The Future Role of Trust in Work –
The Key Success Factor for Mobile Productivity

Optimising the knowledge supply-chain

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Microsoft®

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FOREWORD – Alistair Baker, Managing Director Microsoft Ltd and Vice President Microsoft EMEA

Microsoft launched its project, Tomorrow's Work, in 2003 because we wanted to challenge and inform our own views on the future of work. In particular, we wanted to participate in an active discussion with other experts about the issues this raises for British business.

In addition to our own work in this field through initiatives such as the Information Worker Productivity Council[1], we wanted to work with other experts to understand better how our software innovation coupled with breakthroughs from hardware, telecommunication and service partners could enable UK businesses to lead this transformation of work; improve business productivity and gain vital competitive advantage in world markets.

To support the Tomorrow's Work project, two research papers have been commissioned by Microsoft. The first from Carsten Sørensen at the London School of Economics (LSE), explores what British business needs to do from a structural and management perspective to see significant productivity gains from technology adoption. He has looked in detail specifically at the effect of communication and collaboration technologies - a subject high on the business and government agenda.

The second research paper from Henley Management College is to be released in early 2005 and will look into the management practices critical for success in an increasingly mobile and flexible workplace.

It is clear to us that Tomorrow's Work and workplace will not conform to traditional definitions. Technology has already radically changed the face of British business, and in many ways we have only seen the tip of the iceberg. We believe that the first ten years of this new century will see more technological innovation than we saw in the last fifty years. Many of these advancements will be felt first and most acutely in business.

For many years though there have been frustrations about the productivity gains achieved by British business when compared with other leading economies when you consider the relatively high levels of IT investment. This report from the LSE shows that the IT industry and British business must work together to overcome this if productivity gains are to be experienced.

Technology companies like Microsoft must continue to invest in innovation and commit to continued improvement in the tools we create for business. We need to combine listening to the needs of business with our annual investment of over $6.8 billion in R&D to ensure our innovation is rooted in the needs of business and reflects the social changes we see in the future. We must combine this with thinking deeply about the context in which these technologies operate to ensure British businesses full potential can be realised.

The last few years alone have seen an incredible rise in the availability and use of core technologies in business. Mobile telephony and data, the Internet, mobile computing, broadband and wireless are changing the face of

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[1] *The Information Work Productivity Institute (IWPI) and its governing body, the Information Work Productivity Council, is an independent group of companies and academics that have joined together to study the issue of information work productivity and profitability. The goal of the Institute is to build a model that measures productivity in the information centric business environment of the 21st century. Productivity gains in this decade and beyond will come from understanding organisational capital encompassing people, processes, infrastructures and the enablers of technology and services. Sponsors of the Information Work Productivity Institute and Information Work Productivity Council include Accenture, Capital One, Cisco Systems, Hewlett Packard, Intel, Microsoft and Xerox. For more information visit: http://www.iwproductivity.org/*

businesses of all sizes. Most importantly they are making it possible for our workforces to leave the ivory tower of their office and improve their service and responsiveness by getting closer to customers and partners.

Microsoft has a strong reputation in personal productivity. But the growth of these communication and collaboration technologies has meant we are now focused on putting the needs of the individual information worker into the broader context of both team and organisational productivity - combining these effectively is critical for business success.

We believe Microsoft® Office is a good example of how this has influenced our approach. Microsoft Office started as a suite of standalone applications for the individual authoring of documents. With the growth of collaboration and communication technologies it evolved to be an integrated personal productivity suite and today it enables individuals, teams and organisations to collaborate and communicate effortlessly across operational, geographical and corporate boundaries.

Concurrently with this innovation in technology, business must look closely at how it is changing its working practices and management principles in response to these innovations. In particular (as Carsten points out), we must breakdown the historical command and control management ethos that is present in many British businesses. Without this fundamental change, no amount of IT investment, however innovative will deliver the desired productivity gains we must see to keep Britain competitive.

British business and technology companies are in the productivity challenge together.

EXECUTIVE SUMMARY

THE CHANGING WORLD OF WORK

We are now in the midst of dramatic change to our working lives. Previously we worked in the hierarchical organisation - optimised for mass production of standardised goods. Now networks of relationships are optimised for delivering highly customised innovative goods and services - in a highly complex and uncertain business environment. This has profound consequences for the world of work.

As production and consumption come closer together, employees need to be closer to the consumer. Customer service is therefore growing in importance and as it emerges spontaneously in a dialogue with the customer it cannot simply be conducted in a pre-programmed and centralised fashion.

The overall value of email, fixed-line telephones, faxes and mobile phones has been to creatively destruct rigid organisational structures, making employees more responsive to market needs. But in our attempts to destroy the hierarchical organisation, the challenge will be what we replace it with.

THE CHALLENGE OF THE SUPPLY CHAIN

In the last quarter of the 20th century, supply chain management has brought benefits for all. Lower prices, new business opportunities and new products are among the results of the industrial revolution's supply chain innovations. We are now reaching a situation where the management and creation of knowledge represents the next natural place to seek productivity improvements. The *knowledge supply chain* ties together interdependent knowledge or information workers just as the manufacturing supply chain links together parts and sub-assemblies into the final product – it's just as vital to get this right for business success today.

Optimising the knowledge supply chain is about allowing people to work together and exchange knowledge no matter when and where they need to. For example, two people can optimise their work in the knowledge supply chain by emailing documents to each other and working collaboratively on the documents, using tracked changes to see what the other person has done.

We can no longer rely on a fixed definition of the workplace as a place with clear boundaries. Most importantly, the workplace revolution challenges the idea that the only way work can be managed is through direct supervision and control. If a person is hired to innovate jointly with colleagues, then for a manager to tell them how to do this defies the whole purpose of their job. If a person is hired to deliver services to customers then the work may only be directly controlled to the extent that the services can be codified and standardised - which in most cases will be limited.

Armed with state-of-the-art technologies and located exactly where they either need to or want to be, knowledge supply chain participants can make the necessary decisions simply by contacting the appropriate customers, colleagues or organisational resources. It is at the front-line of the supply chain the decisions emerge; they cannot be decided in detail beforehand. It is, therefore unreasonable to imagine that the management of the knowledge supply chain can be based on old management dictums of command and control.

Despite working much less hours, the rest of Europe is more productive than the UK because these countries generally employ better skilled labour, are better at organising work and at using information technology to promote efficiency. **To continue to compete in this evolving world, UK businesses must invest more in their workforces, improve flexibility and most importantly, redefine the traditional hierarchical order of command and control in order to become more productive.**

INFORMATION OVERLOAD

There are substantial technical challenges involved in optimising manufacturing supply chains. However, optimising the knowledge supply chain is a far greater challenge as it involves monitoring and managing people, not components and sub-assemblies.

