the demand side through the use of KIB services. The complex interaction and learning processes between clients can include a transfer of external technological expert knowledge, adaptation of existing knowledge to the specific needs of the customer, integration of different stocks of knowledge, and exchange of empirical knowledge from different branches, for example. Successful knowledge transfer and innovative problem-solving for clients can increase the competitiveness of both the KIBS supplier and the client.

According to Bessant and Rush (1995, also Bilderbeek et al. 1998; Miles 1999), the innovation process involves parties with various gaps in resources and in innovation management capabilities. Thus, the task of KIBS may be directly to fill in these gaps or indirectly to help bridge them. The bridging functions of KIBS are varied:

- expert consulting, providing particular solution to particular problems;
- experience-sharing, transferring what is learned in one context to another;
- brokering, putting different sources and users in contact across a wide range of services and resources;
- diagnosis and problem-clarification, helping users to articulate and define the particular need in innovation, helping to prioritise the problems, for example;
- benchmarking, where the process of identifying and focusing a 'good practice' can be established through an intermediary; and

- change agency, where organisational development can be undertaken with help from neutral outside perspective.

The three roles played by KIBS in supporting innovation in client organisation can be differentiated. A KIBS organisation may be the facilitator, carrier or source of innovation. A KIBS can be the *facilitator* of innovations if it supports a client firm in its innovation process, but the innovation does not originate from this KIBS organisation. A KIBS organisation can also be the *carrier* of innovation by transferring existing innovations from one firm or industry to a client firm or industry. Again, the innovation does not originate in a particular KIBS provider. KIBS organisations often take on an intermediating role by integrating knowledge from various resources and adapting it to the specific need of each client, mostly in close interaction with the client firm. Then KIBS are labelled as the *source* of innovations for clients. (Miles 1995; 1998; Bilderbeek et al. 1998; Haukness 1998.)

3.   RESEARCH QUESTIONS AND DATA GATHERING

The report concerns work and its organisation in newly developed and rapidly growing knowledge-intensive business service organisations supporting the performance of the telecommunication industry. The focus is on describing the typical features of a specific category of knowledge work, which is IS expert work in a specific category of KIBS organisations, namely high-tech IT service firms. Characteristic of the services are high client orientation, and knowledge base both in terms of producing, interpreting and using these services.

Knowledge-intensive organisations' success depends to a large extent on their intangible assets, mainly on their human capital. Since the employees are the owners of the most important capital and factor of production in these organisations, there continually exists the risk that the knowledge will not remain in the organisation. Thus, in order to guarantee the innovativeness, competitiveness and organisational commitment of their employees, attention to and investment in the organisation of work and competence are essential. New emerging services with increased knowledge intensity implicate a changing content of work, which both provides and encourages new forms of work organisation. These new forms have not yet been studied much, however.

Based on the conceptual discussions and framework presented above, the research questions are defined as follows:

- How complex and knowledge-intensive is the work in high-tech IT services? What is the nature of knowledge and skills as well as the degree of creativity needed at IS experts' work?

- How communication-intensive, flexible and empowered is the organisation of work in these services? What are the recruitment criteria and processes as well as the basis and nature of employment contracts like? In what way is the further development of competence and careers arranged? What are the ways of rewarding the IS experts? Furthermore, what are the forms of control in high-tech IT service firms and how independent is IS experts' work actually?

- How does client orientation of services formulate the organisation of work and working in high-tech IT services? What are the forms of internal co-operation and networking among co-workers within the firms? What are the forms of external collaboration and networking of the high-tech IT service firms?

- What is the contribution of the high-tech business services for the innovation system in the telecommunications sector?

Analysis of work and its organisation in high-tech IT firms is based on organisational case studies. The data is qualitative and it was collected mainly by conducting semi-structured interviews with IS experts and their managers (see Appendix 3). Also, the available annual reports and Internet pages of the case organisations were used as data. The specific case organisations related and supporting the telecommunications sector were selected within the software industry, new media and IT services complemented by a plastic product development and design firm. In total, six firms were selected for case interviews. The cases represent independent, private firms; thus, intra-organisational KIBS, traditional KIBS as well as possible public or semi-public KIBS organisations are excluded from the analysis. The most important criteria for selecting the case organisations in particular were the following facts: firstly, they were T-KIBS; secondly, their key customer segment lies on telecommunications (equipment industry and network operation) and they were, in one way or another, involved in wireless technologies; and thirdly, they were Finnish firms.

In total, the case study data consist of twenty-one interviews, of which thirteen were conducted with the executives or people in other managerial positions at the firms, and eight with expert employees. Only two of the twenty-one discussants were women. The themes of interviews with the managers were the following: the history and organisation of the company; collaborative networks and the KIBS-client interface; innovation activities; and patterns and maintenance of human and social capital within the organisation. The themes of the IS expert interviews concerned skills; competency and expertise; organisation; the conditions and content of the work; the company as employer; and the meaning of work. Expert interviews were complemented by a short questionnaire for all experts in smaller firms and the experts in some specific ongoing projects in bigger firms (47 experts responded). The questionnaire included questions about education, employment relations, various features of work, and work autonomy.

The interviews were implemented in June and September 2000. One interview per each person was made. The length of the interviews varied from one-and-a-half hours to nearly three hours. One interview was completed later via the telephone. All interviews were taped and transcribed. They were then coded and formulated according to the categories indicated by Frenkel et al. (1999) and according their work organisation framework in particular.

The case organisations (see appendix 2.) were selected to represent different ages, sizes, and locations. The oldest firm was established in 1985, the youngest in 1997. All the case firms were rapidly growing, both in their turnover and their personnel. At the time of data collection, the

number of employees ranged between 20 and 30 within the two smallest case firms and from 100 to over 300 within the other firms. The main offices of the case firms are located in Oulu, Jyväskylä, Tampere, and Helsinki. Most of the firms have offices also in other localities in Finland. Some of them were already expanding abroad as well.

Almost all the case firms were pure start-ups of the new business instead of being outsourced services. Business in most of the firms was organised as a project business area producing customer-oriented operational software applications and IT consultation, and the firms' own product development area. In both cases, the firms represent project organisations with industrial or functional organisation. The markets of the case firms are in telecommunications but also in large companies within other industries. Organisational hierarchy is flat and the employees represent mainly expert workers with occupational titles like system designers, software designers, software specialists, application developers, graphics, graphic designers, designers and project managers, for example. The employees of the case firms were highly educated, quite young and principally men. All in all, the case firms can be called knowledge-intensive business organisations.

4 ELEMENTS OF WORK ORGANISATION IN HIGH-TECH FIRMS

4.1. Work relations

The subject of the expert work in firms supplying business services in wireless mobile technology are software service products, which as codes, languages, programmes and networks are also tools for performing work tasks, means of communication, co-operation, documentation, and management during the work process, and also the product of ultimate work efforts. Work is implemented through constantly changing client-oriented projects by both shared and autonomous problem-solving and by producing innovative and new solutions for often quite unique problems. While the commission of the project group mainly focuses on novel problems, its implementation deals with uncertainty and complexity. Expert work in these firms is characterised by theoretic-technological knowledge; due to the high-level client orientation of their work, the experts need contextual knowledge and experience in particular. Their technological knowledge base represents both the input and output of work and business. Client orientation embodies close interaction with clients. Furthermore, the unique task of solving a problem as such requires co-operation among various experts. The medium of work, for example, what is typically worked on in the course of completing tasks (Frenkel et al. 1999, 61) includes both information, knowledge, and people. A project can include experts from one organisation only, but also cross the organisational boundaries to clients, other contractors and locations as well. Thus the place of work might also vary on different projects. Along with changing projects, the expert group within each project also changes, which describes both the flexibility and uncertainty of work. The practices of creating, articulating, disseminating, and renewing the knowledge have implications for the recruitment and training of

staff as well as the definition and delivery of services to clients (Empson 2000). All these features of expert work emphasise the importance of the appropriate organisation of work within the new and developing high-tech firms.

Knowledge and skills

According to the business concept of the case firms working in the area of wireless technology, their key assets lie in their human capital, in their personnel, for example. The most important and also biggest personnel group consists of IS experts, whose occupational knowledge is mainly based on electronics, engineering, and computer science. Formal knowledge and formal higher education are typically used as measures of knowledge-intensive work and workers. Characteristic of professionals, in particular, is that they belong to a highly professionalised collegial occupational group, have higher education, emphasise application and improvement of knowledge in autonomous work, have respect for professional norms of behaviour as well as peer review and sanctions (Starbuck 1992; Løvendahl 1997). However, many professionals and experts acquire knowledge and competency after their formal education in working life by knowing-in-action (Poikela 1999). Some knowledge workers are even less dependent on formal knowledge by education. The education system can only give people standardised basics. Besides theoretic-technical knowledge, expertise develops through reflective practices, experiences, and contextual knowledge. (Starbuck 1992; Alvesson 1993; Poikela 1999; Järvinen et al. 2000.)

There is necessarily no connection between knowledge work and being a member of a profession. Knowledge workers are employed mainly in organisations aiming at profit-making rather than professional excellence. Further, while professionals identify strongly with their professions with ethical codes and collegial cohesion, knowledge workers may lack this kind of collegial code and cohesion and thus identify more with the client or the employer. (Starbuck 1992; Frenkel et .al. 1999).

The IS experts who work in case organisations do have very special technical knowledge and competence on ICT compared with many other competence areas on the labour market. However, within their own competence area, the IS experts saw themselves as generalists who may have gained some special expertise through client projects. Their expertise is more based on and develops through the needs of clients and practices in conducting their work with co-workers and clients. They also respect wide-scale know-how because it allows for more opportunities to work on different projects and, at the same time, to learn the new in the rapidly developing IC technology. Thus, the IS experts can be called generalists within a special competence area. Instead of identifying themselves with their occupation or even with their employer firm, they are very committed to their technical competence in that they are able to maintain and develop by means of client projects. Despite the fact that the IS experts and their managers emphasise contextual knowledge, agreeing with Frenkel et al. (1999, 75), theoretical knowledge permits generalisation and common work

norms; promotes dialogue and hence learning and collaboration among the exerts; enables conceptualisation of a total system and technical specifications; and facilitates solving a problem.

More important criteria for identifying the knowledge intensity of work are skills that are in demand, and that may be relatively esoteric and hard to attain for the common person. The concept of skill (in relation to work) refers to the concrete requirements set for the worker (individualistic capabilities) to execute typical tasks relevant to the jobs or occupations competently. As skills requirements arise from the actual work processes, jobs and occupations vary in their skills profiles as well as skills profiles may change by time and place. Individual workers in any jobs or occupations also vary in their skills according to their formal training, on-the-job training and work experience as well as their personal abilities and suitability. However, at least three types of skill have usually been identified as a basis for further analysis. These are action-centred skills associated with physical sensing and adroitness; analytical or intellective skills consisting of reasoning based on abstract symbols, explicit inference, synthesis and systemic thinking; and social skills related to interaction, communication and coping with different people in different situations. Relevant are also self-management skills including the ability to organise one's own tasks efficiently as well as personal adaptability and applicability. (Zuboff 1990; Alvesson 1993; Lindqvist & Manninen 1998; Pelttari 1998; Frenkel et al. 1999.)

The most important skills needed in IS experts' work, mentioned both by the experts themselves and their managers, fell into categories of social skills, personal adaptability, and analytical problem-solving skills. Interaction and communication with co-workers, project managers, clients' representatives and other potential external collaborative partners are essential features even during the whole work process of the projects. As early as the beginning of the project, IS experts may be involved in the process of defining the problem with clients and other potential partners. During the project, even if not working physically in the same place, IS experts are in contact with the clients' technical project representatives either regularly or as frequently as needed using the telephone, or more generally the e-mail. Negotiation and communication skills in different languages with various people from various sectors, group-working and decision-making skills are also worth mentioning here among other skills. IS experts with higher-level social skills are actually in a very important position in building and maintaining trust with clients, thus generating new projects and customerships over a long period of time (Frenkel et al. 1999).

Projects cannot be usually carried out on the basis of only one individual expert's creative problem-solving skills. Project work is rather based on group work or at least on working in pairs. At the beginning of the project, the project manager divides the defined problem into sub-tasks for IS experts from different competency areas needed in reaching the solution. The project manager co-ordinates, gives advice and evaluates the work of the experts at regular project meetings. Then, the final service product of the project is based on shared expertise and shared responsibility (e.g. Lehtinen & Palonen 1997; Hakkarainen et al. 2000) with lively and continuous interaction and communication among the experts and between experts and managers as well. Most of the IS experts

mentioned the need and the opportunity for spontaneous discussion and guidance with other experts (either within the same project or in the same workplace in general) being necessary in conducting the tasks creatively. In many of the case firms, free interaction was ensured by organising the work premises as open-plan offices. According to director of business development, *'Human relation skills at first of course! [...] it (business) doesn't work if there's 25 tongue-tied experts sitting in an open-plan office. We do not have any tangible assets in this firm. All of our assets are between the ears of our experts. We must take care of the assets that aren't based only on knowledge and know-how but on certain characteristics and skills too.'*

The most important skills emerged from the category of personal adaptability and applicability are: tolerance for constant change, ability to learn continuously, and genuine interest in and enthusiasm about information technology. The duration of service projects can range from a few months to one year or even continue for several years. The project can include experts from one organisation only, regardless of where the offices are but also cross the organisational boundary to clients and other contractors from various locations. IS experts generally participate in one project only at a time. In practice, they may, however, take part on several projects at the same time, but their position and tasks within the teams of separate projects may vary. As the projects may change quite fast, the combination of experts in each project and the closest co-workers and superiors (at least on projects) may also change. The ability to adapt to different situations is essential for experts working in project organisations.

Project work, being either developing former solutions, integrating old and new technology for more permanent clients or solving totally new problems in new commissions, requires studying something new in almost every case. A high level of uncertainty predominates IS experts' work. Firstly, the rapid technological progress in the tools used for design and implementation forces them to maintain and develop their technological know-how. Secondly, both the high level of customisation of the service products and the innovative production development of before non-existent service products ensure the complexity of work as well as the unique solutions within each projects. Then IS experts basically learn on the job, which likens their activity to a craft instead of science (also Frenkel et al. 1999). Many of the interviewees emphasise the fact that *'the experts of the project have the most recent knowledge'* because *'the knowledge needed on projects must be created during the actual problem-solving process'*. Formal education and basic research can give basic knowledge and confidence for IS experts in their work, while the actual competency and expertise can arise only through diverse work experience. Besides the intended service products, co-operation as well as new knowledge and know-how are by-products of the projects. *'The point is that the experts learn new things from each project. They are a little bit wiser project by project collecting human capital for themselves. We (the firm) actually earn our living from that capital in many (business) situations.'* (Manager of Technology)

Constant change and learning are seen as fundamental and self-evident features of the work within firms applying and developing new wireless technology and services. Some of the interviewees saw

these aspects as an indication of a new working culture and a new work identity of a new generation. Among the most positive features of their work, IS experts emphasised particularly its substance, diversity and learning. These experts seem to be extremely committed to the know-how on new high technology as well as living on top of the development of the technology. *'These (workers) are really technology-buffs. All the time there's something new. It (change and learning) is somehow so typical of this work that those who don't bear it don't even apply for this kind of a job.'* (Director, Business Development).

IS experts want to have new challenges in their work; otherwise they might get fed up with their jobs. This might easily lead to a decrease in motivation, efficiency and organisational commitment, and to an increase in the turnover of workers. *'Changing tasks ensure that one cannot get bored on the job. It has been found out that creative people are sensitive to getting bored and then their work efficiency decreases and they are not happy at their workplace anymore [...]. Hype only is not enough to keep people at work in this industry. It (permanence and commitment) must start from the fact that work tasks are varied enough.'* (Graphic designer). *'Personally, I like to do new things and get new challenges at fairly fast pace. It might be common in this industry and in our generation as well that you have to learn new things all the time to cope with your job. This work can never be or become routine, like work in manufacturing. Every day is different.'* (Software designer).

Among important analytical skills, the experts and managers emphasised creative problem-solving skills and the ability to think constructively and contextually as well. Creative problem-solving may, for example, include the following skills: the ability to identify and define a problem, to create various alternatives to be forwarded to the team, and to choose the best solutions according to particular situations. *'Software design is actually selection. Sometimes there's several choices. But our task is to make the right choice and the right decision. So, in reality, we sell our ability to evaluate.'* (President).

Technical skills were thus not the first on the skills list**.** They were rather taken for granted as a precondition for performing IS experts' work. Further analytical skills and problem-solving partly relates to and develops through theoretic-technical knowledge. However, some of the interviewees reminded us of the fact that technology is only a tool that enables the implementing of innovative service products, but in the process of creating new innovations, technology does not exactly help much. Besides technical skills (wide-scale know-how on older and new technology) wider contextual knowledge, experience and understanding from the end-users' standpoint are needed in the work of the IS experts who design ICT service products.

'I don't necessarily speak about technology, but about experience in the context for which or about the users whom the service products are meant for. [...] It doesn't work if we employ a group of highly technically oriented IS experts, who programme a technologically well-designed service product. But then, the quality of that product from the users' standpoint is totally poor. ... But in this business, the service product is the kind of thing that users and consumers find attractive. Then we have to consider everything that the consumer represents. We have to think in advance which

consumer group the service product has been meant to, which way they would use it and why, what surplus value exactly it would bring for the consumers. After all that we have to think about whether it is technologically possible to build this kind of service product. ... Thus we are speaking about very talented experts with wide-scale competencies. We are speaking about excellent technical skills, good human relation skills, extensive understanding of different environments and different social and other groups of people as well as few other skills. The requirement level is quite high and the work is very creative!' (Program manager).

IS experts' work and skills needed are thus not only related to the defining, designing and implementing technical systems. Within project organisations, skills in working on projects, such as the ability to organise one's own tasks, to keep to the timetables and to follow the standards and rules of documentation as well as the ability to negotiate, communicate and work with various other experts in teams are highly prioritised. Further project management skills are seen as especially focal in business. The project manager co-ordinates the project, being in the middle of different actors (clients, experts, managers, etc.). His/her tasks and skills relate to the social, technical and business development competence areas. Among the most important skills of the project manager are the ability to organise and follow-up both time and labour resources; communication and negotiation skills among different partners and actors of the project; leadership skills and advisory skills in technical and organisational problems; and all kinds of expressive and literary skills. Quite many of the IS experts felt, however, that they need further training in project management and leadership.

Project know-how may mean more or less standardised working practices from the beginning of business generation to the end of each project, covering also possible maintenance activities and further developments. These practices, or standards, are developed by the organisation itself in order to ensure the operability and quality of the solutions and service products. Besides being project-oriented, IS experts usually learn these organisational practices through experience project by project. It is usual that the status of an expert may vary from an ordinary programmer to a key specialist to the project manager between different projects. Some experts said they choose to take turns in working on projects as a technical expert and as the project manager because rotation ensures the best learning and work experiences.

The IS experts employed in firms developing new wireless technology are provided with both wide-scale contextual know-how related to business and with high technical specialisation. A clear need for continuously enhancing technical abilities in line with the development of technology and applications is obviously known in these IS experts' everyday working life. Concurrently, they are also expected to develop their organisational and business development skills in order to meet the strategic demands of the clients, employers and co-workers (and even end-users) within project-based business-to-business. (Beirne et al. 1998.)

'In my opinion, most important key qualifications or skills are the know-how on software technology, including implementing technically well-designed applications and solutions from the standpoint of programming. Then the know-how on designing, planning and developing these software

*applications and solutions is another important standpoint and there comes conceptualism (the ability to understand the business context) into the picture. Thirdly comes the quality and usability of the service product, including the ability to think from the user's viewpoint. So, there are three (skills profiles), kind of [...]. The ability to understand the substance of the business, to design visually and functionally usable service products, and then comes the whole invisible software side (e.g. technical skills in implementing the planned product). These are the three key areas, definitely.' (*Director, Business Consulting*)

It seems that at the same time with the rapid development and rising importance of theoretical knowledge within the area of developing wireless ICT, there is also a rising need for more contextual know-how. Knowledge-based competence, such as the ability to use ICT, language skills, technical skills, and knowledge on substance, knowledge on different work processes as well as information retrieval and information processing are still very important. But new kinds of skills and know-how, such as learning to learn, knowledge management, the ability to deduce and decide, communication skills, teamwork skills, creative thinking and problem-solving as well as skills in self-management and developing are becoming even more significant preconditions in the IS experts' work. (Lindqvist & Manninen 1998; Karlsson 1999).

Creativity

Creativity was mentioned as one of the basic skills needed in an IS expert's work. A key characteristic of knowledge-intensive organisations is also said to be the ability to solve complex problems with creative and innovative solutions (Sveiby & Risling 1987; Starbuck 1992; Alvesson 1993). Frenkel et al. (1999, 64) define creativity as a process of original problem-solving, in which an original, relevant and complete solution is generated. According to the description of work and skills of IS experts, it seems obvious that work both in the production development and customised business services within the area of wireless technology requires high-level creativity and innovativeness.

Creativity is related to the various ways of using information and knowledge. Where work is open-ended, the worker must improvise, using and creating knowledge extensively. In the case organisations, participation in the client's production development in wireless mobile technology really means creating something that has never existed before. Creativity does not, however, only limit to technological problems. *'Where does the knowledge come from? Nowhere! We have to create it by ourselves. Creation of new knowledge is one of the most challenging tasks for even knowledge organisations. Of course the knowledge we use while innovating is based on something as well as while specifying and designing a system we transfer and exploit the knowledge from previous projects but always tailoring it to the needs of the present project. Each project development process is also a learning process. While innovating new service products, we need to know if the consumers will use the service, if we can sell the service to operators, and finally, if we can build the kind of service product technically.'* (Program manager). Then the markets and demand are in an

important position when creating new innovative service products. Usually creativity and new ideas arise from intra-firm activity through everyday practices of the experts who themselves are devoted users of wireless services, and through the intensive client interface, but also even through standardised innovation processes.

Bente Løvendahl (1997) has described the value-creating process of professional service firms by means of three processes. The first process concerns the ability of the service provider to sell a credible promise. The more innovative and idiosyncratic the service, the larger the knowledge gap between the service provider and the client, the more complex the process is likely to be. The second process involves the set of activities required in order to deliver what has been promised and involves both the client and the service provider assigned. The third process illustrates learning from the project, including the dynamic process of knowledge creation and organisational learning. The key element of a professional (and also knowledge) organisation is then both the capacity to unlearn existing practices and learn new ones, including the capacity to reproduce what has been learnt over time. (Strambach 1997; Bilderbeek et al. 1998.)

Where work has a clear and straight path to solutions, knowledge can be applied directly to conducting the task. In these cases, however, workers often choose to work creatively, sometimes even passing officially standardised working practises. According to an IT consultant, ' *[...] working practices are always stressed so much. In my opinion, they develop from the process of the ongoing project. We just work according to the working practices that are the most suitable for the whole project group as long as we reach the end, which is, by the way, a satisfied customer. All means are perhaps allowed as long as the result is presentable and the code is readable in a way that, in addition to the designer, the client too can understand the result.'* Creativity is also needed in decision-making when choosing the right one from many solutions for the actual problem. *'We often apply old knowledge on new projects. The same things can be done in so many different ways. But it is difficult to say which is the best way. Sometimes the best solution is not actually the best because the fastest or the easiest way to carry out the work can be the best solution. Creativity in problem-solving is always situational but technical specifications are the facts we have to conform to any choice'* as the project manager/product designer has found out. Clients may determine technical specifications to the service product, its realisation and tools, and even workers in so great detail that there is not much room left for creativity.

Further quality management and other official means for organising software development work has also been seen as constricting the creativity in IS experts' work (Beirne et al. 1998). However, the director in the telecom department at one case firm emphasises the role of standards as the facilitator of the work process for IS experts. *'We try to create and develop (service) processes. We try to create working practices that act as regular standards for experts at work. But new knowledge, however, arises in general from more informal and non-standardised innovations. Anyway, I'm a bit like a bureaucrat and I do support standards. I've always seen that standards and creativity are not the opposites. By developing and standardising working processes and the quality of the service*

production we can only create the frame for working and business within such creative action as programming work still is. These processes must be the kind that they don't limit creativity and innovativeness. Their significance is that the experts don't have to think about the details of their work every day, but they know what has to be done and can then release their creativity for the tasks that aren't specified. This is a young industry but the organisations grow quite fast. It just is necessary to organise the work and business but in the way that doesn't limit innovativeness.'

Kit Sims Taylor (1998; also Alvesson 1993) reminds us that creativity actually forms a fairly small part of knowledge work. He found six more or less distinct types of work from the work patterns of knowledge workers. Firstly, there is routine work that is hard to separate from knowledge work. Secondly, knowledge workers spend more and more time in networking, promoting and socialising tasks, of which most part is done virtually nowadays. Thirdly, lots of time is spent to find the data needed to produce the knowledge needed. Fourthly, knowledge workers usually create again already created knowledge because existing knowledge is sometimes so difficult to find. Only fifthly does he mention the truly original, creative problem-solving, which is, however, something that the least time is spent on in knowledge work. The sixth element is communicating what has been produced or learned. For IS experts, coding or documentation, for example, could be the kind of routine after the more creative phase of specifying and designing the system. However, according to an IT consultant *'typing a code is very rewarding because all the time you can see that it's working, this short piece of program as well as the next one, they are well-designed. It is very motivating. While planning and designing the system on paper, you cannot ever be sure if it's working or not'.*

Starbuck (1992) states that the distinction between creating and applying knowledge is quite hard to make. Each project represent a two-way learning process as a by-product of co-producing service products with clients. Through interaction, the client's knowledge base changes, but the service provider organisation and experts gets more experience and learn more about the characteristics of a specific industry. Thus they can utilise this new socialised and institutionalised contextual knowledge and experience for improving service quality and efficiency with future projects. Creating new knowledge and applying old knowledge intertwine and complement each other. In order for the old knowledge to have significance, it must be related to the current problems, and in order for the new knowledge to have significance, it must be accommodated to current beliefs and perspectives.

According to Mats Alvesson (1993, pp. 1005, 1009), relatively qualified programming work, for example, does not actually involve so much esoteric expertise or direct and creative application of a systematic, institutionalised body of formal knowledge. Instead, it involves wider and highly complicated social and organisational skills as well as the ability to handle knowledge management and project management. He also argues (p. 1000) that creativity and pure knowledge are to some extent contradictory. Creativity could even be said to be needed when knowledge in insufficient, whereas when we have enough knowledge we do not have to be creative. However, formal knowledge often provides the base of creativity but knowledge can never be the only qualification. Instead, using knowledge conceptually as a final point, a more dynamic concept of knowing which

combines the substance of knowledge and its application is more useful here because the application of knowledge and skills is always contextual. (Blackler 1995; Raivola and Vuorensyrjä 1998).

Conclusion

Agreeing with Frenkel et al. (1999, 64), both theoretical and contextual knowledge need to be expertly combined through a process of diagnosis, inference and application in IS expert work. The combination is important where innovative work requires collaboration among different kinds of experts, including clients in highly customised services but also in genuine development of service products for wider markets. The work of IS experts is characterised by wide-scale client-oriented project work with constant change and need for learning. Thus, instead of formal theoretical knowledge only, contextual experience, social skills, project management skills and especially the capacity to adapt to new situations are needed for creative problem-solving. The stereotype of techies shut out from the work community, working alone days and nights and having only the computer to keep them company, seems not to be reality at all!

The degree of creativity, however, varies on different projects, mainly depending on the client-orientation but also due to the standardisation of the work process. Furthermore, it has to be taken into account that original problem-solving is actually a very small part of knowledge work in general. Instead of connecting creativity to an individual IS expert or to a work process of a service provider, creative problem-solving should also be seen as a co-production process in a group including members with a variety of competence areas, both from the client organisation and the service provider organisation. The work of IS experts in the organisations providing services in the area of new wireless technology requires both constant improvement of technical abilities and strengthening organisational and business development skills in order to meet the demands of the clients, employers and co-workers within project business. This supports the view of Blackler (1995) and Frenkel et al. (1999) on the complexity of knowledge work emphasising especially embrained and encultured knowledges focusing especially new problem-solving and knowledge creation. It also challenges organisations to develop an active personnel strategy and to promote their knowledge management practices.

4.2. Employment relations

Employment relations refer to the procedures and practices that define relationships between employees and employers of an organisation. According to Frenkel et al. (1999, 95), employment relations usually contain issues of recruitment, training, career, and rewards. The definition of employment relations also represents forms of indirect control, input control within an organisation. Input control regulates mainly the antecedent conditions of a performance, ensuring that the employee's skills, knowledge, attitudes, values, and interests match those of the employing organisation. In the environment where experts require autonomy and authority to decide about the

most suitable methods and resources required to solve a problem, the organisation should maximise their skills and functional flexibility by minimising traditional organisational control. This may mean flexible work arrangements and the promotion of indirect control methods for facilitating the skilled individuals' task completion as well as ensuring their organisational commitment. (Depicker 1999; Adami 1999.)

Frenkel et al. (1999, 96-97) describe the general features of knowledge-intensive employment relations as follows. Organisations recruit employees usually from the external labour market at the expert status and are then concerned mainly with their qualifications and experience. The main sources of training are provided by specialised institutions and organisations' own on-the-job-learning. Knowledge-intensive work usually offers opportunities for career advancement, either with the same employer or with a different organisation. If the external labour market is strong, employment security is neither sought nor provided. The reward system includes relatively large variable elements based on explicit skill acquisition, and the pay raise criteria are performance-based. Further, Frenkel et al. (1999, 101) continue that knowledge workers tend to be highly qualified, having obtained their credentials in formal high-level education but emphasising systematic training and career planning to maintain their knowledge and technical expertise. They argue to be occupationally stable but organisationally mobile, their mobility across organisations being facilitated by theoretical knowledge. Within knowledge-intensive organisations, there is tension between the workers pursuing primarily knowledge-intensive interests (maintaining their expertise) and the employers who emphasise organisational and business goals contributing to profit-generation. Developing an employment system that would relieve the tension and promote organisational commitment then presents a challenge for the knowledge-intensive organisation.

The economic markets of the knowledge-intensive business services in the telecommunications sector are still developing, characterised by 'environmental turbulence' with growing specialisation and diversity in products produced by flexible SMEs as well as the complexity of the market (Depickere 1999). For high-tech IT service firms, environmental uncertainty and complexity means constant competition for insufficient labour resources, for example. For IS experts, it means an open employment and wage market, which, in turn, might encourage a high turnover of experts within the telecommunications sector. As the personnel is the most dominant capital in these business organisations, their innovativeness and competitiveness are highly dependent on how successfully they conduct their employment relations and thus succeed in promoting organisational commitment and trust.

Recruitment

Because of lack of highly competent experts (despite the enormous increase in computer science education in Finland, see e.g. Tulkki 2001), recruitment was accounted as problematic within the business service organisations in the area of rapidly developing wireless technology. Most of the case organisations hire a new workforce mainly outside the labour market, from polytechnics and

universities. This means either the newly graduated, or more commonly, students. According to the HR manager, students in particular are the most active on the labour market. The usual route is that students are first hired for a summer job, they then continue as part-timers along with their studies and finally get a permanent job regardless of whether or not they have obtained the degree. There is also some natural workforce mobility among the organisations within the labour market of information industry and recruitment of re-trained workers from other industries as well. However, the direction of this mobility seems to take place from large firms into the SMEs. One explanation for that might be that smaller firms offer a flexible work organisation and especially wide-scale job opportunities thus promoting the experts' learning and experience. Due to the lack of resources here in Finland, organisations within the telecommunications sector have also widened their recruitment to concern abroad as well as established offices in different countries.

The IT service provider and consultant firm deviates from the general trend of the telecommunications sector in hiring students. The great majority of the new employees enter the case firm from a competing firm. As an integrator of operative systems, the above company and its business require extensive knowledge, know-how and experience of a variety of the generation of technological tools and data systems. Then the basis of recruitment criteria and the composition of the personnel is a dynamic combination of both seasoned experts and experts in state-of-the-art technologies. The average age of the personnel in the case firms as well as in the IT consulting business in general is higher than within information industry/telecommunications business services generally. *'We can employ only a certain number of the newly graduated. They need so much guidance and tutoring. Although we have created a master-apprentice tutoring system (senior-junior), there is a lack of seniors willing to give such advice; also, they do not have enough time for that kind of work.'* (President of the Board)

Nowadays, the Internet is emerging as the most important and effective means for recruitment as the 'net generation' usually searches for interesting firms and employment opportunities available on the Internet. Other effective ways of recruiting experts are through grapevine and especially by means of personal connections. Many firms also reward employees who give hints on potential experts to be employed. Newspaper advertisements as well as attractive Internet pages are a salient part of imago building and marketing directed both to potential clients and employees. This kind of visibility is especially important for firms who produce business-to-business service products as a part of the end-product owned by their clients, thus promoting the brand of their clients instead of their own. Most of the case firms, irrespective of their customership, size and locality, agreed that, to some extent, they are not well known enough on the labour market.

Establishing and broadening the business into localities with a technical polytechnic or a university have been essential from the point of recruitment of expert labour, both for the case firms and for the whole telecommunications sector. *'All in all, in the course of all these years, because of the university (with the discipline of computer science), it has definitely been the best place in the world to establish the business here near Oulu. Until the past few years, the interrelationship between the*

demand and supply of the workforce has been considerably favourable. It has really been possible to choose the right people with whom to build a work community and business.' (Manager, Business Development). Further, one factor behind the education and research co-operation with polytechnics and universities is the possibility to find new labour. The reverse side of recruiting students might be, however, the loss of credibility and expertise as assets. Although the diploma seems not to be so important as experience acquired through the job, it is important to see to the fact that the employees graduate. Thus, creating processes for support of the student experts graduating is one of the challenges for HR management.