One of the key advancements in supply chain management is that technology makes it possible to monitor the progress of each element in the chain. Similarly, mobile and ubiquitous technologies will increasingly make it possible to monitor the work going into the knowledge supply chain. This is a double-edged sword. On the one side, managers will see an advantage in obtaining insight in the performance of key information workers. At the same time these information workers, since they will seek to

coordinate their highly distributed activities, will need precise information from and about co-workers.

Effective management will rely on this insight or transparency into the work performed. Effective coordination of work between colleagues will require the ability to effectively coordinate what exactly is going on at each stage in the process. Together these challenges are a compelling argument for increased monitoring of the knowledge supply chain.

However, to maximise the efficiency of the knowledge supply chain we need to enable employees to make decisions they feel are the right ones and extend the reach of the organisation to wherever the information workers are – without excessive monitoring or micromanagement. The organisation must extend its reach to manage mobile information workers, but more importantly also be able to offer the full strength of the organisation at the point of contact for the customer, and this calls for a different kind of employee and a different management ethos.

The old organisational hierarchies proved not only a hindrance to increased responsiveness and productivity, they also protected us against unnecessary communication. Flat organisations protect no one. While individual emails, texts, faxes, instant messages all have value, the sheer volume of communication is an increasing problem. We are all facing information overload. Information overload means we are aware of everything but can do nothing – as we are constantly reacting to multiple communication channels.

THE DEMANDS OF THE MOBILE ORGANISATION

The service economy demands innovative creative solutions and clever resourceful people. Self-starters will be more in demand than ever before. Companies will need to have employees that work without the need for close monitoring and have their own supply of motivation.

In this situation, where and when we work can no longer easily be managed by someone else but will much more be up to ourselves and will emerge in negotiations with the people we critically depend upon to accomplish our tasks. In the 21st Century, what for most people constitutes a normal job will be quite difficult to define.

To tackle information overload people should be allowed to reduce the amount of communication they engage in. However, this presents another issue in an increasingly mobile economy – that of trust. When workers were located in offices it was easy to see if they were working. If people aren't in the office and aren't responding instantly on email or Instant Messenger, their phones going through to voicemail, how do you know they are working?

This shift implies that managers can no longer exclusively rely on direct command and control of subordinates, and instead calls for the cultivation of coordination practices in an environment of trust. We need technologies that support us in effectively making decisions together. Email, mobile phones, and Instant Messaging are all very easy to use. However, they often represent additional work, sorting out unnecessary details.

Workflow management technologies or similar types of systems however substantially help us do work - as opposed to talking about it. They stipulate who should do what, and offer more than merely an open communication channel. However, too much reliance on these may run the risk of imposing too tight rules and regulations on how distributed activities are carried out, and they are generally much more difficult to make work.

Optimising the knowledge supply chain must be a carefully negotiated balance between providing the flexibility and ease of use of networking services such as mobile phone conversations, SMS, and email, with more substantial collaborative services that directly help us coordinate distributed work activities.

The future requires technology to facilitate collaboration and replicate some of the face-to-face contacts and social interaction that were common in the hierarchical office based organisation. But collaborative services are much more problematic to assimilate into the daily practices precisely because they attempt something potentially very difficult - technically replicating, representing or modelling social behaviour or even more challengingly, attempting to modify it.

The initial hurdles to implementing collaborative services are higher than those for communication services. This is one of the reasons for mobile phones and email gaining an immense success with little or no organisational push whereas workflow management technologies needs constant push and attention to succeed. But, once successfully implemented in the organisation, collaborative services can form the infrastructure of an efficient organisation and significantly help in optimising the knowledge supply chain.

Introduced correctly it will be seen as beneficial for both sides and trust is key to this. Within work, if individuals are managed by outcomes with collaborative technologies supporting them and trust that the information collected will not be abused with monitoring systems looking only at outcomes, then increased monitoring will be accepted.

THE CRUCIAL ROLE OF TRUST

Lack of mutual trust can lead to severe consequences for all parties in the knowledge supply chain. If employees perceive that they are being watched too closely or that the information being collected is not being used appropriately, they will find ways round monitoring. As one of Murphy's Laws states, "Nothing is foolproof because fools are so ingenious." If the monitoring isn't trusted and is subverted, then company metrics could become unreliable and the integrity of the whole knowledge supply chain suffers. As the validity of the information in any supply chain management system is key to its value, this could lead to very unfortunate business consequences.

The issue of trust cuts both ways. Management must relinquish some of the control of direct observation and management through face-to-face socialising. Instead they will be forced to trust information workers as they can create more value by leaving offices and cubicles and venturing into the marketplace where they can provide their services much more effectively, defining their own work context.

A lack of trust can easily result in efficiency gains being lost as mobile information workers engage in bureaucratic activities to demonstrate their efficiency and cover their own back in a system they do not trust. A lack of mutual trust could force information workers into a permanent state of exposure, engaging in endless communication with the sole purpose of demonstrating that they are working. As one of the essential aspects of knowledge work is that it desperately needs time for reflection and experimentation with the risk of failure without consequences, this could have unfortunate outcomes for British businesses.

Unfortunately, there are no easy ways of shortcutting the process of cultivating mutual trust in organisations. It is all about ensuring that information workers and managers apply appropriate ethics and reward mechanisms when re-defining the way work is done. Trust is at the best of times highly fragile in years of good faith and can be broken relatively

easily. Therefore retaining it will be the key business challenge of the 21st century.

Global markets demand flexible mobile working - supporting the needed flexibility to offer enterprise services where and when they are needed. At the same time employees are requesting flexible working arrangements because they are more suitable to modern living. This circle can only be squared if the organisation mobilises and effectivises information- and knowledge work as it also improves and reinvents the ways work is managed.

This can for example be accomplished through allowing information workers to define their own more appropriate conditions for creating and sharing knowledge in self-organising networks of interdependent colleagues. While at the same time ensuring there is sufficient management of work performance through the use of information and communication technology. All of this can only happen if knowledge is created and shared in an environment of trust and fairness.

Ultimately the consequences for British business are severe if trust continues to be eroded. What appears to be merely an ethical goal is, as we've seen one with profound implications for the future of the UK economy. The lower productivity of Britain compared to continental Europe already demonstrates the risk. If we continue to introduce communication technology without the supporting collaboration tools and management practices, we are likely to end up less productive than ever - drowning under the sheer weight of communication. Only by having the vision and foresight to realise that more communication and control does not equate to greater efficiency can we grapple with the new challenges of the global economy.