The criteria for selecting employees are varied, flexible, and demanding. Because of the technical nature of their work, most of IS experts either already have university degrees or they are students mainly in computer science or in a related discipline. However, the acquired diploma does not actually reveal much about the real qualifications of the IS expert candidates. Therefore, there rarely exist any strict and narrow requirements for formal education as criteria for recruitment. *'Of course formal education of employee candidates is a good thing, but technological know-how through programming avocation and work experience will also do for us because we know that it still takes one or two years to make real experts out of them.'* (Chief Executive). Also, according to the manager of business development, there are no requirements for formal education in the organisation he works for, although higher education is most common among workers in this firm. *'People as such are the fundamental point. And actually we have employed quite a lot workers with wrong education in the highest level, who had wanted to change over to the IT sector from mathematics, physics, biochemistry and humanities, for example. Of course we do hire traditional engineers from information technology but we search for this kind of pluralism deliberately.'*

According to the program manager, there is a need for experts in many fields within the IT business services. *'We have graphics who do not think about anything else except the artistic outward appearance of the service products. They are basically like painters who do things that no one else has done before, beautifully coloured and good-looking. [...] Then we have designers, programmers and innovators, those who write documents and those who think about processes and people having different kinds of leadership skills. Then, the commercial sector as a whole, marketing, bargaining as well as those thinking about client segments. There are lots of different areas in which I see the recruitment style which the IT sector is based on nowadays. Actually, it doesn't matter what your competence at the moment is, but IT firms want to hire good characters who are intelligent and able to learn and develop in their work. After a few months, this kind of person is already a fantastic worker. So there's a lot of job opportunities in this field if you just want to work!'*

Instead of formal technical education, qualifications through experience (from various industries), hobbyism, engagement in new technology and especially personal attributes, for example, are highly emphasised. This is because, within project work, an IS expert is expected to have both the ability to work autonomously and with variety other experts in teams as well as the ability to adapt to changes. The director in the telecom department emphasises personal suitability as the essential

criteria for recruitment: *'When interviewing new candidates for a job, I used to ask them what the most important thing for them in work is. Most candidates have usually answered that actually two things: firstly, success in work, that it is intrinsically rewarding, and secondly, the change that it offers opportunities to learn new things all the time. If candidates answer like that, they have good chances to be employed.'*

The growth of the service sector has increased the need for flexibility in organisations. On the one hand, this flexibility may mean numerical flexibility (working hours and employment relationship); on the other hand, it may mean functional flexibility (work arrangements and multi-skilling). P. Knauth (1996), for example, has argued that contractual flexibility will become more general in future organisations. This means a decrease in the number of the core personnel of an organisation, which is complemented by temporary labour and consultants, when needed. Further, constantly changing project work would in theory make it possible to make flexible contracts and hire labour to each projects' needs. However, IS experts' work demands special expertise and trust based on the business concept of the organisation, and knowledge about the markets and clients as well. For teamwork and shared expertise in projects, it is a benefit if the members of the project group know each other. Further, the personnel's organisational commitment is essential in business that is mainly based on human capital and knowledge of the experts in the sector with scarce labour resources.

The case organisations usually take experts on permanent full-day contracts straight after a trial period. Due to student workers, there are some (about 15%) temporary contracts, but many of the student workers are also engaged in permanent jobs. None of the case organisations reports having used any external freelance workforce for expert tasks, and also part-timers were exceptional in these organisations. Unionisation is not common among the IS experts. According to the managers interviewed, their personnel are rarely members in trade unions. They did not even know if there were any unions for the experts in information industry. None of the IS experts interviewed said anything about being a member of a trade union either. According to those who responded to the survey (N 47), two-thirds were members of a trade union. Most of them belong to the Finnish Association of Graduate Engineers (TEK). A good labour market situation and the firm-specific negotiating of the salaries and terms of employment do not encourage or necessitate IS experts to join the trade unions. Also, because the labour force within the information industry and business services is so heterogeneous, they are scattered in different unions, when the uniformity of the supervision of the interests disappears. There was no union that would have concentrated on supervising the interests of the employees of the field. Further, both the organisations and their personnel in the business area are young and might thus be unaware of the opportunities and importance of interest supervision. The labour market situation will probably change in the future, as indicated by other countries. Likewise, the manifold issues on working hours and related burn-out give emphasis on the significance of the supervision of employees' interests.

Training

The IT Services Association (TIPAL) is the leading Finnish trade association for computing services and software vendors. Its member organisations employ in total about 15,000 experts in ADP business in Finland. According to the salary inquiry from the year 1999, about a quarter of the personnel of the member organisations had some university degree, and a third had a degree from vocational colleges. More than two thirds of the personnel had only general education. The exactly same trend was found in the case firms in this study. These results actually confirm the fact that IT firms employ a lot of students.

As knowledge-intensive business services in telecommunications are newly developing and rapidly growing, the personnel in the area is young and thus their work experience is also quite slight. The average age of the personnel in the case organisations was 27,5 (except the IT service provider in which the average age of the personnel was 36). Over 70 per cent of the IS experts (who responded to the inquiry) were under thirty years old. The third of the experts started on their jobs during the year 2000 (when the inquiry was done) and 40 per cent said that they have less than two years' work experience. Because of the great share of students, the personnel's young age and short work history as well as the emphasis on contextual knowledge and experience behind the development of the expertise within the IT sector, maintenance and development of workers' know-how through on-the-job-training are especially essential.

While the ability and willingness to learn constitute the basic recruitment criteria in the case organisations and the diverse work tasks and opportunities to learn new things are the main motive and premise behind the organisational commitment of the IS experts, all case organisations have taken developing their personnel's competence very seriously. It was both recognised as a need and established as a functional part of their business strategy. Nevertheless, many of the interviewees emphasise the importance of contextual learning and learning by doing. Training was also seen as waste of time that had to be measured against the achievement of short-term goals.

'Of course there are also courses. But we, for example, function in such an exactly defined space that (teaching) it from outside sources is quite difficult. It must be very good if it's worth our while, it must be really beneficial, considered and of good quality. But mainly the courses are suitable for teaching basic knowledge. If we want to have instruction in higher level knowledge, the problem is finding good teachers. As there is a lack of employees within the IT sector, there is also a lack of teaching resources.' (Program manager). Concrete advantages of external courses were also criticised: how much, how new and how relevant knowledge and information the courses can offer for organisations who themselves create specialised technology and knowledge. Thus, the organisation and processes of training vary among the case organisations by their age and size in particular.

Within the well-established case organisations (the oldest and the largest), human resource management, including training processes, are organised as a functional part of their everyday business. These kinds of organisations themselves have usually produced specific personnel

programmes. They offer both internal and external training opportunities for their personnel. Internal training is arranged as an inter-company college or related activity. In addition, the organisations acquire training from external education institutions and private instructors, of which partners from hardware business in particular are the most important. The focus areas of training lie on technique and technical know-how, project management, customer service, and business. *'Knowledge on project management is the number one for us. [...] because the project manager is in a very critical position in this kind of project work. He/she works for us and also keeps up the client's end so that the project is on schedule and in hand at the same time. Actually, he/she is between a rock and a hard place. [...] Both the client and the workers should be able to trust him/her. That is why we have started very intense project manager training. We want to build up these facilities. There is an acute shortage of competent project managers within this sector.'* (Director, Communications).

Training is led by an appointed co-ordinator who maps the shortages and demand for training from the personnel and through customer feedback, organises it yearly or when needed, informs on the supply as well as evaluates acquired education and training. The final decision about whether or not an individual expert attends training is made in co-operation with an expert and his/her manager according to the needs of the expert as well as to the working situation on the project. The development manager of a software house, for example, estimated that the amount of both internal and external education is about ten days per person per year. However, due to project schedules, it is common to arrange courses on the weekends, whereupon workers have to (and they also want to) use their free time for learning. *'We call it (training) as our service production development. When some software firm spends such and such a large share of their turnover for production development, we spend about 10 per cent of our turnover for our own service production development, including the development of competence of our personnel.'* (Director, Communications).

In the younger, smaller but rapidly grown organisations the need for organising separate competence development functions is identified but not yet formally organised. Rather, the need for new competence has been fulfilled through recruitment. Some acutely needed courses on technique and technical know-how has been bought from external sources, mainly from hardware business partners, such as IBM, for example. Some of the organisations were, however, in the process of creating personnel policy functions starting from a just hired HR manager.

It is common in these organisations to encourage and support their personnel's spontaneous learning as well as agree with their IS experts' suggestions about taking part in a course, a seminar, or a conference. Experience gained through working on projects is also seen as important for learning and increasing human capital. It seems to be part of the knowledge management practices in the IT sector that the new knowledge from the projects is circulated through the expert organisation by Intranet documentation or internal training, for example. In all case organisations, an either formally organised or spontaneous senior-junior tutoring system exists as projects are customarily build up

of experts with different competence areas and experiences. Furthermore, some case organisations also set up groups consisting of technical key experts for advising and supporting the IS experts in their work.

In the smallest case organisations, both management and experts emphasised the importance of everyday co-operation and creative informal communication as being essential for maintenance and development of knowledge and learning. These organisations are also most often faced with the problem of shortages in resources (in terms of both time and money). *'We cannot afford to hire an incompetent worker. Not even an average worker. Then we just have to somehow find the most competent experts. It is ruinously expensive to train the experts, which we in any case have to do, and it is eating away resources from business.'* (President).

According to the IS experts, both the employers and employees are seen as responsible for maintenance and development of the personnel's know-how and competence. In addition to formal training, the IS experts themselves take care of their knowledge and competence by following the current and relevant journals and books. As especially convenient for acute technical problems are seen the chatlines on the Internet. Many hardware and software tool providers also keep up Internet pages with practical exercises through which it is possible to learn independently about the new functions and applications of the technical tools. As many of the IS experts are still students, they said that their work is actually helping them in directing their studies and choosing the most relevant courses. They also said that their employers support their graduation by arranging for flexible working hours and work contracts. For instance, it is possible to work for three or four days per week and study the rest of the week, and students may be hired by hourly wages instead of full-day contracts. But still, many of the students have permanent contracts and students with hourly wages may work even longer days those with permanent contracts. Anyway, shared knowledge and learning as part of everyday work were highly stressed among the IS experts.

Careers

A career has traditionally been understood as a vertical movement up the hierarchical ladder, either within an organisation or within a profession. Economists (segmentation theorists) speak about the internal labour market, either firm-internal or occupational labour market, for example, that employment and careers are dependent on firm-specific knowledge and skills, or they are based on occupational qualifications and experience. The Finnish telecommunications sector is still new and developing without big firms specialised only in business services. Flattened hierarchy is typical of the business service organisations in the area and the features of project work in general promote the performance of occupational labour market (or perhaps we should rather talk about the labour market for ICT competence) instead of firm-internal labour market.

In the well-established case organisations, there are mainly two career routes: one is specialisation for technical expertise, and the other is specialisation for project management and administrative

work. Like training, career development is also an integral part of personnel strategy in these organisations. The decision of workers being placed on these routes is usually made by regular, mutual discussions between the manager and the individual worker in career advancement consultation. The concrete specialisation takes place both through arranging suitable work tasks within suitable projects and through suitable training and courses, always planning and deciding everything together with the expert worker according to his/her needs.

'Everything starts from the horizontal development of the technological expertise supported by certain functions in our quality systems. Then we have training in project management and administrative tasks, so we offer opportunities to promote also vertically. But for that, the desire of the expert to be promoted alone is not enough, but he/she must also be appropriate for leadership. That's why the regular manager-worker career-development consultation is an important tool for us to know what the experts really want for their careers in our organisation. There is a group of experts who want to proceed in their career to project managers. This group is, however, smaller than that of those who want to stay as experts and widen and deepen their technological expertise.' (President of the Board).

Also, Bente Løvendahl (1997) has found out that the best technical experts rarely want to spend their time supervising others, and only exceptionally do they have the necessary talents and skills to become good managers. Most of the experts are driven by intellectual curiosity and interest in the topics of their area of expertise instead of an effort to be promoted to managerial positions. *'[…] software developers are software developers. They are not interested in any paperwork. We want to give for them the freedom to do the job they prefer to do.'* (Director, Business Development).

For IS experts, the question of their future careers was not clear at all, partly because on project work, career opportunities are rare, but also because they are young and they do not have much work experience. Further, they mentioned that working in constantly changing projects has offered enough challenges so far, and the employer has offered enough opportunities for work rotation, and that the career is not the most important thing for them. They, however, admitted that the hectic project work might be too stressing after getting older and having done it for several years. The IS experts seem to be very committed to the new wireless technology, not exactly for the job title or even for organisation they work for. As to the options for future career development, they mentioned advancing to technical key experts or project management and other administrative duties, for example. *'I did not want to choose either of them (management or key expert line of career) because I think it narrows down my prospects in my career. I wanted to develop myself as a general expert as much as possible. Then I heard that I was placed in the key expert line, so I chose then to participate in the project management line. It is good that you can choose yourself. And the employer supports and encourages work rotation on purpose. If you have done similar task for too long, they come and suggest that how about if you transfer to these and these kinds of tasks because they might be interesting for a change.'* (Project manager).

In spite of limited career opportunities, the IS experts were expected to remain with their current employer. Despite of the open labour market for the IS experts, the turnover of the personnel within the case organisations is not considered as a problem. A natural explanation for the fact is the age and the size of the organisations. Within the smaller organisations, in which most of the employees have less than twelve months' work contracts, the measurement of personnel turnover is not yet relevant. Also, according to the IS experts, smaller organisations are more flexible in their working arrangements and practices, offering varied work tasks as well as a close working community that leaving the organisation is not so probable or easy, or even interesting.

However, the personnel turnover is also quite low within the well-established medium-sized organisations with ten to fifteen years' history. Especially in the USA (Saxenian 1994), a general feature within the IT labour market is to increase the knowledge and competence of an organisation by the mobility of the employees between firms, which is not common in Finland. According to the development manager, for example, the IT labour market in Finland is still quite small and the firms within the sector are so specialised that lots of knowledge rather goes missing while changing from one organisation to another. It is also mentioned that the kind of inter-firm work rotation ideology does not fit the Finnish business or working culture. Further, the mobile labour force is seen more as an expense than a benefit. Work guidance and training of an expert is a drawn-out and expensive process, and new employees are also always more expensive concerning their wages than those who left. The main reasons for more substantial personnel turnover than usual, according to both the managers and IS experts, are inadequacy in leadership and personnel management, on the one hand, and the experts' efforts to raise their wages on the other.

According to the Sveiby (1996; Løvendahl 1997), knowledge organisations compete in two markets: for clients and for personnel. The business logic of knowledge organisations depends on the process of how organisations attract and keep their clients and their personnel, and how they match their capacity for solving problems with the needs of their clients. The core of the resource base of the knowledge organisations resides in the professional experts they employ and in the experts' ability to solve the problems of the clients. The experts are a strategic resource in the success of the knowledge organisations. While the experts are voluntary members of these organisations, their competence and expertise are to a very large extent owned and controlled by the experts themselves. Thus, human resource management and personnel strategy are essential preconditions for creating loyalty and trust between the personnel and the company, and especially for the organisational commitment of the experts.

The president of the board attaches importance to understanding the reasons why and in what kind of circumstances workers are willing to leave their jobs. *'In my opinion, there's two things. Firstly, IS experts are, on average, very eager to learn. If they feel that they don't to have enough challenges for learning, they change to another firm. Secondly, is the fast pace of our business. In this area, occupations (or work tasks) usually change every second year because of the rapidly developing technology. Too similar and stable work tasks leads to the willingness to change employers. Thus*

learning and the changing nature of work are intertwined.' While project work in project organisations as a such already guarantees the versatility and change at work, there were also formally organised intra-firm mobility programmes in many case organisations. Again, both the managers and the experts agreed that challenging and changing work tasks, being on top of the technology with opportunities to learn and a good leadership are very important features in motivating and committing IS experts.

Rewards

While employees are the most important asset for new, emerging high-tech business service companies, an important issue in employment relations are also the requirements for new ways to reward employees. Because work and its organisation in high-tech business services are rarely studied, the reward systems of expert work in this area are not defined either. Further, because union membership is not common among IS experts in high-tech business services, and those who belong to a trade union are scattered in different unions, income studies on different trade unions do not offer much information about the rewards of IS experts working in high-tech firms in particular. The information presented in this chapter is based on the interviews done mainly in two case companies (cases D and E, Appendix 2), and the salary inquiry of the Finnish Information Processing Association (FIPA)[2] is from the year 2000. P. Knauth (1996), for example, has argued that, in addition to financial support, rewards include all aspects of work and working that people find rewarding, such as recognition, career development, feedback, and meaningful work. The focus of this chapter, however, is primarily on the forms and basis of financial rewards.

'The principal rule is a fixed monthly salary. But then, depending on the nature of tasks, there are different kinds of rewards and bonuses. Predominantly, extra bonuses are related to client projects on which it is possible to convert implementation and outcome into money. As we are now developing our organisational practices, we are also elaborating our reward system. We cannot deviate much from the other companies on the market. We do have plans on new patterns which we are also soon going to implement in practice. A competitive salary is, of course, a baseline for the recruitment, but not the key factor. We have, for example, managed to recruit employees on a smaller salary. It is especially occupational career development and possibilities to learn and deepen employees' knowledge, which are not possible in other companies, that are important. This thus allows employees to participate in building the company brand. Anyhow, we live in the same world as our competitors. That's why we have to be able to be competitive and thus follow the general trends

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[2] FIPA was founded in 1953 to promote various aspects of information technology. Today it consists of 25 member associations, which have as members some 27 000 individuals and nearly 700 companies and other organisations. The majority of the member associations operate regionally to promote professional growth of IT professionals by offering various types of activities, such as seminars, training, get-togethers with guest speakers, leisure activities, etc. Occupational categories of the members includes all kinds of professionals and experts in design and development but also management and administrative occupations, sales and marketing, HR and training occupations as well as students and those without an occupational title. IT professional occupations covered 45 % of the membership in 2000. A quarter of the all members and 27 per cent of IT professionals are women.

concerning wage levels, rewards and other commitment systems typical of the markets.' (Human Resources Director).

As the employment contracts in the case organisations are generally permanent full-time contracts, the main form of salary is also regular, fixed monthly salary. Student workers on temporary contracts, however, are paid by the hours they have done. The wage level is based more on the competence and know-how of an individual employee instead of an accurate occupational title or hierarchical position in the organisation. In addition to the basic salary, bonuses and other incentives are commonly used in case organisations. Individual employees can be paid additional rewards according to the quality of their performance in the work (finished projects), or because of acquired training and new competency, or when they participate in the tutoring and training system of the company by distributing acquired knowledge to other employees. A recruitment fee, that is, when tipping the company off about new potential employees, is also commonly used in the case organisations. Further, company mobile phones, computers, cars or medical expenses insurance, lunch benefit as well as free coca cola, pinball machines and different kinds of recreational services in one's free time, for example, are common benefits for the employees in case organisations.

Bonuses are usually based on the financial outcome of the whole company or of a separate project. In addition to individuals, it is also common to reward the project team, especially when the team have undercut the budget. The bonus system rests on the performance of the team and is meant to motivate the project's internal co-operation and goal attainment, thus encouraging some kind of team-internal entrepreneurship. A calculatory follow-up of a project can also be used as a basis for a general prospective rise in the salaries of the company's employees. The bonus tied on the economic success of the company is the most common incentive form according to FIPA's salary inquiry, since 40 per cent of the respondents were within this kind of bonus system. A quarter of respondents were in the bonus system which is based on the performance of either a team or business unit.

Three case companies out of six have further implemented the directed issue of shares for its personnel. Business service companies cannot 'own' their human capital in the way that manufacturing companies can own their machines. According to Don Tapscott (1998), for example, it is increasingly important to find new ways to commit employees to the company. A broad employee share ownership is one way to ensure that employees feel they have an influence of the success of the company in general by owing the profits created actually through their own efforts. According to FIPA's salary inquiry, options were not, however, so common as the public discussion has implied, because only 14 per cent of the respondents were on the sphere of the personnel option system.

On the salary inquiry of FIPA, the basic salary of IT professionals is FIM 17.261,00 and the aggregate salary (with fringe benefits and additional rewards) is FIM 18.985,00. The increase in the wage level compared to that of the previous year was almost 12 per cent. The reason for the rapid growth has been seen to be especially the lack of labour in the sector. Compared to all wage earners

or wage earners of AKAVA (Confederation of Unions for Academic Professionals), IT professionals are quite well paid. The gap between AKAVA's and IT professionals' average monthly earnings was, however, only 6 per cent.

Women's share among IT professionals is about 28 per cent and it has been quite static during the 1980s and 1990s. The rapid growth of the sector has mainly been based on the increase in male employment. Despite of the low share of women in IT occupations, the wage level between women and men in these occupations is quite equal. The wage gap between female and male IT professionals concerning the basic monthly salary is only 7 per cent and the aggregate monthly salary 9 per cent, whereas in the case of all wage earners, the gender gap in wages is approximately 20 per cent. Contrary to the general trend, the higher the position of women in IT professional occupations, the narrower the gendered wage gap. However, the share of women among top managers is only one per cent and among managers only 11 per cent.

According to FIPA's salary inquiry, IT professionals are, on average, quite satisfied with their wage level. Based on the questionnaire of this study, IS experts did not consider the salary either among the most problematic or among the most positive features of their work. Although some IS experts supposed that mobility of experts between IT companies springs from the wish to raise the wage level, it seems, however, that the majority of experts emphasised more the work they do instead of how much they get paid for doing it. As the employees in high-tech business services are usually quite young, it is important for them to get work experience and learn from their work and changing projects. IS experts highly respect competence and know-how. They also enjoy working in an organisation that employs competent professionals and invest in the maintenance and development of the know-how of its employees. From this standpoint, the most motivating incentives are training as well as challenging and varied work tasks for which it is also important to offer financial rewards and other fringe benefits.

Conclusion

Employment relations with the elements of recruitment, training, career development and rewarding are essential for the organisations operating in the area of new technology. While there is a growing trend of technology-based business services in the information industry, competent IS experts are the most valuable, but at the same time insufficient capital for the service organisations. Despite the increase in higher education in computer science, there is a definite lack of labour resources on the labour market. Further, orientation and training of an IS expert takes time and is also expensive, whereupon the turnover of personnel is counter-productive for the organisations. Because the industry forms an open employment and wage market for the experts, their commitment to their organisation is no longer self-evident.

Case organisations recruit employees mainly outside the labour market, which has led to a quite large share of students or employees who do not have a formal degree in their personnel. Assuring

the availability of the labour force is one of the factors behind their education and research co-operation with polytechnics and universities. Supporting the employees' graduation is a challenge for the case organisations from the standpoint of ensuring the quality and trust of the service delivery for the clients. The organisations naturally recruit somewhat from the external labour market, usually from bigger firms and competitors. The IS experts themselves seem to respect wider work opportunities, autonomous work, and flexible work arrangements offered in SMEs. Problematic for recruitment is that the firms are not that known on the labour market on account of which the organisations should pay more attention to the marketing directed to the potential labour force. The criteria for selecting new employees are quite demanding but varied and flexible. Although higher technological education is highly respected, the more important is personal suitability and engagement in new technology with social skills and the ability to learn. The case organisations seem to be secure workplaces, since they offer permanent employment contracts for their employees.

Maintenance and development of knowledge and competence of the personnel is recognised as a need and established as part of business strategy within the case organisations. Because of the rapid development of technology and the number of students in their personnel, training is especially essential. In bigger organisations, training was formally established, including both external and internal training on technique, project management, customer service, and business. In smaller organisations, training concentrated mainly on technique, and technical know-how was organised more on an ad-hoc basis, when needed. They are also faced with the problem of a lack of time and money for organising formal training. All the case organisations emphasised contextual learning and learning by doing as the most effective way of learning. They also support the spontaneous training of their personnel. ICT and the Internet are, in addition to being a means for working, they are also a good means for training and learning. It is common in the organisations to spread knowledge on projects through the Intranet. The IS experts also said that they can find the latest knowledge and fastest advice for general technical problems from the Internet chatlines and Internet pages provided by hardware and software tool providers.

Due to the flat hierarchy of IT organisations and the features of project work common in these organisations, career development means mainly widening occupational competence improving the technical and other competence horizontally instead of hierarchical promotion. The main career routes, supported also by formal training where organised, are the careers of a technical key expert or a project manager. Most of the IS experts are driven by intellectual curiosity and enthusiasm about new technology instead of attempting to achieve hierarchical positions. Despite the limited career opportunities of the employees, the turnover of the personnel is not (yet) a big problem for the case organisations (this is probably somewhat a problem in the Helsinki area). This is partly due to the young age and small size of the organisations but also to a high specialisation of business services in the IT sector leading to high costs of the mobile labour force. Further, by arranging opportunities for job rotation as well as offering challenging work task within various projects in one's own company, for example, the case organisations attempt to assure the organisational commitment of the IS experts. The reward system in the case organisations is variable, including

performance-based and skill-based criteria. It seems obvious, however, that instead of extrinsic features of work, such as wages and promotion, the IS experts respect more intrinsic and social features of their work, such as challenging and changing work tasks, opportunities for learning as well as the feeling of being on top of the development of new technology.

4.3. Control relations

Project-based knowledge-intensive work organisations challenge the traditional conceptions of control and trust relations as well as organisational commitment in many ways. The key relationships of work are no longer only those between the employer and the employee, but also those between the client and the contractor, and those among the members of the project teams, for example. Professional expert work calls for autonomy and opportunities to influence one's own performance. Experts do not take action because they are told to do so, to satisfy their superiors or for the benefit of a reward only. New motivators are goals, innovation, and being part of creating something significant. This demands trusting relationships and certain conditions in which to perform the job. (Tapscott 1998; Frenkel et al. 1999.)

Trust and commitment are inevitably intertwined with patterns of control within an organisation. Control via a traditional hierarchical structure of an organisation is not appropriate for experts in knowledge-intensive business organisations. In an environment in which experts require autonomy and authority to decide about the most suitable methods and resources required to solve a problem, the organisations should maximise their skills and functional flexibility by minimising organisational control. This may mean flexible work arrangements and change from direct to indirect control methods for facilitating the skilled individual's task completion. (Adami 1999; Depickere 1999.)

According to the discussions with the managers and the IS experts, there really exist both direct and indirect forms of control in the case organisations. Within project organisations, forms of control and worker participation in the control process might vary project by project. These fluctuations highlight firstly the changing nature of commissions, and secondly the importance of clients for the working process. Due to the flat hierarchy and a quite loose division of labour by job descriptions, a lot of responsibility has been delegated for IS experts, especially for the project group and its manager. This promotes both clan control within project group and self-control of an individual expert in the group because of common and shared goals in project as well as socialised values and norms in the organisation (Frenkel et al. 1999; Adami 1999).

Emphasis in management control in high-tech IT case organisations seems to be on a result-oriented system after the project. There might also be a notable, client-led control within the definition phase at the beginning of the project as well as formal forms of monitoring the implementation and schedule of an ongoing project. Further, as generally known, IS work process has been rationalised by formal methodologies and quality management procedures which can be seen as forms of direct, bureaucratic behavioural control. These structured methodologies prescribe the procedures and

protocols to be followed in software development, the tools and techniques to be used at each stage, the timing and extent of user consultation at various points, and the required documentation (Beirne et al. 1998). In addition to direct and indirect project-based control, the input control system, including recruitment, development and socialisation processes, is also important in guaranteeing that experts have the capabilities and values to perform well and are especially suitable for the client-oriented project organisation (Adami 1999).

Both direct behavioural control and output control before starting a project are problematic because of the uniqueness of each commission and problem-solving in each project due to either highly customised service products or the development of new complex technological innovations. Occupational specialisation of IS experts and the rapid development of technology narrows down the manager's knowledge about the labour process, thus diminishing the opportunities to programme the concrete working and outputs too much. However, as an integral part of their IT business, all case organisations have to follow structured software development methodologies and processes. They also either apply (smaller firms) or have established the quality system (more established firms) based mainly on ISO 9001 certification.

Further, depending on the stage of development, the case organisations have formalised project management and working practises or they are at least building up these processes. For example, a project can comprise such defined key phases as definition, design, implementation, testing and introduction, complemented by maintenance and further development. By a structured project management with intensifying the delivery process on schedule, managing personnel resources, and controlling the cost-effectiveness of projects, for example, the organisations aim at ensuring the operability and quality of their solutions and at improving the efficiency of their business in general. Since these formalised standards and processes can be seen as a means of controlling expert work, they can also be seen to support and form a framework for conducting IS experts' work[3]. These standards also guarantee the documentation and thus the retention of knowledge in organisations after experts leave. *'The labour force is the most important resource of this kind of organisation. Thus once a day our knowledge walks away. We can always say that documentation and other systems leave for us more or less these things ... and our aim is of course to generate knowledge also in a bit form. Because at the end of the day it is the only way to retain the knowledge capital in the firm.'* (Director, Business Consulting).

In the end, in quality management (if organised), quality managers and quality developers support and control the technical and functional implementation as well as the quality of the service production process and output of projects. For each project, there is also a constituted board with members from both the service provider and the client organisation, and depending on a project, from other subcontractors. The purpose of the board is to evaluate the progression of the project and value the quality of results in each phases of the project according to the planned goals, budget,

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[3] See pp. 33-34 for a comment from the director of the telecommunications department on loose enough standards that do not exhibit the creativity and innovativeness of work.

and timetables. *'The board assembles to meet once a month or every second month, and usually just checks on the situation of the project at the meeting. When everything goes well, the board meetings are just forums for discussion. But if something goes wrong on the project, it should be brought to the board meeting because it is the highest collective organ for problem-solving.'* (Director, Telecom Department).

At the practical level, however, after being established, the project group itself and especially the project manager have the main responsibility for attaining the defined results. The project manager organises and co-ordinates the project in respect to IS experts who work on the project and in respect to management, the organisation and the client. While the project manager might be involved in several projects at the same time, the need for self-direction of the project group is evident and also a natural part of expert work. *'The project manager leads the whole project. But within there are smaller teams which do things together, usually through team dynamics. If a newcomer does not know so well how to do the work, the others then give advice and help. Because they know that the sooner the newcomer learns, the better the whole group proceed in work. These teams are so small that they usually control themselves.'* (Director, Business Consulting). According to a graphic designer: *'Since everybody on the project works together for a shared goal, everybody also makes progress. Then if somebody starts to laze or something else happens, it is possible to react easily and say that you are now a little behind schedule. And to check how much behind and what can be done together for it. We don't leave the worker alone but find out together how to get back on schedule. This kind of co-operation is actually very important in this job.'*

A project has phases for group work and shared expertise (e.g. defining, planning, and testing), on the one hand. It also has phases for autonomous working (e.g. coding), on the other hand, in which phases as well live communication among the team members is needed and necessary. Formally, projects have weekly meetings to inform their team members about the progress and also possible problems, to follow-up the budget and timetable of the project, and to discuss the programme for the coming week. The memos of these meetings are also sent to the client. Further, the organisation has usually established a project-specific Intranet (with limited entry) for each project. In this Intranet, all documents of the project as well as each phase of the project is in full view and available for everyone involved in the project. Also, by means of the Intranet, the participants are able to discuss the progress and problems of the work. The project-specific Intranet enables firstly the co-ordination of knowledge and documentation of the process and the results of the project; secondly, it can be used as a means for management and control; and thirdly, it is also a means for learning and development of know-how for IS experts.

When working on new technology and tailored client solutions, output control in general is possible by means of a customer satisfaction survey after the project. If the project lasts longer (several years), the client is usually asked to evaluate the project yearly. Typically, the evaluation includes an assessment of the quality and economic efficiency of the work process on the project and the quality of the final service product as well. Sometimes, although the process has been successful, its

results might nevertheless be unsuccessful due to a variety of reasons. The evaluation might even include a performance appraisal controlling the working and competence of each IS expert on the project. This assessment is connected to workers' wider career development but it might also have an effect on their rewards. As mentioned many times by interviewed managers, long-term client relations and partnerships are the most important and salient evidence of successful control and co-ordination, and also the main motivator of working. *'Our client relations are actually partnerships, which indicates that the relations are long, lasting for years. And this points to the fact that the relationship really works well. We know the client and the client knows us. There is no need for very bureaucratic (controlling and organising) systems for ensuring the collaboration. It just works.'* (Director, Telecom Department).

IS experts (by inquiry) conceive of themselves mainly as planners; that is, adapters and revisers of innovations but also as operators performing tasks, either independently or guided. However, most of the IS experts regard their work as fairly independent: on the given project plan (the planning of which they usually have taken part), they can decide themselves about how to proceed in their work. There is no direct supervision or rules controlling the concrete everyday work of IS experts. They value highly the low hierarchy and flexible working arrangements and hours at the organisations they worked for. Instead, as the most constricting factors in their work, IS experts highlight the project timetables and dependence on other experts regarding co-operation in completing tasks and achieving results. They also consider the clients as one of the most constricting factor. Limitations in flows of information especially on the projects with participants from client organisations and other possible partners but also within one's own organisation in general might affect the autonomy of an individual IS expert. Further, technical equipment as well as performance and quality appraisals was seen as constricting the autonomy in everyday work.

On average, IS experts, as knowledge workers in general, have a considerable job and project-related autonomy but they do not have much influence at a wider workplace or organisational level (Frenkel et al. 1999). They do have a certain, clear influence on the content of their jobs, working practices, working pace and hours as well as on whether or not to participate in training, for example. They do have some opportunities to influence the decisions concerning conflicts and order within projects, the content and extent of personnel training, wage and incentive system, and the division of labour within the workplace, for example. Instead, they do not have much influence on management practices or the definition of organisational goals, or on project evaluation methods. Further, they do not have a lot of opportunities to participate in the selection of project managers or of the composition of the project group.

The opportunities of IS experts to participate in decision-making and to influence their work varies project by project. After the higher management of an organisation has set up a project group, all experts usually participate in the definition and decision processes in every phase of the project. According to the director of business development, *'They (project manager and IS experts with the client representative) define the project's goals together. This must be clear in the definition phase*

that the designers can commit themselves to the project. It cannot be supervised only by the project manager, because he or she doesn't necessarily have so a perfect impression of what it (the commission) in practice actually demands.' The project building stage is a critical determinant for the success of the project. Besides clearly defined tasks and objectives, the commitment of participants to shared values and norms is governing the way the group will work and effectively perform their tasks. (Tidd et al. 1997; Björkegren & Rapp 1999.)

There are both positive and negative assumptions and experiences among IS experts. *' Working practices of course we can influence a lot. In the definition phase when thinking about timetables and task divisions within the project group, we have a lot of opportunities to take part in decisions. And the goals for project, they come mainly from clients. They dictate what kind of vision it is that they have, what kind of system they want and whom they want to affect. ... But when we get further ideas of possible added value for the output, these ideas are usually taken into account. So if we have here an idea that this and this kind of thing could be added to it (the service product), we just contact the client. New ideas are usually taken for granted; thus that way we can influence.'* (Software designer). *'Sometimes tools are ordered in advance and timetables are set up by the client for an already defined project. Thus within these limits that are left we have this one big entity which we can divide into parts and decide who will do each task. Not much is left for us when the client defines almost everything, specifications and documents. [...] but we can comment on those and recommend alternatives. It depends on your own activity.'* (Project manager/Product developer).

Time is a contradictory factor related to control and autonomy in IS experts' work. On the one hand, knowledge work has been said to be independent of time and place as well. On the other hand, projects are bound to more or less rigid timetables for everybody involved to follow. The most critical factor in project management is designing the timetable and then managing the project on schedule. Almost on every project, timetables caused some problems; they were also seen as limiting the autonomy at work. Within the case organisations, the personnel's working hours were not controlled, and IS experts highly respect the flexibility of these working arrangements. However, the IS experts interviewed said that they do not prefer teleworking or working in the clients' workplace when it is possible to choose. This is because in addition to project members they consider discussions also with other colleagues in the organisation as essential during the problem-solving process.

Further, they also said to be working mainly normal hours (37.5) per week, although doing overtime is common in project work, especially close to deadlines and at the end of a project. Usually their working time per day varies between nine to six, which actually covers the prime time in business in general. Prime time working is necessary for co-operation with clients and other possible partners as well as for shared knowledge and co-operation between the IS experts in specific projects. The timetable and follow-up of working hours of each worker of the project is the basis for billing the client; they might also be the basis for rewarding individual workers or alternatively the whole project group. Thus time is, however, an important means for management to control the

performance of employees. Furthermore, the follow-up of working hours can be used to taking care of the working capacity of the employee, because there seems to be a higher risk involved in working overtime in knowledge work and within the IT sector in particular.