UK business must learn to trust their employees to define their own working contexts and in turn they can request the employees to trust that measurements and mechanisms of performance evaluation and effective co-ordination will be applied in a fair and ethical manner. This leads all stakeholders into the unknown where there is everywhere to go and nowhere to hide.

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OPTIMISING INFORMATION WORK

The application of information and communication technologies has traditionally been associated with the automation of manual labour - their reengineering and streamlining represent a strong force where fierce competition forces manufacturing companies to lower costs - through optimising the manufacturing supply chain. Organising complex manufacturing requires planning and control and this has traditionally been conducted in a hierarchical system. Recent years have seen significant changes where the organisational arrangements of the manufacturing supply chain have been embedded into various forms of technology-based systems, such as ERP, Just-In-Time and MRP II.

However, as manufacturing increasingly relies on continuous innovation - at the cost of employment in manufacturing and primary industries - and conversely, the percentage of people producing and delivering services increases, the emphasis on productivity is shifting from the manufacturing supply chain to the *knowledge supply chain*. **What matters is how we can organise our collaboration, in terms of meetings, communication and work so we together can innovate or deliver services.**

We conduct more and more of our work through virtual means such as the telephone, the Internet etc. This virtualisation of work in turn with recent technological developments has led to a mobile revolution putting a mobile phone in the hand and a notebook on the lap of information and communication workers and thereby enabling extensive support for mobile working. It is therefore essential for modern information and communication workers to be able to move to where they are needed to engage in intense collaboration with project partners, to negotiate contractual arrangements or to deliver services to clients and customers.

This report raises essential questions regarding the future of information and communication work such as the challenges of mobile and remote working supported by advanced information and communication technologies. When work is out where the collaborators and the clients are, and not inside the familiar office, how do we then manage each other? How do we enable distributed sharing of knowledge? What issues will we need to tackle in order to gain further productivity gains in information work?

DISTANCE AND MOBILITY

In 1997 Cairncross pronounced the death of distance in that the cost of electronic communication decreasingly depends on the distance [5]. However, as argued by Olson and Olson, "distance matters" [42]. We simply can not naïvely assume that interacting and working together can be done as easily at a distance as when we are located in the same room or building. Conducting business in an increasingly complex and uncertain world, however, requires highly complex patterns of collaboration and interaction across small and large distances. The advent of communication technologies was followed by predictions that business travel would reduce since work could be conducted at a distance. However, business travelling kept soaring and the world is experiencing flexible and mobile working like never before, for example with more than 300,000 people in flight above USA at any time [57; 58]. Furthermore, **work is becoming increasingly dependent upon people and not only the information moving. We can therefore proclaim that *distance is dead, long live going places!***

Our management of information, interaction, knowledge and personal relations is increasingly supported by advanced technologies, making these attributes available to us wherever we are. The past thirty years has therefore brought our information processing from the tightly controlled and impersonal

mainframe bunkers, through to individual PCs on desks, laptops and a variety of small hand-held devices. Looking at this long view, it appears that quite radical change has occurred smoothly. However, some of the issues that were relevant already in the 1960s debate on surveillance of citizens are still relevant today, and perhaps more so now. Furthermore, there are a range of emerging issues indicating that when we move from organisationally embedded to socially embedded information and communication technologies, then we also meet new challenges in the relationship between humans and technology.

Let us for the sake of argument look at a specific and very popular technology - the telephone. The telephone has served many purposes through its long history, as a means for communicating short business messages, which was Edison's original idea, or as an essential psychological life-line between relatives and friends separated by great distances. Cutting the wire and replacing the ordinary telephone with a mobile one can naïvely be seen as a minor change, and certainly one that will only bring benefits to the users in general. If however, we consider that one of the key properties of the stationary phone is that each person using it would know *where* the other person is, then the mobile phone raises a whole range of new issues. If a person does not answer a fixed-line phone we can assume that they are not at home or that they may be away from the phone temporarily. The mobile phone brings with it the promise that the person we call will carry the phone and therefore automatically will reply. If a person does not pick up a mobile phone call they would probably later on need to justify this. In their private lives, people would be assumed to make their own informed choices as to whether or not they reply to a mobile phone call.

However, in the context of contractual arrangements such as those we engage in when we work for an organisation or for clients, there is a social expectation for us to answer calls. The opportunity for people to call us on our mobile phone automatically raises the question of where we are and what we are doing both when we answer and when we do not. Although mediated interaction has been around since the telegraph and the fixed-line telephone, we are here used to the long-established conventions of face-to-face interaction that we at least know where the other person is situated if we call.

THE FUTURE OF WORK

WHAT IS A NORMAL JOB?

We are in the midst of radical changes to the way we conduct and organise most work. In particular, more and more work is information work, and most of us generally use computers on a daily basis as an integral part of our work [9; 38]. Our notion of what constitutes a so-called "normal job" is rapidly going out of fashion. Farmers shook their heads in disbelief when they saw the young men and women head for the brand new factories in the cities of the industrial revolution "why are you going there? How are you going to find food to eat?" Work was then intrinsically linked to farming the land and all other jobs, apart from the priest and the schoolteacher seemed rather suspicious occupations. Work in factories rapidly took over in defining what constituted "normal work". Manufacturing replaced farming as the primary occupation, then since World War II it was replaced by the services industry. **In the 21st Century, what for most people constitutes a normal job can be quite difficult to define.** In a survey of the Californian workforce in 1999, only 33% of the sample fitted the description of having one, single day-shift, year round, permanent employment paid for by the firm for which the work is done and not working from home [Study cited from p. 95ff, 10]. Adding the additional criteria of three or more years of tenure within the same firm reduced the matching sample to 22%. There is no doubt about the fact that the world of work structurally has changed dramatically over the past fifty years, and it is continuing to do so. People do not expect to do the same job for many years, within the same organisation, at a fixed workstation and between 9 and 5.

MANAGING THE DISTRIBUTED ORGANISATION

So, what is happening here? How can we characterise these radical changes and what challenges do they impose on the conduct, organisation and technological support of work?