Conclusion

Control relations in knowledge-intensive project work deviate from the traditional top-down manager-worker conception of control. In continuously changing projects, the key relationship is turning from the manager-worker relationship to the client-service provider relationship, and to interrelationships among the members of the project group. The work of professionals and special experts is usually regarded as highly autonomous with full opportunities to influence one's own performance. However, the work of IS experts in high-tech case organisations, as in most of organisations in general, is characterised by a combination of direct or indirect input, behavioural and output control. Emphasis is, after all, on input control (e.g. recruitment, training, career development) and client-led output-oriented system after the project.

In a high-tech organisation, quality management procedures, standardised methodologies of a work process and standardised project work practices can be considered as most salient forms of direct (behavioural) control in IS experts' work. Standardised technological methodologies are actually so an integral part of the software developing work that supervision is based more on self-control than management control. Quality control and control of project practices, instead, are supervised formally by either organised quality management functions, by project board with members of at least the client organisation and the service provider organisation, and by the project manager. Further, the follow-up of the budget and of the schedule on projects are forms of direct control. Depending on the project and knowledge as well as clients' activity, client control may exist both at the definition stage of a commission, during the service production, while the client may evaluate the process and the quality of the service, and after the project, when clients evaluate the quality of the output and process of attaining the goal. Output control in advance is problematic because of the ambivalence in working with rapidly developing new technology and due to service products, which are not always very foreseeable. Further, the work process in high-tech organisations producing business-to-business services requires close interaction with the client almost on each project, which also complicates defining the exact output, thus supporting the output control after the project.

In everyday work, the responsibility for organising and performing the work and its quality remains mainly with the project group and especially with the project manager. Project management and leadership is highly respected within the organisations whose business is based on projects. Thus, the success of each project and customer satisfaction stands or falls along the ability and skills of the project manager to organise co-operation between project members. Because of the forms of direct control and output control with client control, socio-normative (by Frenkel et al.1999) clan control did not, however, emerge very strongly from the case organisations and IS experts' work. Nevertheless, at the level of an individual IS expert, these forms of control do not express direct

supervision; thus, they seem not to be constricting their feeling of autonomy in work. IS experts called themselves mainly planners who autonomously adapt to and revise knowledge and innovations or as operators who independently perform tasks. Especially they respect the low hierarchy and flexible arrangements of work in their work organisations. While IS experts, in general, have great jobs and project-related autonomy, they do not have much influence on the wider workplace level. Especially problematic seems to be the communication and flow of information through the whole of the organisation.

The assumption of unlimited time and place of work in information society seems to fit the IS experts work only partly. Although they have flexible and uncontrolled working hours, they have to follow project timetables, which almost without an exception causes problems. However, instead of a project timetable being flexible, the experts are those who have to be flexible in their working hours. Nevertheless, IS experts tend to work normal weekly and daily hours despite project pressures. Co-operation in project work with co-workers, clients and other partners requires being at work prime time (from about 10 to 16). Further, IS experts are not in favour of teleworking, although it would be possible at some stages of the project, because they wanted to be close to their co-workers in order to get help easily in problem-solving. The place of work may, however, change in different projects, while the IS experts may work in the client's organisation, for example. Also, the project group may consist of experts from different locations and from abroad as well. This kind of virtual project work was considered somewhat difficult from the communication point of view. IS experts also emphasised the importance of face-to-face contacts in their work.

In short, decreasing direct supervision and increasing employees' opportunities to influence their own work, the project's goals and the wider organisational level are important for employees' organisational commitment and trust. These factors also ensure the permanence of already existing knowledge workers in the organisation and affect the recruitment of competent new experts.

4.4. Intra- and inter-organisational relations in project organisations

The concept of network economy has been used to describe the new trend of organising production. Discussion about the development of the network economy shows that, in a number of industrial sectors, network organisational forms, that is, intra-firm networking and external networking with subcontractors, partners, distributors and public services, have emerged in response to the new complexity and rate of product innovation required by external environments. Especially common networking is in the industrial sectors characterised by uncertainty, instability, and transitions. Flexible production, cost-minimising and the specialisation of an organisation in its core competence in order to ensure competitive advantage, for example, can be seen in the background of networking. A network relationship is more than the sum of its components. Fruitful intra- and inter-organisational interaction induces knowledge spillovers and technology transfers, which then stimulate innovations and competitiveness. (Mannermaa & Ahlqvist 1998; Ranta 1998; Harris et al. 1999; Ali-Yrkkö et al. 2000.)

Along with the increase in knowledge intensity and complexity of work in the information economy, the organic-professional network, or so-called adhocracy, has been claimed to have become a typical form of organisation. Within the network, organisational authority is based more on personal knowledge, expertise and social connections rather than on status and position. Information and decisions are negotiated laterally across the networks rather than vertically top-down. Network organisations or adhocracies mainly focus on novel problems thus designed to deal with instability and complexity, which stresses the increase in both formal and informal interaction among workers and functional interdependency. Project work and teamwork are typical of an adhocracy or of a network organisation. Depending on the degree of co-workers' interdependency and on what hierarchical or participative supervisor-worker relations are like, the forms of interrelationship vary between organisations. (Risling 1987; Mintzberg 1989; Reich 1992; Castells 1996; Frenkel et al 1999).

Frenkel et al. (1999, 172) speak about work groups and parallel teams in a work setting with low co-worker interdependency and hierarchical control. In self-managing work teams, there is a clear task division but the team have some discretionary authority. However, in knowledge work emphasising problem-solving and autonomy, they distinguish between supervised or egalitarian project teams and network design. Project teams consist of temporary groups of specialists with different functional or technical backgrounds, who sometimes also come from different organisations or geographical locality. Network design emerges out of informal co-worker relations. Networks may exist in project teams or alongside them. Knowledge work usually involves diverse collaboration among co-workers within and sometimes also outside one's own organisation.

The term 'network' may be understood in many ways, and networks can take many forms. The most common forms of inter-organisational networking can be called production networks and product networks. The former connects firms or production activities vertically along a particular value-adding chain, whereas the latter consists of horizontal functional areas complementing each other loosely coupled. Networks built around firms or organisations can develop into a cluster, or into a 'network of networks', which has economic importance at the macro level of national economies. A cluster consists of different interactive categories of sectors including key industries in the core of the cluster and around it, supporting industries in supplying speciality inputs, associated services enhancing functional preconditions, and related industries complementing products and share activities in the value chain. Organisations operating in the cluster do not necessarily have direct relations with each other, but the knowledge spillovers and positive externalities generating from the intra-cluster interactions upgrades the whole system. (Porter 1990; Mannermaa & Ahlqvist 1998; Ranta 1998; Paija 1998; Harris et al. 1999; Hämäläinen & Schienstock 2000; Ali-Yrkkö et al. 2000.)

This chapter first describes shortly the forms of intra-organisational co-operation among IS experts on projects; and second, the forms of inter-organisational collaboration common for case

organisations. The focus of the latter is on client relations and on the role and the contribution of knowledge-intensive business services to the innovation system.

Co-worker relations

According to the formal organisation of business, the case organisations can be mainly called functional, matrix or project organisations. The organisation of business is mainly divided into two parts. Firstly, there is the business area that concentrates on software production and aims at integrating enterprise application or IT consulting. Secondly, there is the business area that develops wireless software products. These can be further subdivided into separate units, mainly by industry or by functional service product, for example. Thus there is a high horizontal job specialisation of expert labour organised either formally or informally into specific competence areas within different business units. Despite the formal organisation of business, the work of IS experts is carried out on projects. Projects are not permanent organisations, but they have a clearly defined begin, aim, process, and end. Furthermore, depending on the commission, one project may consist of several either internal or external co-projects that have at least some collaboration. In these cases, the client is usually the co-ordinator of the main project and the co-projects are implemented in distinct subcontracting companies.

A project group is build up of experts from different competence areas, depending on the demands of each commission. After finishing the commission, the project group breaks down and usually the expert composition of the next project is totally different. The project can include experts from one organisation only, but also cross the organisational boundary to clients and other contractors. Further, when case organisations have offices in different cities in Finland and also abroad, the project can extend to various locations as well. Anyhow, a project consists of workers mainly with the same knowledge and status level. The duration of projects varies from a few months to one year, or even several years especially in the cases when service organisations participate in clients' production development. Within longer additional development projects, it is quite usual for the composition of the project group to change during the project. This is mainly because the experts want alternation and the employers want to keep the experts motivated.

An individual worker may participate in several projects at the same time, and his/her position and tasks within the groups of each project might vary. More common is, however, to participate only one project at once, because projects generally deal with the complex and usually secret problem-solving and new knowledge for their clients' needs. As the projects may change quite fast, the combination of experts in each project and the closest co-workers (at least in projects) may also change. Thus the continuous change of work tasks and learning new project-specific knowledge as well as changing working environment characterise the work in high-tech business services.

'We have big assignments which we divide into parts, such small parts that finally only one worker can do it. In that way, individual experts are important but the entity is composed of only by putting

these parts together. … An entity is more than a simple sum of its part.' (Project manager). On the project, all project members work for a shared goal which, after being defined and designed together, is divided into separate tasks and distributed for each worker for implementation, and put together afterwards. This means open and constant communication and co-operation in order to reach the shared goal. In addition to the responsibility for performing one's own task on the project, all project members have to be aware of the tasks of the other experts and of the progress of the whole project at the same time as well. These organisations, while selling projects to their clients, actually sell the knowledge of the project group that is able to perform the commission.

The extent and intensity of interdependency might, however, vary during the project. Besides close group work, shared expertise also includes phases of working alone. In finishing a project, IS experts are, however, highly dependent on each other's specialised expertise. *'It's important that there is an opportunity to discuss and clarify one's own solutions with others. It really facilitates the progression of work. There is always somebody who you can ask for hints or who throws thoughts in the air thus helping you to think differently […]. It (interaction) is very spontaneous because we all are close to each other in the same room. It is easy to ask when the other one is near, there are no thresholds in calling somebody or something, otherwise it would be somewhat slow and inflexible.'* (System designer).

The closest partners in co-operation for IS experts are mainly the other members of an ongoing project but also other experts within their own organisation. This fact varies, again, among the projects. However, the main form of project composition in the case organisations is an autonomous intra-organisational expert group supervised by a board with members from the service provider's own organisation and the client organisation. This is the most usual case even in larger projects with several subcontractors co-ordinated by a client. During the work process, IS experts might also communicate directly with the client's contact person, or with the experts from the client organisation working in the same project. This interaction occurs only when needed and usually concerns technical questions central to carrying out the job. In general, formal co-operation and communication with the client and other possible partners occur through the project manager.

In larger organisations, the most intensive interaction takes place among the experts participating in the ongoing project. In smaller organisations in which the work premises, such as open-plan offices, support wider communication, interaction with other experts of an organisation, besides the project group, is also common. *'Although at the moment I'm working alone on this project, we have here a small circle of employees sitting close to each other and thus exchanging general ideas despite the fact that each of us may work on different project. Discussions with other colleagues are also needed because sometimes you may just be so blind to your own efforts in finding the right solutions that you simply must ask somebody what is going wrong with this piece of code.'* (Application developer). The project contract may, however, forbid wider and general discussions about project matters with other than project members. It is common that an expert has to sign a personal secrecy agreement with a client, for example. As the case companies are somewhat concentrated in specific industries,

such as telecommunications, they also offer services for clients that compete with each other. The secrecy aspect may thus affect the internal functional organisation of a company in a way that the company has to establish separate departments for producing services for these clients.

Project managers are the key persons on projects. They are responsible for the whole work process continuing on schedule and according to plan as well as for the final results. They also have to communicate and interact in many directions, with the management of their own organisation, the project group, the client, and other possible partners. The role of the project manager can also change between the projects. They can be just administrative managers or be deeply involved in the technical implementation of the project goals. Further, project managers may direct and conduct several projects at the same time. The more the project manager is involved in the project, the better it is because the manager may also be in the senior position, thus being able to give advice to the other experts on the project. Among other things, how the project will succeed is highly determined by effective team leadership and effective conflict resolution mechanisms within the group as well as the organisation of the work process and decision-making, which are the responsibilities of the project manager (Tidd et al. 1997). One of the main duties of the project manager is to lead the expert group so that its members' competencies are utilised. Project management skills are highly valued. They were also considered to be a route for career development in the case organisations. According to IS experts, there is a need for further training in project management and leadership.

Because intra-organisational project groups are most common in the case organisations, IS experts rarely work in client organisations. According to the director of business development in a firm developing wireless software applications, *'We all work here. We don't want that our personnel go and work in the client organisation's premises. That is, we as an organisation do not necessarily benefit from it, since the knowledge and competence may thus not come across our organisation'.* Sometimes clients may, however, expect that a project settle itself at the client organisation in order to supervise it better, for example. Further, the project may also include times at which the job has to be done in the client's place of work. The testing phase, for example, may typically be carried out in the client organisation.

In only one case organisation of this study it is more common to work in the client organisation. Then the project might also consist of experts from various organisations, however, mainly from client organisations, and sometimes also from other sub-contractors. While the interaction in expert work is the closest among project participants, depending on the length of the project, the client organisation might be more familiar to the IS experts than their own organisation. The client's project group also forms a working community for the IS experts. Further, many of the IS experts interviewed mentioned that the client or the project is their employer; these facts may have an effect on the organisational commitment of the IS experts and thus challenge the experts' own organisations to develop knowledge management and human capital management.

Along with project timetables, communication is also seen as somewhat problematic on the projects. Selecting the participants of a project is crucial because differences in the members' personalities as

well as differences in their special areas may create tensions especially when projects change quite fast. Adaptability and social skills were the most important requirements for IS experts to be employed. Communication with the client during the project is more difficult than among the IS experts participating in the project because the service provider and the client may be from totally different industries and totally different localities as well. Further, if the project is made up of experts from offices in different cities, the geographical distance among project members may complicate communication because of lacking face-to-face interaction. Despite the project Intranet, telephones and video meetings, for example, project work demands some personal interaction.

Expertise of software developers and graphic designers or among different technology specialists, for example, may also be so different that it might in some phases cause misunderstandings or limit discussion. Further, as their differentiated tasks are bound together, IS experts might be at different stages in their work, which thus hinders their communication and co-operation. *'If everything on the project goes well, there is not so much need for communication, but difficult things, of course, need much more interaction. It takes time and you really need to work on it and react. And people are different. If somebody says something once and thinks it's all right now, the others may not even listen to what you said at that time, because they are so concentrated on some other matter. [...] Further, it may be also that being in their own situation they can't quite understand yet what the other party in their situation just says. They can understand it only a day after the next when they have progressed in work far enough.'* (Design co-ordinator). As the IS experts considered good work climate and work mates as among the most positive features in their work, they also saw the close linkages of their tasks to other experts' tasks as limiting their autonomy at work.

Because of close interaction and constant communication among co-workers as well as of continuously changing tasks through changing projects, significant learning on-the-job emerged as noted in the previous chapter on training. The projects usually consist of a good balance of senior and junior experts from different competence areas needed, and can thus be seen as arenas for spreading organisational knowledge. As by-products of the project there emerge important learning and experience, but also new knowledge that is useful in future projects. Both IS experts and their managers agreed that the best way to maintain and develop the professional expertise is learning by doing within multidisciplinary project teams. It has been argued that temporary organisations, such as projects, have few possibilities to reach farther than just individual learning. On the other hand, it has been asserted that after completing a project, the members are transferred to new projects, which means that knowledge can be shared with individuals who did not participate in the previous project. (Løvendahl 1997; Björkegren & Rapp 1999). *'Knowledge exchange and experience exchange, that is. What you can find from books, is only an impulse, and our quality system, for example, is a checklist supporting the quality of our service and knowledge documentation. But how knowledge really emerges here in our organisation is through senior-junior training on the job. Those who have more experience bring their own knowledge forward in the organisation.'* (Chief executive).

According to the theory of organisational knowledge creation by Nonaka and Takeuchi (1995), an organisation cannot create knowledge and learn by itself. Organisational knowledge creation is a spiral process starting at the individual level and moving up through expanding communities of interaction that cross sectional, departmental, divisional, and organisational boundaries. They distinguish between tacit and explicit as well as individual and organisational dimensions of knowledge and identify four modes of knowledge conversions. *Socialisation* refers to a process of sharing experiences and thereby creating tacit knowledge. *Externalisation* involves the rationalisation and articulation of tacit knowledge into explicit concepts and formal models. *Combination* involves the systematisations and conversions of different formalised explicit knowledge systems together. *Internalisation* occurs when explicit knowledge is converted into specific know-how in the process of learning by doing.

The larger case organisations in this study encourage job rotation among IS experts in order to increase fluent communication and interaction between their personnel of different business units. Rotation also ensures change, learning and new challenges that IS experts respect the most in their jobs, thus ensuring also organisational commitment and permanence of the personnel. ' *If we can enforce our workers horizontal mobility between different tasks and sectors within our own organisation, they do not have to change workplaces. It is quite a service for the personnel.*' (Manager, Business Development). Job rotation may occur horizontally between the different competence areas and, if organised formally, between industrial or functional units of an organisation. The larger organisations which consists of both product and customer service businesses, regardless of the ambition to reach synergy, differentiation in knowledge and tasks between the business areas may be so wide that it sets limits to expert mobility.

Job rotation may also occur vertically so that the status of an IS expert may vary on different projects. On one project, the IS expert may be the project manager, on another the key technical consultant and on the next the permanent performer of tasks. Instead of strictly divided job descriptions for each IS expert, the case organisations respect more flexible and wide-scale competence. It is possible, depending on their tasks and the length of the projects, that IS experts work on several projects at the same time. Yearly or more often arranged manager-worker career discussions are important arenas for management to find out the expectations and needs of their IS experts as well as for the IS experts to influence management's decisions and their own career opportunities as well.

Conclusion

High-tech case organisations producing software services as a part of their clients' production development or for their clients' strategic business operations actually sell projects. That is, they sell the knowledge of the project group that as a whole is needed for conducting the commission. The project groups in these cases are not permanent groups or teams. Depending on the commission, the group is always made up separately for each project to reach a jointly defined and

shared goal. The project group includes experts from the different competence areas needed and may also include experts from different organisations, mainly from the service provider and client organisations, as well as from different locations. While the commission for the project group mainly focuses on novel problems, its implementation deals with uncertainty and complexity. The work requires shared expertise and responsibility for attaining the goal. It thus indicates functional interdependency and a need for formal and informal interaction and mutual learning among the experts. After finishing the projects, the group breaks up and individual experts join other projects, diffusing the newly learned knowledge to other experts on other projects and to client organisations as well. Thus project work can be said to promote both individual and organisational learning.

What was earlier in the report referred to as "project groups" can, according Frenkel et al. (1999), also be called either "supervised project teams" or "egalitarian teams", or even "network design", depending on the role the clients play and on the participation of projects managers in project work. In each project, however, there exists high interdependency among the participating experts. The projects in which the commission is clearly specified by the client and both the project manager supervision and client control limit the autonomy and informal interaction among the project group, can be called "supervised project teams". However, more common are project teams which are either somewhat self-managed, because the project manager is supervising many projects at the same time, or egalitarian with a participatory project management.

A project and a project organisation can also represent a network design because of the flat hierarchy and authority based on personal expertise and lateral information as well as laterally negotiated decisions. Further, there is informal co-operation and communication among co-workers across the case organisation alongside the projects. Face-to-face communication is obviously needed in IS experts' work, but the person they discuss with can well also be a co-worker or some other expert outside the project. Active informal co-operation in the case organisations is partly due to the small size of the organisations but also to the fact that larger organisations support strategically job rotation and knowledge sharing throughout the organisation. Because change and learning are the main motives for IS experts in their work, the case organisations attempt to assure challenging work opportunities and an enabling work environment for them. In this way the firms seek to ensure the motivation and organisational commitment of the experts, who eventually are their main assets.

Client relations and other inter-organisational co-operation

Client relations are a constituent part of work organisation in the service sector. As the focus here lies on business organisations, the client is another organisation, not an individual person. The primary market-area of the case organisations is in the telecommunications, while their service production and service products (software) contribute to the development of wireless mobile technology. In addition, they also produce IT services and consultation mainly for large companies for other industries, such as for finance and insurance, the public sector and the export industry, for example. Client orientation is a central feature of all case organisations' business. Instead of client

relations, most of the interviewees speak about partnerships. The number of clients is not seen as a measure of success but the proximity and length of the relationship as well as mutual advantage and knowledge sharing are. Instead of only getting new clients, there is a clear tendency towards an increase in knowledge about the business and industry of already existing clients and towards deepening these interrelationships in a way that the service supplier is involved in the life span of the production process still earlier. *'At the moment we actually have so excellent clients that we cannot take more of them. [...] We are quite careful about with whom we co-operate, and without exception, our clients are large companies and concerns. Our firm is still relatively small, so if we want to be good at our client service, it is not possible to keep too many clients. Besides, it is important to understand deeply enough the business of the client in order to offer something more than just designing Internet pages.'* (Vice President, Strategic Business Development).

In project work, operations are based on close collaboration directly between the case organisation as the service supplier and the client organisation. This is the case even in extensive client-led production development projects with several corresponding subcontractors. In these kinds of projects, the client enters a separate contract with each subcontractor and also co-ordinates the entity of the project. Therefore, the interface between the subcontractors is rare or unnecessary, and there are also projects on which one subcontractor does not even know about the existence of the other. The most important parties in the business network of the case organisations are the clients, on the one hand, and technology providers on the other. Besides clients, the most strategic partnerships the case organisations have are mainly with the large hardware and software technology dealers and vendors like IBM, Microsoft or Hewlett Packard, for example. This kind of partnership is an example of the value-added chain within the projects on which a partner company delivers equipment and technologies, whereas the case company delivers applications for the end-users. However, it is usual that partners in co-operation vary according to clients and project commissions whereupon networking is fluid and constantly redesigning. Case organisations seems to belong to a loosely coupled ICT production network or cluster which is formed by the core organisations, such as Nokia, Sonera, Radiolinja and IBM and other possible operators and portal owners.

On their projects, including the projects co-ordinated by clients or by case organisations themselves, networking and subcontracting in business seem to be more common among small firms. While the case organisations grow, they aim to be independent and self-sufficient in their service production. This leads to decreasing subcontracting networks because of an increasing need to keep the knowledge and competence sprung from the projects in-house. One factor behind the rapid growth of many case organisations has not only been the recruitment of new experts from outside but acquiring them through acquisitions. This kind of 'insourcing', integrating smaller innovative firms by acquisitions to complement the core competence of a firm, for example, seems to be a usual strategy within KIBS at the stage of developing from a small to an SME company. Along with this strategy, internal and virtual networking within an organisation among different departments and offices, perhaps in different locality and countries, is becoming more common. Organisational growth and especially virtual organisational forms challenge the formal and informal communication

and co-operation practices and create a need for new forms of knowledge management within an organisation. This kind of 'insourcing' strategy also broadens other external networking relationships of an organisation, thereby increasing the competency, business opportunities, and competitiveness of the organisation.

Despite the client orientation, the role of the client, and thus customisation of service product, alternates among different projects. Firstly, within firms' own production development, the significance of a client may be marginal and the designers have to only think about whether or not a client, an operator, for example, will buy a completed service product. However, for these projects as well, experience from previous innovation processes bring surplus value. As these kinds of service products are duplicated and can be sold from stores or via the Internet, the degree of customisation is very low or completely absent. Secondly, while participating in clients' production development in wireless application, for example, the specifications made by the client may be so accurate that they do not allow for much variation and room for innovations for the service provider. In these cases, the service product is unique and thus highly tailored to the client's needs.

Thirdly, providing Internet-based new media solutions for clients and solutions integrating the operative systems of clients, for example, the intensity of the clients' role and co-operation is dependent on their knowledge on the potentials of information and communication technology. There have been cases in which the client has given free hands to the service provider to specify and implement the service, only evaluating the final service product. It is common in the IT sector to somewhat standardise services and technological applications useful in several similar types of commissions as modules. The creation of these modules and applications emerge, however, from the needs of the clients as well. The service solution for the client is then collected from the different modules with some degree of client-based tailoring on top. *'If we use a metaphor of building a house, the footing and ground floor are built from the completed modules. The other floors would then be built to the client's needs and implemented as co-operative client projects on the footing.'* (Director, Business Consulting).

Generally, then, in both production development and service projects, the client is during the whole project process either the co-producer or at least the evaluator. Projects are based on a live dialogue between a service provider and a client within a shared goal. Thus, the service product is always more or less customised. '*They (projects) are based on the client's commissions and realised through intense co-operation and interrelationship with a client. In production development projects in particular, when the goal that we believed to achieve in the beginning turns out to be different in the course of the project, that's why we have to modify the process and the goal together with the client. We may do the work better, cheaper or quicker, etc., than we thought before but the definitions change anyway. It is the name of the game.'* (Manager, Business Development). Further, according to the Sundbo & Gallouj (1998), service innovations are usually either incremental improvements in

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existing services or ad hoc innovations[4] for clients' particular problems. Innovation activities in business services emerge mainly as part of everyday process of working and delivering the service. Thus, in addition to the service organisations' own personnel, the clients are seen as the most important source for innovations also in the case organisations.

The services of the case organisations involve production development as part of clients' products, IT integration solutions, and Internet services for the clients' business. Thus the case organisations solve problems for clients by acquiring, exploiting, formulating, applying information and knowledge from various sources client-orientedly and then bring the new solutions forward to the client. *'Perhaps we are knowledge producers for clients because many of the client's problems demand definition at first, they only have a need and a problem. Then our different experts either solve the problem or produce more information on it so that it is possible to proceed. We actually circulate information from appropriate sources and process it producing better information and knowledge. Then we of course circulate or distribute the new knowledge because, as a by-product on every project, knowledge capital also emerges, which we can bring in for the next projects.' (Director of Technology).* As some of the case organisations have an informal status of being the R&D department for their clients, they are also involved in producing totally new knowledge in wireless technology in the telecommunications sector. In addition to concrete software product or Internet pages, for example, a service project may also produce some organisational or practice-related results as by-products. *'What typically belongs to our service products is not a purely technical matter in a way that we just build a machine or something. There is always some action connected to our services, for example, clients have to change their working practises and perhaps something else besides that. If we sell some kind of software framework, we also sell the changing working practises as well.' (Director of Technology).*

In addition to varying and redesigning co-operative networking in actual business especially with clients, the case organisations are also engaged in other forms of collaborative networking which supports the business and the development of the ICT sector in general. The most important of these are the research and training collaboration with the technical universities and polytechnics. Many of the case organisations participate in research and development projects that consist of partners from universities, central ICT companies, such as Nokia, Sonera or the international Symbian concern, and from VTT and Tekes[5], for example. Research co-operation can be either

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[4] Gallouj and Weinstein (1997) have outlined modes of service innovations by dividing between radical innovations (totally new product or service), improvement innovation, incremental innovation by substitution or addition of characteristics, recombinated innovation and ad-hoc innovation. The latter they defined as the interactive (social) construction of a solution (strategic, organisational, social, fiscal, legal, etc.) to a particular problem by a given client. This type of innovation is co-produced by the client and the service provider and it usually appears during the normal process of delivering the service, which is thus recognised as an innovation only after the service has been provided. Ad-hoc innovation is not reproducible as such but indirectly through the codification, the formalisation of part of the experience and the competence. It is then closely linked to cumulative learning processes. Ad-hoc innovation seems to play a great role especially in knowledge-intensive business services.

[5] VTT is research institute which produces new applied technology in co-operation with domestic and foreign partners. Tekes, the National Technology Agency is the main financing organisation for applied and industrial R&D in Finland.

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national or international. Some of the case-organisations have participated in EU projects as well. However, university co-operation has been seen as more important from the standpoint of recruitment of new labour force than of producing new knowledge needed in work. As many of the interviewees mentioned, university research produces quite slowly technologic-theoretical knowledge which can be valuable for further product innovations but cannot automatically be applied to the practical problems of the clients the case organisations solve in their every day work.

Because of the lack of teachers in computer sciences and related education, many of the case organisations also participate in knowledge creation and dissemination by teaching at relevant educational institutions, by participating in planning curriculum as well as by participating in sponsoring professorships for universities. *'Research and training are important parts of the expert organisation. Continuous research is needed in different sectors. We actually co-operate closely with universities of technology. It was also the starting point of our business concept to be near to universities. It guarantees us certain types of knowledge needed as well as knowledge exchange, and opportunities to recruit competent workers.'* (Vice President, Strategic Business Development).

In the information technology sector, there are also various local, national and international associations for systemic development of the industrial sector and business in general, and professional trade organisations, such as the Finnish Information Technology Development Centre TIEKE and IT Services Association and Software Entrepreneurs, TIPAL, for example. This kind of collaboration concerns supporting the development of the IT service industry, the creation of collaboration and partnerships as well as internationalisation, and contributing to the legislation, taxation, contracting, and the availability of the labour force and education, among other things.

According to the manager of technology, for example, the business area of information technology in Finland is quite small. Thus co-operation and networking, regardless of their purpose, are greatly based on personal relationships along with the technological or business synergy between the organisations. People know each other, which means that mainly the same people are involved in different networks. The manager speaks less about networks than about different roles of the individual actors in different collaborative contexts. On both the personal level and the organisational level, networking resembles an amoeba which redesigns itself all the time. Networking then represents very complex and multi-level co-operation concerning various and changing functions in which organisations are involved in their business.

The contribution of the case organisations to the innovation systems can be seen as based on both direct effects on the supply side through their applications development of wireless software, and indirect effects on the demand side through the use of their professional IT services. They have a role of a producer of new sector-specific knowledge and novel solutions as inputs to product development in the telecommunications sector. They also make a contribution to the diffusion of technological knowledge within the telecommunications sector and the information sector as well as within other industrial sectors. The case organisations work with each client to identify the distinct strategic advantages to be gained from wireless networking technologies. As a result, operational

solutions supported by tailored software are developed, enabling the client to pursue a range of market opportunities in a competitive, highly profitable manner. The case organisations help their clients in adapting to the changes driven by wireless technology. Thus they actually carry out all the three roles as the facilitator, carrier and source of innovation in the case of KIBS in supporting innovation in client organisations.

Conclusion

Clients are an integral part of work organisations in high-tech business organisations. In addition to either tangible or intangible service products, complex interaction with clients produces as by-products also collaboration, two-way learning, and new, shared knowledge. Client relations in the case organisations seem to be established and long-lasting. Instead of customerships, the interrelationships are defined rather as strategic partnerships. The case organisations do not aim at getting a number of new clients (naturally younger organisations do need more established customers) but rather want to maintain and deepen the existing partnerships. As the organisations grow older and larger, there seems to be tendency to reduce the number of possible subcontractors and co-operation with them. Instead, their strategy for growth and credibility on the market emerge through insourcing; that is, by complementing the core competence of an organisation by acquisitions, for example.

Besides clients, the case organisations establish strategic partnerships mainly with large hardware and software technology dealers in order to ensure more comprehensive solutions to their clients needs. The high-tech case organisations seem to belong to a loosely coupled ICT production network or even to the Finnish ICT cluster. In addition to networking in business, there are various forms of loose network formations for other purposes as well. One of the most important is collaboration with universities and other educational institutions related to training and research. Also, co-operation with other IT business service organisations within several local, national, and even international associations is seen as important. Inter-organisational networking is thus characterised as multi-level, complex and constantly reorganising collaboration according to the different situations and business needs.

High-tech business organisations contribute to the innovation system both directly by supplying software applications and products, and indirectly on the demand side through clients that use their services. They have a role in both producing new sector-specific knowledge and diffusing the technological knowledge to other industrial sectors as well. By diagnosing and defining clients' problems, consulting and solving these problems as well as gathering and diffusing knowledge through a variety of forms of networking, the case organisation promote, for their part, innovative knowledge creation in new wireless technology.

5   CONCLUSIONS AND POLICY ISSUES

The aim of the study was to describe the typical features of IS experts' work and its organisation in high-tech business services concentrating on supporting especially the performance of the telecommunications industry in Finland. Along with the growth of the service sector, the most rapid growth has occurred in business services, including computer and related services. New emerging high-tech business services with increased knowledge intensity of work implicate the changing content of work, which both provides and encourages also new and varied work organisation forms. The features of work and the forms of work organisation in knowledge-intensive IT services have not yet been studied much.

The data of the study are based on interviews made with the managers and the IS experts within six different private firms operating in the area of high-tech IT business services. As a conceptual framework, the study applies the ideal type of the elements of the work organisation developed by Frenkel et al. (1999). By means of the framework it is possible to describe the nature of work, and both the lateral and vertical relations of the work in different organisations. The framework consist of work relations, employment relations, control relations, co-worker relations and client-worker relations added to inter-organisational relations. It has to be noticed that in practice these elements are firmly intertwined. Actually all of them together describe the work relations, namely the nature and complexity of work in a specific case organisation, although Frenkel et al. have separated work relations into one distinct element.

The original framework, in comparing different forms of knowledge work, concern mainly the internal relationships between managers and workers, between co-workers, and between managers, workers and clients within an organisation. The framework thus excludes inter-organisational relations. However, for KIBS organisations, their clients are other organisations, not individual persons. As their focus lies on knowledge-intensive services that are essential for their clients' business, the client relations are usually long-term and established. Further, the service production is usually implemented as to close co-operation with the client. The same project might involve other partners as well. In addition, knowledge-intensive organisations, in order to maintain and develop their knowledge intensity and business, also need other external relationships around them. Thus this study extends the framework also to concern inter-organisational relations.

According to the general assumption of knowledge-intensive work organisations (Starbuck 1992; Reich 1992; Frenkel et al. 1999), characteristic of the work is creative problem-solving with the demand for both theoretical and contextual knowledge as well as analytical and social skills. Further, implementation occurs as team-based within flexible, communication-intensive and empowered organisations in which especially client orientation is an additional source of learning and satisfaction for workers.

The results of the report partly support this ideal type of knowledge-intensive work organisation. The IS experts' work is based on application of theoretical and technical knowledge both as input, tools and output of the service process. However, agreeing with Alvesson (1993), their work does

not actually involve so much esoteric knowledge and problem-solving but rather broad and complicated social, organisational, and analytical skills. Contextual knowledge of the business concept, clients, users of the service products as well as of working methods and practices developing through the work processes in different projects has seen very essential. Although IS experts do clarify and solve complex problems for the clients, the degree of creativity in work is varied and depends on the specifications coming from clients and also on the standardisation of the computing work process. Further, in project work, problem-solving and knowledge creation is based on shared expertise of the project team including members from a variety of competence areas and even different organisations. However, features of the IS experts work illustrate Blackler's (1995) and Frenkel et. al's (1999) conception of the complexity of knowledge work demanding embrained and encultured knowledges.

IS experts are the most valuable, but at the same time an insufficient capital for the high-tech IT service business organisations. Because there is a shortage of labour force in the firms, there are open labour markets for the IS experts. Thus employment relations with the elements of recruitment, training, career development and rewarding are essential for the organisations operating in the area of new technology from the standpoint of acquiring the labour force and making them to commit themselves to the organisation. Problematic for recruitment is that IT service organisations are not as widely known as larger firms operating in telecommunications. The case organisations recruit a lot of students who have not had much regular employment. This challenges them to organise on-the-job training as well as to support the graduation of the students in order to ensure the quality and trust of service delivery for the clients. Instead of a diploma in higher technical education, more important criteria in the selection of new IS experts are personal suitability, engagement in new technology as well as social skills and the ability to learn. Although the IS experts' work does not offer a lot of career opportunities, the turnover of the employees is not a problem in the case organisations. The IS experts who seem to be especially committed to the development of new technological know-how, respect more intrinsic and social features of their work rather than extrinsic features, such as high status or wages. Then offering challenging, changing and wide-scale work tasks with opportunities to learn within flexible organisations is a challenge for IT service organisations, providing that they organise human resources and knowledge management functions properly in order to be innovative and competitive in markets.