Firstly, it is important to recognise that the radical change is an interactive process. The demands on people and organisations drive changes in the organisation of work, but are themselves changed by technological developments. As argued by JoAnne Yates discussing the birth of modern scientific management in North American large businesses

between 1850 and 1920, several of the technologies critical to this development of the fundamentals in modern management were already around long before but their utility was simply not recognised as there was no pressure to adopt them. One of the driving factors of technological innovation was the shift from small and medium-sized factories where the owners directly could supervise operations, to large-scale distributed firms where it simply was impossible for the owners or shareholders to keep an eye on the day-to-day operations. The most notable examples are the railway and oil companies. One of the attempts by the railway tycoons to keep an eye on the state of affairs was of course to spend a significant proportion of their time in luxuriously decorated train cars. In the long run this strategy proved impossible. Systems and information technologies were put into place that basically ensured a smoother running and management of the organisations through systematic collection of operations data from the field as well as through top-down systems ensuring that everybody in the organisation was generally informed and received appropriate instructions. **Systematic use of information systems ensured the centralised organisation of work could be conducted across great distances. Systematic use of centralised systems ensured the smooth running of hierarchical organisations. The challenge is now to devise decentralised technologies for decentralised technologies.**

INFORMATION INTENSITY IN WORK

Companies could only grow from small to large through centralising their decision-making. This centralisation subsequently became a hindrance for effective decision-making when faced with the uncertainties of modern world demands. Information and communication technologies play an essential role in ensuring that large organisations can organise their knowledge supply chain in a de-centralised manner. The technologies primarily do so by ensuring cheap means for coordinating activities. However, even if big does not necessarily mean centralised, we still need to work out how to conduct and manage de-centralised work. The centralised organisation of work responds quite well to Mintzberg's [36] machine bureaucracy where decision-making is conducted in a bureaucratic and centralised manner through programmed processing [34]. Since there was relatively little uncertainty and complexity, it made sense to centralise decision-making and to establish fairly stable systems dictating appropriate action.

Organisations respond to environmental uncertainties using networking services such as email, mobile phones, faxes and instant messaging.

Zooming forward to the 21st Century, we are now experiencing a world where work is not only geographically distributed; it is also conducted in a complex and uncertain environment. When the focus is on the production and consumption of services we are no longer in the safe haven of predictable production to a warehouse according to plans set out for two or five years at a time. **Services cannot be stored in warehouses ready for shipment. They emerge real time with the customer. Service work can not be conducted in a pre-programmed and centralised fashion, but must rely on an "ad hocracy" where decisions are made in a distributed and emergent manner.** The answers cannot be decided and written down beforehand, but must be negotiated in the situation by those who have the freshest information. This has led to a re-orientation of the way we understand business strategy where the top-down view of strategy has been supplemented by a much more bottom-orientated view lending more importance to local innovation and adjustment and relatively less to decisions made exclusively in the boardrooms [11; 13; 30]. Corporate strategies for change increasingly involve bottom-up processes supporting localised innovation [30].

WEIGHTLESS VALUE

All these developments have led to information as a strategic entity. As Coyle and Quah [15] argue, the economy is becoming weightless in the sense that value is less and less directly related to the physical mass. Value is more and more related to intangibles such as innovation, creativity, intelligence etc. The information or service society still relies critically on manufactured goods, but the value of these goods are as much related to ephemeral aspects such as brand, innovativeness, informational aspects, and associated services. We can add value to the good-old toaster by sticking a computer inside it allowing customers to toast frozen bread or to connect it to a computer in order to select a range of popular cartoon images to be toasted onto the bread. **Much of the technological development of the past decades relates to the increasing information intensity of innovation at work**. It has been estimated that the yearly combined amount of new information produced in the world stored on magnetic media represent an average of 800 MB of

information for each of the 6.3 billion inhabitants [27]. Along with intensification of the amount of information used in most aspects of working life, the nature of the information and the ways in which we process and present the information is also changing. From structured information centrally compiled into reports towards much more decentralised collection, interpretation and compilation of data relevant for particular stakeholders to make sense of their work. The spreadsheet perhaps represents the best example through its generic canvas for defining simulations and small databases. Perhaps more interestingly, there is a dramatic increase in information flows through electronic channels such as telephone, radio, TV and the Internet. Around 98% of the information transmitted electronically is on landline and mobile phone calls. Instant messaging has been estimated to generate five billion messages or 750GB each day globally during 2003 and e-mail is thought to generate around 400,000 terabytes of new information each year [27].

THE PRICE OF COMMUNICATING

When our forefathers and mothers moved from the rural areas and into the modern world of factories, they were forced to accept radical changes to the ways they would live and work in the villages and on the farms. Strict functional divisions of labour and direct supervision and control of work became integral parts of the new life in the industrial cities. Everyday life became directly governed by time carefully measured and managed. Geographically, work was through division of labour often restricted to workstations and generally situated within the physical boundaries of the factory. Out of this emerged the scientific management of work and the importance of middle-management bridging the shop-floor operations and the executive office strategies.

We are now in the midst of another dramatic change to our working lives when we move from the hierarchical organisation optimised for mass-production of standardised goods, to networks of relationships optimised for delivering highly customised innovation-based products and services in a highly complex and uncertain business environment [32]. In this new world the boundaries of work are much more difficult to define. Narrowly defined roles and work places do not match the ever-shifting world in which we work. Where and when we do work can no longer easily be managed by someone else but will much more be up to ourselves and will emerge in

negotiations with the people we critically depend upon to accomplish our tasks. This new industrial revolution challenges a range of our most basic assumptions about work. The nature of work is challenged through the emphasis on ephemeral value of services as opposed to the tangible goods of the industrial society. We can no longer rely on a fixed definition of the workplace as a clearly marked out office or work station. **Most importantly, the new revolution challenges the idea that the only way work can be managed is through direct supervision and control.** If a person is hired to jointly with colleagues innovate, then a manager telling him or her what to do would defy the whole purpose of the job. If a person is hired to deliver services to customers then work may be directly controlled to the extent that the services can be codified and standardised. However, services will often be delivered and consumed where the customers are and will often need to be defined through customer-provider interaction. Services that can easily be codified and standardised are encounters and these can only accommodate relatively simple needs, whereas complex service needs call for engaging in service relationships fostering trust [19].

Malone argues that the main reason we now can engage in much more flexible ways of working is the dramatic decline in the price of communicating and co-ordinating [32]. Malone argues that the centralised system of organising work as seen in the large corporations of the 20th Century represented the only feasible solution since the means of communication were relatively slow and expensive. Malone further argues that the radically decreasing communication costs now enable organisations to form decentralised networks as replacements for the centralised organisational arrangements of command-and-control, where work was carried out and hence could be managed within the narrow confines of the a factory site or office.

The telephone and the modern postal system have the past decade been supplemented with the Internet with hosting email and web-based technologies driving the cost of communication almost to zero. The mobile phone has become a ubiquitous business tool offering a flexible means of communicating and accessing data. Emerging technologies such as Voice over IP (VoIP) is poised to make the step further by reducing voice-costs.

OPTIMISING MANUFACTURING SUPPLY CHAINS

The heart of manufacturing operations is the supply chain, which orchestrates the movement of parts and sub-assemblies. One of the main innovations contributing to increased productivity in manufacturing is technology support for coordinating highly distributed supply chains. Manufacturing Resource Planning (MRP II), Just-in-time (JIT), and lean manufacturing are just some of the essential concepts that characterise these efforts to make the manufacture, assembly and distribution of goods cheaper, faster and deliver higher quality. Optimising the manufacturing supply chain involves the core element of representing the supply chain in information and communication technologies such as Enterprise Resource Planning (ERP) systems in order to ensure streamlined operations across organisational boundaries. What characterises the manufacturing supply chain is exactly that it increasingly ties together mutually interdependent parts across geographical distances and across simple organisational units defined by ownership [50]. It has been a major challenge to represent the physical movement of parts and sub-assemblies inside information systems and to optimise this process according to forecasts or actual orders pulling the parts and the ability of the supply chain to push the products along. It has critically relied on complex infrastructure technologies enabling smooth transition of data across organisational and departmental boundaries and the Internet has played an important role as setting a basic standard for communication. As a result of this effort, manufacturing organisations has managed through technology investments to optimise the manufacturing supply chain enabling speedy delivery of cheap high-quality goods.

OPTIMISING THE KNOWLEDGE SUPPLY CHAIN

In this paper I coin the term the "knowledge supply chain" a shorthand to explain that the primary challenge for organisations now is to support and effectivise information work. Innovation processes as well as the delivery of services critically depends on the proper management of organisational knowledge [40], and for most organisations the arrangement and support of information or information workers is a primary concern. Looking at the management of knowledge in terms of optimising a knowledge supply chain provides us with a strong metaphor for

what we are attempting to obtain . It also potentially can mislead us to believe that the effort is identical to the one successfully accomplished in manufacturing.

Let us begin with the positive aspects of considering the strategic task of rendering information work more effective through perceiving the project as optimising the knowledge supply chain. **The knowledge supply chain shifts the focus from thinking about information work in terms of people sitting in the same office within the same building owned by the same organisation. When people provide services they need to engage in networking activities with a range of other persons potentially from all over the place.** When they innovate together in projects then they will work together with people holding crucial expertise. The knowledge supply chain signals that organisations need to support people in negotiating their mutual interdependencies and exchanging knowledge across organisational boundaries - not just with people in the same office. This is similar to the organisation of the manufacturing supply chain with a number of independent suppliers forming an integral part of the supply chain. **The knowledge supply chain ties together interdependent information workers similarly to the manufacturing supply chain linking together parts and sub-assemblies into the final product.**

The contemporary focus on communities of practice illustrates the move in organisations from considering knowledge as a commodity to be codified and stored in databases, to being results of ongoing social processes between people who possess the knowledge [14; 39]. Whereas much of the information needed to optimise the manufacturing can be fixed when actual orders come in or when forecasts have been made, knowledge critical for innovation or for the provision of services is emergent, which means that it appears as a result of the process [20]. **The knowledge supply chain will always be governed by an element of uncertainty making the generation of new information essential [34].**

Optimising the knowledge supply chain therefore implies using information and communication technologies to allow people to work together and exchange knowledge no matter when and where they need to. Technologies such as email, web-servers, mobile phones, PC applications etc. already provide such support. **Two people forming a small link in a larger knowledge supply chain can optimise their work together by emailing**

documents to each other and collaboratively work on the documents. Through tracked changes they can see what the other person has done.

The essential feature of optimising the knowledge supply chain is precisely to represent, support, model and optimise the negotiation of interdependencies and the collaborative production of documents, ideas etc. There are two essential organisational elements in this exchange of knowledge, namely the extent of *economic exchange* and the extent of *social control*.

If the exchange of knowledge in one element of the supply chain is governed by a high degree of social exchange and a low degree of economic exchange, then the supply chain critically relies on hiring experts and retaining them within the organisation – they are so strategically important for the organisation that they become *prisoners* in a hierarchy where the knowledge supply chain facilitates the communication of knowledge through sedimentation [49]. A good example of this is the traditional way of organising information work with the traditional hierarchical organisations offering jobs for life.
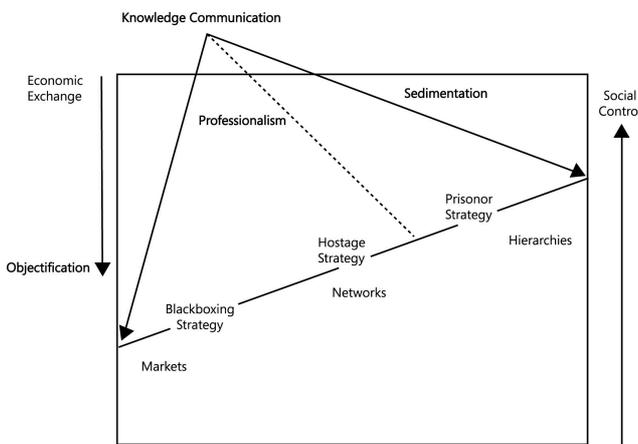

Figure 1: *Scarbrough's [49] model characterising types of knowledge communication based on dimensions of social control and economic exchange*

If the supply chain critically relies on the expertise but not necessarily for an extended length of time, for example if key-expertise is brought in to innovate the organisation, the exchange of knowledge is one governed partly by economic exchange and partly by social control. The information worker is here a *hostage* that through established professionalism exchanges knowledge in networks. Extensive use of management and technology consultants, and the extensive use of freelance information workers both

demonstrate the hostage strategy in inter- and intra-organisational networks.

If elements of the knowledge supply chain can be subjected to objectification, which means that the necessary knowledge to be exchanged and communicated can be codified and embedded fully in technology, then the knowledge can be communicated through a high degree of economic exchange and a low degree of social control. This *black-boxing* strategy enables knowledge to be communicated in a market. The extensive use of standard application packages or commercial-off-the-shelf (COTS) technology has been a highly successful way of ensuring the effective exchange of knowledge through black-boxing.

CHALLENGES WHEN OPTIMISING KNOWLEDGE SUPPLY CHAINS

Managing the knowledge supply chain in networks of relationships mediated through information and communication technologies challenges both managerial wisdoms of control and operational assumptions of privacy and control directly linked to observation [31; 65]. Armed with state-of-the-art technologies and located exactly where they either need to or want to be, knowledge supply chain participants can make the necessary decisions simply by contacting the appropriate customers, colleagues or organisational resources. **It is at the front-line of the supply chain that decisions emerge - they cannot be decided in detail beforehand. It is, therefore unreasonable to imagine that the management of the knowledge supply chain can be based on old dictums of command and control.** Management implies supporting the appropriate coordination of geographically distributed activities and the cultivation of the organisation to function as an effective unit [31]. This shift implies that managers can no longer rely on direct command and control of subordinates. Conversely, it also implies that members of the organisation no longer can rely on the same levels of individual privacy at work since the effective coordination of remote and mobile work activities critically rely on others knowing what exactly is going on. The changes, therefore critically rely on all parties adapting to work becoming mobile and de-centralised. Changing expectations of management from constant pro-active decision-making to facilitation of a tightly coordinated knowledge supply chain and cultivation of the appropriate environment marks a significant challenge. Similarly, challenging

the expectations of organisational members to willingly share details regarding their daily activities and whereabouts challenges the expectations of the right to privacy at work and to organise work activities according to the perceived need. However, as the management relinquishes some of its direct supervision and control when work becomes mobile, the need for efficient coordination and governance requires both colleagues and management to gain insight in detailed information previously considered private. Changing one without the other will result in a mismatch jeopardising the whole effort. Unilaterally relinquishing control can lead to lack of proper management and control. Unilaterally relinquishing information worker privacy will foster a surveillance culture where detailed information about activities and whereabouts is used for detailed managerial decisions.