Well-organised employment relations also represent a form of input control ensuring that the IS experts skills, knowledge, attitudes, values and interests match those of the employing organisations. Control relations in knowledge-intensive project work deviates from traditional top-down manager-worker conception of control. There is more emphasis on client control, peer- and self-control as well as on output and performance control after the project has ended. Controlling the work process or the output in advance is difficult due to high client-orientation, rapidly developing technology as well as service products which, in general, are not always very foreseeable. Standardised working procedures and quality management systems can be seen as forms of direct control in IS experts' work. Also, following up the timetable and the budget in project work might

be used to control workers. Depending on the project, the client might control both the work process and the output during and after the project. Within everyday project work, the responsibility of organising and performing the work and its quality, however, remains with the project group and especially with its manager. On the level of individual IS experts' work, the forms of control do not seem to express direct supervision or constrict their autonomy in work. Instead, they respect the low hierarchy and flexible arrangements in their work. The work of professionals and special experts is usually regarded as highly autonomous, with full opportunities to influence one's own performance. However, IS experts' work in high-tech case organisations, as in most of the organisations in general, is characterised by a combination of direct or indirect input and behavioural and output control.

All these features of IS experts' work, employment and control relations in high-tech IT service organisations already emphasise the fact that project work is characterised by complexity and uncertainty. Along with changing commissions, the composition of the project team also changes. The work and problem-solving done for clients call for shared expertise in and responsibility for attaining the jointly defined and shared goal. It indicates functional interdependency and a need for formal and informal interaction and mutual learning among the experts who diffuse the new knowledge between different projects. Thus project work can promote both individual and organisational learning. Change and learning are IS experts' main motives for work and commit them to the organisation. Besides changing projects, one means to increase the variation and challenge of work is job rotation among different departments, for example. This also enhances informal communication and co-operation between IS experts thus promoting the intra- organisational network design of co-operation.

Clients are an essential part of a work organisation in high-tech business services from the standpoint of knowledge creation and innovativeness. By consulting and solving the client's problems in close co-operation with them, high-tech IT business service organisations also increase their own knowledge base. The most important partners in co-operation are especially the clients with a few strategic partnerships with hardware and software technology dealers in order to ensure a comprehensive solution for clients. Besides intra-organisational networking, the case organisations operate in a loosely coupled ICT production network. One can also say that they belong to the Finnish ICT cluster. In addition to networking in business, there are a variety of forms of loose network formations with education institutions promoting co-operation in training and research, and with several associations supporting the maintenance and development of the IT service industry in general, for example.

Networking is a concept which can be understood in many ways as it can take many forms on many different levels. For high-tech IT service firms, it is possible to differentiate co-operative networking firstly at least on the individual level between co-workers within projects and within wider organisation. Secondly, there are network formations also on the organisational level between the service provider and the client organisation, potentially enlarged with other essential service

partners, and between different business organisations, knowledge creators and labour providers within the large ICT cluster. Because of uncertainty with constant change is typical of the markets in the telecommunications sector due to the rapid development of technology, for example, networking is also characterised by continuous restructuring.

All in all, high-tech IT business services are growing fast and becoming more and more important actors within the innovation system in the telecommunications sector. These business services might contribute to the innovation system first directly by supplying their own software application products to the markets. Second, they might contribute indirectly through client organisations using software production services as a part of either their production process or as intensifying their operative business. High-tech IT business services both produce sector-specific knowledge in a new technology and also diffuse it to other industrial sectors, as their markets widen also to other industries than telecommunications. Thus, through the variety of forms of networking, high-tech IT business services promote, for their part, innovative knowledge creation in new technology. This makes the organisation of work, especially the development of appropriate human resources and knowledge management practices to maintain their intellectual capital, as well as education and training in general important policy issues.

Enhancing intellectual resources, mathematical and scientific knowledge and, alongside it, humanities, social sciences and business know-how in general are important. Besides the need for technological knowledge, there is also a need for wider industrial, organisational, social, and business know-how. Because the high-tech IT services and information industry as a whole is very male-dominated area, it is especially important to strengthen the position of women in education and training as well as in recruitment in information industry. Also, the growing need for competent teachers must be satisfied. Boosting of collaboration in planning and developing curricula between education institutions and private companies from rapidly developing new industries is essential in order to direct the content of education according to the practical needs in business organisations. In addition to production-oriented technical competence, education in business management and social skills, for example, should also be included in curricula.

Issues of continuous training and knowledge sharing on the organisational level are increasingly important. This is not only because of the rapid growth and thus the labour shortage of information industry, or the rapid development of the technology, but also due to assuring the satisfaction and organisational commitment of the expert labour. Especially, there is a demand for suitable and adequate training in project management in addition to technical issues. Organised on-the-job training is essential also because IT firms employ a lot of students. Work and employment relations that promote the graduation of the student employees present a challenge for IT firms.

Labour shortage and, at the same time, the need for special and general expertise also bring forth the requirement for well-established organisation of human resources and knowledge management, in general, with secured employment contracts, training, career advancement and other incentives as policy issues. A work organisation which supports the change, challenges, and learning of IS experts

also guarantees their work satisfaction and organisational commitment. This, for its part, has a positive effect on enhancing the innovativeness and competitiveness of the whole business. Further, a proper and functional work organisation might also inhibit the possible stressful outcomes of hectic project work and thus enhance the working abilities of IS experts. The majority of IS experts do not belong to any trade union. Although expert work within the new and developed high-tech firms is somewhat based on individual competence, employment relations and conditions are a collective matter which IS experts should be aware of and given information about. Although the labour market situation has been good, it might change as the news from the international telecommunications markets have lately revealed.

Promoting high-tech IT service firms to improve their know-how related to the management of their own service processes and the economic exploitation of service innovations is also needed. According to the interviews, instead of supporting technology development in which know-how is already high in Finland, there is a need for support the know-how related to growth, marketing and internationalisation of business.

The innovativeness and competitiveness of high-tech IT service firms within the global markets are highly dependent on their human resources, especially on their experts. Well-designed work organisation facilitates recruitment of proper personnel, and at the same time, confirms the motivation, commitment and permanence of the personnel. Instead of either mechanical, controlled bureaucracy or empowered adhocracy, there exist combinations of many different ways and forms of organising work within innovative services. High-tech IT service firms in particular operate within rapidly developing 'turbulent' markets which bring about changes and present them a challenge to transform their business and organisation of work along the changes.

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APPENDIX 1.

THE INTERVIEWEES:

Kari Auranaho, Plamec Oy

Fredrik Husberg, Mediaclick Oy

Ari Hyvönen, Digia Oy

Ilkka Innamaa, Digia Oy

Jukka-Pekka Kemppainen, Plamec Oy

Petteri Koivunen, Sysopen Oyj

Pekka Kähkipuro, Sysopen Oyj

Rauli Käppi, Yomi Media Oy

Jani Lahtinen, Mediaclick Oy

Sami Leppänen, Digia Oy

Marko Liimatainen, Yomi Media Oy

Jouni Miettunen, CCC

Sari Niskanen, CCC

Paavo Pietola, Plamec Oy

Kimmo Rahkamaa, Sysopen Oyj

Mikko Rintanen, Mediaclick Oy

Matti Savolainen, Sysopen Oyj

Jari Silaste, CCC

Pirkko Valtonen, Sysopen Oyj

Jarkko Virtanen, Digia Oy

Olli Väätäinen, Yomi Media Oy

APPENDIX 2

ORGANISATIONAL FRAMEWORK OF THE CASE ORGANISATIONS

This appendix provides a brief description of each case organisation according to the following features (when available):

- Service/business concept and mission
- Year of foundation, brief history
- Markets and clients
- Organisation form
- Occupational structure
- Number of personnel
- Types and length of job contracts
- Age, sex and education of personnel

Case A

The case organisation A was founded in 1994 to produce mechanic product development services to its clients. The company was specialised on new plastic materials and production techniques. In 1996, industrial and product design was integrated into the company's business concept. Nowadays, it represents a unique, innovative service concept that combines design and technical product development into a seamless entity. As its main services, the company then concentrates on design, product design and project management. As additional services the firm also produces prototyping, visualisation, animation, graphical design, training and dealership, and support material to help clients to promote the products. The company operates as project organisation in the business-to-business sector. Its slogan is *'We give your ideas a form',* and the mission of their innovativeness is that in giving form to concepts they can produce the best aesthetic union of ergonomic, economic, and functional values.

The case company was founded by its present managing director as an experiment in co-operation with a company he was worked for previously. The parent company produces technically demanding precision mouldings. Within the parent company, it was noticed that production development and know-how on industrial and product design should integrate in order to achieve good plastic products. After noticing that the business concept of the case company was functional, the case company broke away from the parent company and also moved into another locality (Oulu). The parent company, however, is still one of the main clients of the case-firm and their relation is functional partnership. The development of the case company can then be characterised as a start-up within the parent company, which was later voluntarily and deliberately outsourced.

The company form of the case company is corporation and its founder, the managing director, and the design co-ordinator are the principal shareholders. Together with the senior product developer, they also form the management group of the firm. Despite its rapid growth, the fiscal years of the company have been profitable. From 1997 to 1999, its turnover became nearly threefold, being over

FIM 4 million in 1999. By 1999, the firm had grown from a two-man firm to an organisation employing about 15 employees: 5 product developers, 5 designers, 3 model builders, who are men, except for one female designer, and 2 female office workers. Employees are hired on permanent employment contracts based on full-time hours and monthly salary, but mainly in the summertime, the firm also employs students on temporary and hourly contracts. The average age of the personnel is around 30. The vocational educational background of the expert workers is mainly higher education with a university degree (or they are university students).

In the summer 2000, the case organisation established another office in Espoo in the Helsinki metropolitan area. This also meant an increase in the number of its employees. In the future company strategy, there is a plan to open at least two more offices, in Jyväskylä and in Tampere. The growth of the company has been based mainly on a strong demand for its services, because of the booming development of information and communication technologies and their use in modern economies. Although a small firm, the case company is among the largest industrial design firms in Finland. According to the managing director, the size of the personnel is now quite optimal for design business. That is why the company's growth strategy is based on building new autonomous offices in other localities in Finland. It allows keeping the size of each organisation small enough.

The markets of the company concentrate on the industrial sector according to its main services. They divide their clients into three categories on the basis of the benefit of their services for the client. They produce services first for companies that manufacture new products; second, for companies that seek to extend the life-span of their existing products (updating products by improving functionality and design), and third for companies that develop new concepts and ideas for products (give form to concepts, supporting ideas with visualisations and prototypes). The case company is therefore an important actor in its client's product innovation process. According to the managing director, about 80% of their business are directed towards telecommunications. Not surprisingly, Nokia is one of their biggest clients along with the parent company. Because of the short history of the company, the number of its clients is still quite small but the client relationships are formed to be long-term partnerships. However, widening the clientele also into other industries is part of the company strategy.

Case B

The case organisation B is an advanced software technology supplier specialised in interactive broadband services. Its business is divided into production development and professional services with content providing. The company's solutions are software architecture and software infrastructure, which are needed in addition to the physical broadband network infrastructure to build the value-added Internet services. In addition to software technology, the company provides professional software development services designing and implementing interactive broadband solutions for communication, collaboration and content distribution applications. The company operates as a project organisation in the business-to-business sector.

The company was established in 1997 as a spin-off from a university of technology for commercialising the results of a research group on software technology architecture for 3D visualisation and content distribution. In addition to applied research, basic research is also an essential part of business in the case company. The company form is corporation. Along with the founding research group, its shareholders are two venture capital companies. In the autumn 2000, the company was just finishing the first phase of its production development. Thus its profit amounted to zero in practice and its turnover to about FIM 2 million. The case company's markets are still domestic. Its aim is to expand first in Finland and then to gradually build networks and co-operation abroad as well. The company provides solutions for the telecommunications sector and their main clients are telecom operators, Internet service providers and broadband network equipment manufacturers.

The organisation of the company consists of management and two core competence areas, programming and graphics. Management includes the president, the chairman of the board, project the manager, who are men, and an assistant to the management, who is a women. In programming there are system designers, application developers and an algorithm developer, who are all men. In graphics there is an art director and graphic designers, who are also all men. 'Application developer' and 'graphic designer' are the most common job titles within the company. At the moment of the interview (August 2000), the company employed a total of 25 workers and was actively searching for new employees, especially in software development and project management. Its main principal is to employ workers on permanent employment contracts and full-time. Almost a third of its employees had a temporary contract, but they were mainly students. The employees of the company are quite young, their average age ranges from 23 to 24. The educational background of the employees, however, was mainly higher technical education, or the employees were students at a university of technology or a polytechnic.

Case C

The case organisation C is an IT company specialised in developing integrated solutions for information technology, wireless communications and digital media as IT projects and value-added service products for teleoperators. It also creates software solutions for websites, extranets and intranets for customers in different industrial fields. *'Make your net work'* is the slogan of the company. The case company was founded in 1996 as an affiliated company of a larger teleoperator corporation, which is listed on the Helsinki Stock Exchange. The teleoperator corporation bought functions concerning the Internet and multimedia services from a local software house and established the case company on the basis of these service functions. The company started as a project organisation providing IT and new media integrating services for its clients. In 1999, the company broadened its business into software products directed especially to international teleoperators. In order to consolidate its competence, the company bought a software house that

concentrated on the development of data systems for telecommunications, electronics and software industry companies in international markets as its autonomous affiliated company.

At the time of the interview, the case company was in the middle of an organisational restructuring process. Along with the structural change of the whole teleoperator corporation, it was decided that the case organisation's different functions be combined to form a business group of the corporation. This business group is divided in two functions: software product business and information systems development and integration. Three distinct accountable business unit organisations in three different localities in Finland are implementing these functions. The software product business organisation develops and markets applications for mobile operators, portal owners and service providers (ISP, ASP). These applications aim at offering; developing and administrating value-added services for mobile phones. In the information systems, the development and integration business area focuses on project business operations. There is an organisation for developing and implementing eBusiness-enabling solutions for select major Finnish and international customers, and another organisation for carrying out elaborate software development projects under subcontract. About a half of the case company's turnover comes from the telecommunications sector, including international and Finnish teleoperators, portal owners, and ICT equipment producers. The other clients of the project business in particular come from banking, insurance, retail, energy production and distribution, and the wood and metal industries.

The case company is a flat expert organisation with a project organisation as an oldest form of work organisation. During the year 1996 and the summer 2000, the number of its personnel grew from 10 to 220 employees. Rapid growth also continued after that. According to the Internet pages of the company, in March 2001, the company currently employs 320 persons in Jyväskylä, Helsinki, Kuopio, Oulu, and Tampere in Finland. 'Designer' is the most general job title of the expert workers in the case company, regardless of the content of work they do. According to the managing director, the average age of the personnel is about 30, the share of women among the personnel is about 30 per cent, and the most general educational background of the personnel is technical studies and a degree from a university or a polytechnic.

In addition to the interview of the managing director of the case company, two expert interviews were made in a software product business organisation.

Case D

The case organisation D represents a change in the business concept from a new media company focusing on design and implementation of Internet services (www-pages, Intra-/Extra-/Internet services, e-business solutions) into a software company specialised in wireless Internet applications, especially third-generation mobile communications. Business focusing on Internet solutions started in 1996 as part of an advertising agency owned by a shareholder of the case company. Very soon it was discovered that the activity was more technology-oriented than content-

oriented. This led to a 'divorce' from the advertising agency and to establishing a new company as a brand for digital business development by three individual shareholders (including the owner of the advertising company) at the beginning of 1997. The company's business operations concentrated on the Internet solutions, electronic business solutions and related application development with consulting and branding activities as integral parts of its operations. As early as 1998, the company changed its strategy. Then, the emphasis of its business shifted to more complex e-business packages and production, and applications development of wireless software, especially the third-generation mobile communications. The origin of the company, then, is reflected in a mixture of spin-off and start-up routes of the emergence of KIBS through deregulation in the telecommunications market, which offered a dynamic and competitive marketplace for new service providers.

In 1999, specialisation in business was enabled by new shareholders, who came from the field of telecommunications (Sonera) and a venture capital investor (Eqviteq Partners Oy) specialising in technology companies, as well as by collaboration started with an international Symbian concern as a result of co-operation with Nokia. The case company is among 11 Competence Centres of the Symbian concern worldwide but the only one in the Nordic region. Through acquisitions and strategic alliances, the case company is seeking to further consolidate business in its core competence areas. The company has bought firms concentrating on software development and technologies, for example. At the moment of the interview, the case company was implementing its second financing method. At the end of 2000, the company announced to have collected FIM 206 million from venture capital firms abroad. However, more than a half of shares are still owned by the personnel of the case company. *'If it can be wireless, it will be wireless'* is the slogan of the company.

The year 1999 was a year of strong growth for the company. Its turnover amounted to FIM 20.5 million and the growth of the turnover compared to that of the previous year was 233 per cent. Its main business areas are now divided into two: first, into professional services, including the Internet, Intranet and Extranet solutions, e-business solutions, interactive multimedia and wireless solutions; and second, into Symbian Competence Center, including product development, software subcontracting, Symbian licensing and related training and consulting. A separate R&D unit was also established in 1999. These business areas, however, back each other up. The clients of the case company are in the telecommunications, financial, energy, entertainment, media, and travel sectors. The company headquarters is located in Helsinki but through acquisitions the company has offices for wireless software development in the cities of Espoo, Turku, Lappeenranta and Tampere as well as in London. These offices are accountable units representing specialised competence areas overlapping, however, with the professional competence teams within the main organisation. The case company, especially its professional service business represents a project organisation, which is formed on the basis of a matrix organisation. Due to the changes in its business concept, the organisation of the company is also changing from project-driven to product-based.