In order for us to re-invent information work and to maximise the efficiency of the knowledge supply chain we need to both enable organisation members to make decisions they feel are the right ones as well as to extend the strategic reach of the organisation to wherever the information workers are. The organisation must extend its reach both to be able to manage mobile information workers, but more importantly also to be able to offer the full strength of the organisation at the point of contact for the customer.

One of the main challenges for businesses shifting from a centralised way of operating to engaging in shifting networks of relationships is optimising the knowledge supply chain. It is, however, not possible to treat the management of knowledge among information workers as a strict supply chain similar to the ones managing the material flows in and across factories. The most obvious difference between the two supply chains is that modelling and optimising the flow of parts and sub-assemblies can be conducted without these parts and sub-assemblies minding in the least. The car-seats for a BMW will not complain that it now suddenly need to spend less time in a warehouse waiting with 2000 other seats to be shipped to the assembly factory. Optimising the knowledge supply chain, however, is not only a matter of organising knowledge that already has been objectified through a black-boxing strategy [49]. It is the much more critical matter of optimising processes critically depending on social control. This implies that optimising the knowledge supply chain can only be conducted through some form of representing, modelling, supporting and optimising information worker activities. However, contrary to

the BMW car seats, people *do* care very much about how they are represented in systems. The recording of detailed information about their activities and outcomes of their work can be made subject of assessments regarding their performance.

Now, obviously this issue has previously been managed through organising the knowledge supply chain more or less within the same building where work can be managed and supervised through direct inspection and potential conflicts can be resolved through people socialising. However, current developments where information work becomes mobile and distributed in virtual teams fundamentally challenges the viability of direct supervision as a means of managing information work. The pressure to create mobile ways of working can then result in either less efficient management of work or technology-supported management of work. Obviously, this intensifies the whole issue of ensuring that recruitment and retention processes within firms are able to secure information workers who are highly motivated and who will not require intensive direct management and control. However, it is not likely that human resource practices alone can address this problem.

Managing the "invisible" information worker and providing substantial support for them to collaborate effectively is at the core of optimising the knowledge supply chain. This can only be accomplished through the use of information and communication technologies that represent aspects of the knowledge supply chain in technological systems.

THE MOBILE ORGANISATION

PHONE EXAMPLE

Imagine two engineers walking towards each other along a hallway in a Swedish mobile phone organisation. They know each other quite well as colleagues through a few years. They are each speaking on the phone and as they pass each other in the narrow hallway they smile and nod and one of them makes a funny remark on the fact that they are indeed speaking to each other on the phone but still decide to continue walking as they both are expected at meetings in the building. This image is quite telling for much contemporary work. Office work that is not conducted in offices and work that is not conducted in silence but indeed talking is an essential element of much work. Manufacturing goods requires careful

engineering and inwards attention. Providing services to customers requires reaching out and listening.

VIRTUALISATION

One of the most essential and often neglected fundamental changes is the virtualisation of work. Our activities are for a variety of reasons carried out through technology instead of exclusively face-to-face. We interact directly through the phone, email, SMS, and voicemail, and we interact indirectly through meeting scheduling systems, workflow management systems and through up/downloading documents from shared file-servers. One of the characteristics of this virtualisation of work is that it is not exclusively a phenomenon found in high-tech knowledge-intensive organisations – it transcends sectors, organisations of all types and different roles within organisations.

Mobile phones are used by building site contractors, plumbers, council street-cleaners, management consultants, engineers, marketing executives and shopkeepers. The laptop is a ubiquitous part of a range of jobs and where information workers cannot find a stable resting-place for a laptop, they use hand-held devices or tablets. However, virtualisation goes far beyond immediate interaction between people. The establishment of standardised systems supporting the management of work also led to virtualisation of work for example when we do not meet people we work with but only observe their contribution to filling in forms in a distributed work-flow.

It is obvious that the virtualisation of work has led to effective working. The independent contractor does not need an office with a receptionist, but can through a mobile phone conduct basic scheduling and coordination tasks whilst working on a site. Many organisations seek to virtualise customer contact, most commonly through telephone access through call-centres. These illustrate the attempts to meet customer demands for extensive services whilst reducing costs. However, paradoxically the drive for better access to firms and better service, for example through 24-7 call-centres, also leads to the call for more personalised services [66]. It is not realistic to believe that the consumer and client of tomorrow is willing to accept an increasing automation and standardisation of services unless there are compelling economic arguments. They will demand some level of personalisation. Furthermore, with organisations increasingly focusing on sales, service and marketing, the direct personal interaction with

key people can both ensure that they experience a high service-level as well as help the information worker better understand the real needs of the client. Our study in a multi-national bank in the Middle East clearly demonstrates the importance of bankers visiting key clients on a regular basis in order to socialise and to engage in critical negotiations [2]. Zuboff and Maxmin argue that the provision of proper personalised service represents a significant strategic challenge for the 21st Century business organisation [66].

If the virtualisation of work is viewed primarily as a means of rendering the operational aspects of connecting the organisation to its customers, then it can lead to the customers feeling that they are the ones paying the price. Virtualising work between colleagues, although implying a softening of geographical barriers for where work is conducted, also imposes the risk of alienating social relationships.

Both on a very practical level but also fundamentally in terms of how we experience the world there is an immense difference between talking to someone on a mobile phone and standing in front of the person. This virtualisation is fundamentally different from what we could call "*real-world*" interaction in that we mainly use one or two of our human senses - when we are on the phone or emailing we become a big ear or a big eye [24; 43]. When we engage whilst physically present, there is a very strong relationship between the content of our interaction and the context in which it takes place. We can see if the people we interact with are tired and we unconsciously can not help guessing what they think about us, and at the same time we, also unconsciously, present ourselves in the way we would like others to see us [17]. When we engage in virtualised interaction with colleagues or customers the link between the content of interaction and its context has been weakened in favour of a precise symbol system [23]. Although we of course can write what we wish in an SMS or email message, there is a well-defined symbol system and the separation between content and context can easily be identified when we engage in mobile phone conversations and try to re-connect our contexts by negotiating where we each are and what we are doing.

CONTEXT IS KING!

Information and communication workers are more and more busy interacting through a range of communication technologies; there is an increasing battle for their attention. The services society is a

"talk" society where services are rendered through intense interaction across geographical and temporal distances. People's attention and time is the limiting factor and they must dispense it wisely in order to be productive. This can be accomplished by virtualising the interaction for example through mobile phones, email and other communication means. It can also be done through partly automating the provision of services and through shifting some of the effort from the service provider to the client, as has been attempted in internet-banking. However, as we will argue later on, the careful management of where you are and whom you interact with will increasingly form the essential strategic choices for information and communication workers. Socialising is the hard capital of the mobile organisation. Context is king. Trust, experiences, service, emotions are all essential aspects of modern business.

CHOICES OF CONTEXT

An extensive study of mobile professionals in Tokyo clearly demonstrated how the use of laptops and mobile phones allowed the flexible design of socialising and working. A CEO of a small mobile services software house enjoyed gaining inspiration from nomadic treks around Tokyo and was in constant touch with his back-office. Similarly, an independent town-planner would make a policy of spending considerable time with client-municipalities, something he regarded a major source of competitive edge over his large competitors [21]. We have seen bankers from a global bank nurturing their most important clients through extensive travelling, where mobile access to client engagement data through wireless Pocket PCs both enabled the bankers to provide better information when meeting the clients, but also to provide accurate data strengthening their position in negotiations with the clients [2; 3].

21ST CENTURY FACTORIES

When work is supported by and organised within a complex hierarchical organisation clearly demarcating the individual's place and time of work as well as the specific tasks to be carried out, then there is relatively little need for individual management of interaction. For example when considering software developers we have studied who, based on relatively stable specifications, must produce parts of a technical system, then the main managerial challenge is to ensure that they are undisturbed and at the same time have sufficient access to negotiate mutual interdependencies amongst each other. This implies that the organisation will place the software developers in large open-space or cubicle areas with only very few stationary telephones and a ban on the use of mobile phones. Silent interaction through instant messaging or email ensures access to colleagues without disturbing others working, and meeting rooms provide the needed context for group discussions. In this respect, the software developers' environment constitutes the factory of the 21st Century manufacturing modern "machines" consisting of computer code.

ORGANISATIONAL HIERARCHIES PROTECT INDIVIDUALS

The organisational hierarchy protects the individual in terms of setting up rules, procedures and norms for whom they are allowed and expected to interact with. **The hierarchy is a mechanism supporting the coordination of work. The value of email, fixed-line telephones, faxes and mobile phones has exactly been that it supported members of organisations to creatively destruct [53] rigid organisational structures, thereby allowing the organisation to be more responsive to market needs through setting its members free.**

The future of work is flexible arrangements of work moving from centralised hierarchies to networks [9; 32]. The ease of communication allows flexible arrangements of work processes and the use of mobile technologies support an active choice of the physical context of interaction. This means that information and communication workers can decide to interact with colleagues and clients without having to be physically present - one of the commonly used reasons to adopt mobile information and communication technologies. However, if we place great importance on delivering personal services and if project-working is becoming more and more complex and critically dependent on the creation of new ideas in cross-functional teams, then the active choice of being in a particular place with a select group of people is a primary element of work of the future. This has of course always been an option since the advent of modern means of transportation, but has previously always come with the price of disengaging from all other contexts while being out and about. The traditional image shows us the jet-setting top executive who with the strategic outlook would not need to engage in day-to-day operational activities in the office, but instead was required in day-to-day circling the globe in order to understand and proactively influence the strategic order to

things. One of the main developments has been the addition of large groups of mobile professionals, who in the name of knowledge intensity and innovation must travel to actively offer their operational knowledge where it is needed.

CHOOSING CONTEXT OF INTERACTION

Our study of Arabian banking executives revealed a division of work making extensive travelling a necessity for a large group of banking professionals beyond the traditional top-executives. In the manufacture of goods or the provision of services, knowledge supply chains are increasingly distributed through international networks of innovation, collaboration or as a direct result of outsourcing. **The knowledge supply chain consists of fragile and complex elements that need intense human interaction to interconnect**. Knowledge supply chains only connected by procedures and codified knowledge will easily break when the codification in the model escapes the modelling. **Knowledge is all about keeping constantly in touch, sharing and contesting views. It is a fresh commodity and not simply something that can be stored indefinitely for later consumption.**

NETWORKS CREATE NEED FOR INTERACTION MANAGEMENT

When the organisational hierarchy is replaced by lean networking practices it allows people to create their own organisation. This is defined not through hierarchical wall-charts and job-titles, but through the knowledge supply chain as it unfolds when people meet to innovate and deliver services. Therefore it requires that people leave the safe haven of the organisational hierarchy and suddenly are all on their own armed with technologies connecting them to each other and to customers. When the main characteristic of work is interaction, collaboration, external contact and constant processing of information rather than working in relative isolation, and if this takes place outside the protection of the organisation, the information workers will need to solve the problems themselves.

This implies that one of the primary tasks of the modern mobile information worker is to manage his or her interaction. For people who are much sought after, this will represent such a big problem that they will need a personal assistant to shield them from the requests. Whereas the classic organisation enabled people to interact through telegraph, telephone, letters, and more recently through fax, the modern networked knowledge supply chain provides a wide range of interaction media to choose from. One of the characteristics of communication technologies is that they generally assume human interaction to be symmetrical. If we both have the same communication medium then we also equally wish to use it. However, just because two people have a mobile phone and each other's numbers does not automatically mean that they equally desire to speak to each other at any given point in time [22; 26]. One person may be in a meeting while the other attempts to engage in a conversation. What for one person is the right time to call is for the other quite disturbing. Each day we make a number of these choices. When to answer an email. Whether or not to answer at all. Should all phone calls be picked up or should some go directly to voicemail? Once during an interview with a personal assistant I asked if she ever chose not to pick up the phone. She answered, as most people would tend to do, that she generally always picked up the phone when at work – it's you duty etc. However, during the interview, which was conducted whilst she was working, the phone rang and she commented, "Oh, I am going to talk to her soon anyway, so I won't pick it up." We have probably all tried the game of "voice-mail-tennis" where we leave a message, which results in a message on our voicemail. This can go on for a while until there is a lucky break and we manage to speak to each other.