In 1998, the average number of the company's personnel was 14. At the end of 1999, it employed a total of about 80 permanent employees and, by summer 2000, the number of employees was about 140. 'Software designer', 'software specialist' and 'graphic designer' are the most common job titles within the company. The company recruits personnel mainly on permanent full-time contracts. It also employs students on hourly contracts (a common practice in the field which suffers from labour shortage), whose weekly working hours, however, come close to those on permanent contracts. The average age of the personnel is 28 and the majority (80%) of them has a university or polytechnic degree. Technical qualifications were the most common and commercial qualification secondly common educational background of the personnel. About 20% of the employees (administrative personnel included) are women, which represents the average of the field

Case E

Case organisation E is an IT service provider focusing on integrated eBusiness solutions. The company is specialised in developing, integrating and maintaining the client's business operation systems, especially in integrating operative systems with new Internet and wireless solutions. The mission of the company is to provide their customers with eBusiness solutions and software products that ensure that they meet their business targets. *'Create solutions, integrated solutions'* is the slogan of the company. As the company is a system integrator, its solutions are based on the client's business needs, and the required techniques are also chosen case-specifically.

The company with the above business concept came into existence in the summer of 1990 when the three present shareholders, who are also actively in the business as managers, founded the company. The company, however, dates back to the beginning of the 1980s and to an IT service concern, one of the founders of which the managing director was. After a rearrangement in holding, the managing director left the company with most of its employees and established the case company in Helsinki with two other IS experts in 1990. Soon after its establishing, the company opened offices in Tampere, Finland, and Stockholm, Sweden. In the course of 1999, the company's operations expanded to Kuopio and Espoo and its subsidiary company started to operate in London.

The company form is corporation, in which the parent company concentrates on administration and management of the whole concern, while the 11 affiliated companies concentrate on business. The main shareholders of the company are its personnel. In 1999, the company was listed on the Helsinki Stock Exchange. The growth of the case company is based both on internal growth and growth through acquisitions. The 1999 growth especially was based on acquisitions and new company partnerships. The case company's turnover increased from FIM 35.7 million to FIM 91.0 million in 1997 - 1999. At the same time, the number of its personnel grew from 71 to 194, and in summer 2000, it was about 290.

The case company's markets are domestic, but it also operates internationally. Expanding internationally is in the strategy of the company. Its customer segments include

telecommunications, which is the biggest segment by turnover (almost a third of the turnover), banking, insurance and finance, the public sector, manufacturing, logistic, and the service sectors.

The functional organisation of the case company deviates from its formal concern structure. Its special expertise is divided into three complementary main business service areas. Each service functions are further divided in accountable business units, either according to the industry and/or clients, or according to functional competence areas or products. The affiliated companies also operate as business units within the main service areas. Within all business units, the main work organisation form is a project organisation.

In the first service area, the company supplies mission-critical IT solutions particularly in the field of eBusiness for large private and public organisations. The implementation of solutions is based on object and component technologies. Especially in this area, the company focuses on telecommunications and logistics. This service area is the biggest one in the company and is divided into 9 different business units. It employs over 200 experts and the share of its turnover is about 77 per cent of the total turnover. The second service area is IT business consulting services, which integrates business process with the opportunities offered by new technology. Consulting services form a basis for building customer solutions, and clients can also use them to develop their businesses and IT strategies. This service area includes two business units with about 30 experts, and its turnover is about 17 per cent of the company's total turnover. In their third service area, the company supplies complete software solutions supplementing eBusiness solutions especially in two areas of know-how: Customer Relationship Management (CRM) and Enterprise Document and Output Management (EDOM). The company can also partly customise these complete solutions, and the solutions include all additional services, such as installation, integration into other systems, training and maintenance. This area consists of 5 business units and employs about 40 experts, but its turnover is still only about 6 per cent of the total turnover of the company. The company is, however, investing in its software product business area in the near future.

The occupational structure is as narrow as the hierarchy is flat within the case company. The occupational titles are either 'senior consultant' or 'IT consultant'. These expert workers covered 89 per cent, administrative workers 5 per cent, and managers 6 per cent of the total number of personnel in 1999. The average age of the personnel is 36. Only 17 per cent of the personnel are women (administrative employees included). About 74 per cent of the employees have a degree in higher education (universities, polytechnics and other higher educational institutes). Full-time permanent employment contracts are the main job contract form in the case company. The turnover of the personnel is low, only 7.9 per cent/year.

Case F

The case organisation F is a software company specialised in software production and software products. Software production focuses in delivering unique, customer-oriented solutions to various sectors either as operationally integrated systems or as part of production development of clients. Software products consist of software designed to meet the high requirements of mobile smart communication equipment, CAD, multimedia, and virtual templating in the e-business. These products are owned by the case company and have tens of thousands of users around the world. The case company was among the first to start developing wireless communication solutions at the beginning of the 1990s. Wireless communication is now one of the leading areas of expertise of the company, which is also one of the top developers in this area. Another important area of expertise is mobile data transfer solutions in co-operation with the customers in their production development projects. The company is also participating in several international research projects aiming at developing leading software solutions of the future. *'Delivery date never late'* can be mentioned as a slogan of the company.

The principal shareholder (60 per cent of shares), who is also the managing director, established the company as a pure start-up in 1985. In the beginning, the company employed about 10 key experts who came to the new company from a few different software houses. The managing director of the heart-rate-registering equipment producer with the company is another owner of the case company (40 per cent of shares). The company form is a concern with 10 autonomous enterprises locating in Oulu, Rovaniemi, Turku, Uusikaupunki, and Espoo, Finland, in Budapest and Szeged, Hungary, in Guildford, UK, and in San Jose, USA. The company has been growing quite steadily (despite the recession at the beginning of the 1990s). Both the turnover and the personnel have been growing by about 20 per cent per year. In the summer 2000, the company employed more than three hundred people, but in the spring 2001, as many as over four hundred software professionals. The company's turnover for the year 2000 is estimated to reach FIM 2000 million.

The functional organisation of business in the case company consists of project business and product business areas. The software production projects are the predominant form of business, since about 80-90 per cent of the total turnover of the case company comes from that area. Both of the main business areas are further organised as autonomous and accountable units, or system groups, as the company calls them. In the project business area, the system groups are formed on the basis of industry, and in some industry, there might be two or even more units according to the clients. The system groups are telecom services, industrial systems, public sector, mobile technology, media business, space technology, and wellness services. In addition to these, there is also an R & D unit in the project business area, although the main part of research and development is done in system groups as part of everyday work. In the product business area, the system groups are based on the products created in the company, and at the moment, they have 6 different products to develop and market. Within each system group, work is organised as projects, either client projects in the project business area or product development projects in the product business area. The manager and IS experts interviews were done in one of the mobile technology group units. This system group operates in Oulu, Turku, Budapest, and London. They construct solutions that

utilise wireless terminals and design software for various kinds of mobile equipment, such as mobile phones, communicators, and palm computers.

The case company's markets are both domestic and international. In software production, project business concentrates on domestic markets, whereas software products are meant for global markets. The internationalisation of the company, in particular, is related to product development and marketing. The client segments in project business include public administration, welfare services, big export industry companies, media business, space technology, and the telecommunications sector including both telecom operators, service and content providers, and equipment and network producers. The share of professionals working in wireless data transfer (including employees from some groups of product business, telecom services and mobile technology) cover more than a third of the total number of the employees in the case company.

The case company mainly hires employees on permanent full-time job contracts. As many other firms in the sector, it also employs students on hourly, temporary contracts. The turnover of the personnel is not a problem for the company; instead, they have problems in recruiting software professionals because of the general lack of labour in this area. About 80 per cent of the employees of the case company already have a university degree, or at least they are students at the university mainly in computer science or related technical science, but also in other disciplines, such as the humanities. The average age of the employees is around 30-33. The share of women in the personnel is about 10-20 per cent.

APPENDIX 3.

THEMES OF THE INTERVIEWS AND THE QUESTIONNAIRE (in Finnish)

Sitra/EKI-projekti/2000: johdon teemahaastattelurunko

I   Yrityksen perustiedot ja historia

I   Yrityksen tuottamat palvelut tai tuotteet, ydinosaaminen sekä asiakkaat

I   Organisaatio
- Mikä on (Miten kuvailisitte?) yrityksenne organisaatiomuoto? (Perustelut)
- Millaisiin toiminnallisiin yksiköihin/osastoihin yrityksenne on jakautunut? (itsenäisyys vs. vuorovaikutus tai yhteistyö, Epäviralliset ja viralliset yhteistyötavat
- Päätöksenteko ja tiedonkulku

I   Henkilöstön osaaminen ja rekrytointi
- työnjako ja osaaminen, työntekijöiden saatavuus, alalle tyypilliset urat

- rekrytointikanavat ja –kriteerit?
- työehdot
- taidot
- osaamisen kehittäminen ja urakehitys
- kontrolli
- vaihtuvuus
- palkkiosysteemi

I   **Yhteistyöverkostot**

I   **Tukiorganisaatiot yms. instituutiot**

I   **Asiakasprojektin kuvaus**

I   **Yrityksen oma innovaatiotoiminta**

I   **Kehittämistarpeet ja tulevaisuus**
Sitra/EKI-projekti/2000: työntekijähaastattelujen teemat

I   **Asiantuntijuus ja osaaminen**
- Työn kuvaus
- Työn aika- ja paikkasidonnaisuus (työyhteisö)
- Avaintaidot
- Osaamisen ja asiantuntijuuden muotoutuminen + rooli tele-/biosektorilla
- Osaamisen ja asiantuntijuuden ylläpitäminen

I   **Työn tekemisen tavat ja ehdot (työn organisointi ja asiakaskohtainen projektityö)**
- Työn organisointi
- Projektityö
- Vaikutusmahdollisuudet
- Yhteistyö ja tiedonkulku
- Valvonta/kontrolli
- Asiakkaat
- Ongelmaprojekti

I   **Yrityksen työkulttuuri ja työn merkitys**
- Yrityksen imago työnantaja
- Työehdot
- Joustava tietotyö ja jaksaminen

- Työura ja työn merkitys

Kyselylomake asiantuntijapalveluyritysten työntekijöille

Yrityksen nimi &
sijaintipaikkakunta: _____

Tiimi tms., johon kuulut: _____

1 sukupuoli

- nainen

- mies

•2 syntymävuosi _____

•3 asumismuoto

- yksin

- avo- / avioliitossa, ei lapsia

- avo- / avioliitossa, lapsi/-a

- yksin lapsen / lasten kanssa

•4 peruskoulutus

- kansakoulu

- keski-/peruskoulu

- lukio

•5 ammatillinen koulutus (aste, ala ja tutkinto)

 _____

•6 muu koulutus _____

•7 ammattinimike _____

•8 nykyisen työsuhteen alkamisvuosi _____

•9 nykyisen työsuhteen luonne

- pysyvä
- määräaikainen työ

•10 työaika

- kokopäivätyö

- osa-aikainen työ

1 Toimitko esimiesasemassa, jos toimit, niin paljonko sinulla on alaisia?

• en

• kyllä, _____

•2 Miten pitkä työkokemus sinulla on yhteensä?

_____

1 Miten pitkä työkokemus sinulla on nykyiseltä toimialaltasi?

_____

1 Miten pitkä työkokemus sinulla on nykyisistä tehtävistäsi?

_____

1 Kuulutko ammattiliittoon?

¥ en

• kyllä, mihin _____

•2 Mihin seuraaviin tietotyön luokituksiin katsot oman työsi sijoittuvan? Ympyröi molemmista listoista (A ja B) <u>yksi </u>vaihtoehto.

A

• johtaja (strateginen päätöksenteko ja suunnittelu)

• tutkija (tuote- ja prosessi-innovaatioiden tuottaminen)

• suunnittelija (innovaatioiden soveltaminen ja muokkaaminen)

• integroija (päätöksenteon, innovaatioiden, suunnittelun ja toimeenpanon suhteiden hoitaminen ja toiminnan yhdenmukaistaminen)

• operaattori/suorittaja (tehtävien joko oma-aloitteinen tai ohjeistettu suorittaminen)

B

• verkostoija (rakentaa yhteyksiä yrityksen sisällä esim. eri osastojen välillä tai ulkopuolella eri yhteistyötahojen kanssa)

• verkon osa (on osa verkostoa, mutta ei päätä milloin, miten tai keneen otetaan yhteyttä)

• verkon ulkopuolinen toimija (hoitaa omia verkon ulkopuolelle sijoittuvia tehtäviä)

1 Millaista jatko- tai täydennyskoulutusta tarvitsisit työssäsi?

_____

_____

1 Kuka on mielestäsi vastuussa ammatillisen osaamisesi ylläpitämisestä ja kehittämisestä?

- yksittäinen työntekijä

- työnantajayritys/-organisaatio

- julkinen valta

•2 Teetkö työtä pääasiassa

- yksin

- työparina

- ryhmässä, miten nimitätte ryhmäänne (tiimi, pienryhmä, solu tms.)?

_____

1 **Keitä muita henkilöitä ryhmääsi kuuluu (ammattinimikkeet ja lukumäärät)?**

_____

_____

_____

2 Ovatko ryhmän jäsenet arvoasemaltaan ja ammattitaidoltaan suunnilleen samalla tasolla?

- kyllä

- ei

•3 Miten itsenäistä työsi mielestäsi on? Ympyröi valitsemasi vaihtoehto.

- Erittäin itsenäistä (suunnittelen ja päätän itse, mitä teen ja missä järjestyksessä)

- Jokseenkin itsenäistä (otan huomioon annetun suunnitelman, mutta päätän itse, mitä teen ja missä järjestyksessä)

- Vain hiukan itsenäistä (työtä ohjaavat ylempänä laaditut suunnitelmat ja työmääräykset, mutta voin itse päättää, miten työni parhaiten teen ja myös tarvittaessa poiketa ohjeista työn sujuvuuden takaamiseksi)

- Ei lainkaan itsenäistä (työtä ohjaavat ylempänä laaditut suunnitelmat, työmääräykset ja ohjeet sekä valvoo esimies)

1   Mitkä tekijät rajoittavat työsi itsenäisyyttä?

Itsenäisyyttä rajoittava tekijä	ei lainkaan	jonkin verran	paljon
Työpaikan säännöt			
Esimies			
Sidonnaisuus muiden töihin			
Työn tuloksellisuuden tai tuottavuuden arviointi			
Asiakkaat			
Aikataulut			
Tekniset laitteet			
Palkkausjärjestelmä			
Tiedonkulun puutteet			

1   Laita numerojärjestykseen neljä myönteisintä asiaa työssäsi! (1=myönteisin asia)

__ asiakaskontaktit

__ hyvä palkka

__ hyvä työilmapiiri

__ hyvät työsuhde-edut

__ hyvät urakehitysmahdollisuudet

__ itsenäisyys

__ toimivat ja monipuoliset yhteistyösuhteet organisaation sisällä

__ toimivat ja monipuoliset yhteistyösuhteet organisaation ulkopuolisten tahojen kanssa

__ työn aika- ja paikkajoustavuus

__ työn monipuolisuus

__ uuden oppiminen

__ muu, mikä? _____

1. **Laita numerojärjestykseen neljä tärkeintä ongelmien lähdettä työssäsi!**
   (1=ongelmallisin asia)

__ heikot osallistumis- ja vaikuttamismahdollisuudet työpaikalla

__ huonot urakehitysmahdollisuudet

__ kiireinen työtahti

__ työntekijöiden välinen kilpailu

__ rajoittunut tiedonkulku

__ työn osaamisvaatimusten kasvu

__ työn projektiluonteisuuden aiheuttama työn epävarmuus

__ palkkaus

__ työaikajärjestelmä

__ vastuun lisääntyminen

__ vähäinen itsenäisyys

__ vähäiset yhteistyösuhteet organisaation sisällä

__ vähäiset yhteistyösuhteet organisaation ulkopuolelle

__ muu, mikä? _____

1. **Missä määrin voit työpaikallasi vaikuttaa seuraaviin asioihin?**

Asia	En voi vaikutta a asiaan	Asiasta keskustella an minun / tiimini kanssa	Asiasta pyydetään minun / tiimini mielipidettä	Asia päätetään yhdessä esimiesten kanssa	Asia kuuluu minun / tiimini päätösvaltaa n
työyhteisön tavoitteiden määrittely					
oman työni sisältö					
käyttämäni työmenetelmät					
työyhteisön toiminnan suunnittelu					
työnjako ja organisointi (työyhteisön töiden järjestely)					
työprosessin kehittäminen					
työtahtini					

Asia	En voi vaikutta a asiaan	Asiasta keskustella an minun / tiimini kanssa	Asiasta pyydetään minun / tiimini mielipidettä	Asia päätetään yhdessä esimiesten kanssa	Asia kuuluu minun / tiimini päätösvaltaa n
tiimin / työryhmän koostumus					
ristiriitojen ratkaisu					
henkilöstökoulutuksen sisältö ja määrä					
koulutukseen osallistuminen					
tiimin vetäjien / esimiesten valinta					
järjestyksen säilyminen tiimissä tai lähityöyhteisössä					
tiimin / työryhmän edustaminen ulospäin					
työtulosten arviointimenetelmät					
työyhteisön johtamiskäytännöt					
työaikani					
palkka- ja palkkiokäytännöt					

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