INDIVIDUAL STYLES IN MANAGING INTERACTION

Whereas interaction management to a large extent previously has been governed by organisational rules and policies, it now suddenly becomes the direct responsibility of the individual. The personalisation of technologies making them available wherever the information worker is located, also makes the choices of who to talk to when and how subject to highly individual preferences. Studies show that people handle large amounts of interaction differently, for example that some people simply must categorise and carefully deal with all emails whereas others are happy to pragmatically adjust the time they spend on each email to the amount of emails they get and therefore avoid getting overloaded [28; 29; 52]. Our studies clearly show that people experience both the advantages of being able to flexibly arrange their work and a great deal of frustration caused by the need to constantly juggle their availability and interaction with others. Although the foreign exchange traders at one of the largest Arabian banks

saw it as an advantage to engage in out of office trading, they also paid a high price in terms of always being available for disruptions when important financial events called them to work wherever they were.

INTERACTION IS ASSYMETRICAL

What we found in our studies was also the constant value judgements of when face-to-face interaction was needed in order to resolve problems, ensure contact and socialise, and when mediated interaction would better suit the situation. People were constantly designing their context and means of interaction. Solicitors provide a good example of the asymmetry of human interaction where they constantly seek to minimise the time they spend on interacting in order to effectivise the handling of client contact at the same time as they must ensure to document all important decisions. Solicitors will favour different means of interaction for contacting clients compared with the ones preferred for clients to get in touch with them. Writing letters and emails works well for both since the solicitor will employ an assistant for writing letters based on taped memos or face-to-face sessions. Voice-mails from clients are generally conceived as time-consuming although they can represent an important means for resolving uncertainties with clients.

MR 1000 EMAILS A DAY

A study of City of London professionals' use of information and communication technologies [54] showed investment experts preferring to keep in touch with their clients through instant messaging since it was a sufficiently lean and effective way of ensuring instant access without greatly cutting out other clients or indeed disturbing the natural flow of work. We also saw the example of one investment banker that processed around 1000 emails each day. Most of these were automatically generated based on positions monitored and were considered an effective way to filter vast amounts of information [55] [54].

EXTENDING THE REACH OF THE ORGANISATION

The access to corporate databases and to vital colleagues through mobile and wireless technologies not only represents a practical solution to a problem. The use of mobile technologies extends the reach of the organisation into remote contexts. The best illustration of this is the use of a variety of mobile information and communication technologies within the police. Only a minority of UK police officers are armed and their ability to manage the incidents they are thrown into is largely due to the ways in which the uniform, the car and the extensive information and communication technologies relate back to the police institution [33; 56]. The police radio signals that you may get away from this officer, but not from the ten other officers he or she will call. Similarly, commercial organisations can leverage their position through demonstrating that they are able to extend the reach of their knowledge supply chain to any context and not only from the reception and inwards.

LEARN FROM THE POLICE WHEN TO DISCONNECT

Perhaps the most extreme case of individual judgments of managing interaction we found was in the study of operational policing [56]. Their context of work often chooses them through calls from the public. Operational police officers are in the business of converting uncertainty into risk. They have a keen interest in knowing as much as possible about the scene of incident they are attending to be able to access the risks they may face. For them uncertainty can result in dangers both for them and for the people involved in the incident. They therefore naturally use a wide range of mobile information and communication technologies ensuring the best possible connection between the central control room, other police units and themselves. All of this happens in a hectic and noisy process of driving to the incident at high speed with blue lights and loud motor noise. Once at the incident officers will often rather hesitate slightly and ensure they have a good understanding of the situation before entering the scene. They use mobile phones extensively; even their own private phones, and they of course also rely heavily on their personal radio. However, one thing is quite clear - that once the officer chooses to enter the scene of the incident reported, they are extremely selective about the means of virtualised interaction they use. They may issue sparse statements on the radio attached to their jacket, but quite often they will fully immerse themselves in the situation. As one officer argued: "*When faced with a person, who potentially can hurt you badly, you want to look that person in the eyes and not stand there and stare into a screen*".

BE HERE NOW!

We can learn something from this in the ways information workers can view their interaction with technology and the day-to-day judgements made as to how interaction is conducted. Just because an information worker is in no direct physical danger by staring into a screen does not imply that it is a bad idea explicitly, considering when clients are more important than whoever may decide to call on the mobile phone. Information workers are still grasping with the idea of instant contact and when not only voice but also email and other data connections are generally available we will have even greater problems discerning when we are on or offline. If we allow the continual sliding of behaviour, we will all always be immersed in the virtualised interaction and actually never immersed in reality. This may imply that we are good colleagues who answer our emails promptly, but it could also leave us poor professionals if we cannot be present in the situations that really matter. The future information worker must be able to actively manage their interaction and not only juggle a wealth of complex technologies. The future is just as much a challenge of being able to deliver presence in the situation where face-to-face interaction has been chosen because it really matters. Here the information worker must demonstrate the ability to extend the reach of the strategic organisational capabilities through the use of mobile information and communication technologies at the same time as they deliver the full presence required of the situation. We know how to manufacture stuff and we also know quite well how to sell. What we need in the service economy is to nurture clients and colleagues, give them experiences and generally seek to meet their essential needs [66].

DARE TO DISCONNECT

Information workers will be facing a more ruthless future where they simply cannot deliver equal service to all. Information workers are for example, already spending a significant proportion of their working life reading and replying to emails. If no value-judgements are made, this will slide into levels of unacceptable proportions. For organisations this will represent the challenge of striking the right balance between setting information workers free to roam the world, and establishing organisational rules, norms, etiquettes, and procedures to identify creative spaces of seclusion and peace for reflection and innovation. This balance is still largely unchartered territory for many organisations and their members.

WE CAN ALL HAVE 15 MINUTES OF FAME

With no or very few barriers to each other's attention, we may not be ready to handle suddenly becoming the "talk of the organisation" when our skills or opinions are needed – for good or less good reasons. If we are to succeed in delivering quality presence we must be present at least occasionally. If we are, and we understand how to use all the interaction media to our advantage we can achieve great things and not only drown in hundreds of unimportant emails each day. The sliding phenomenon of interaction management represents a daily challenge for modern information workers. A member of one of the organisations we studied seriously suggested a two-hour time-lag on all internal emails ensuring that people only used the medium for interaction of a more substantial nature than issues that should be sorted out with a brief chat or an instant messaging interaction. Books have even been written on the new phenomenon of interaction management, teaching email etiquette or how to disconnect from the technologies as a means of getting an improved quality of life [18].

LOOSE OR TIGHT COUPLING OF LOCAL AND REMOTE ACTIVITIES

One of the determining characteristics of work that we must consider is to what extent co-workers are loosely or tightly coupled in their activities. Loosely coupled activities are ones that can be conducted independently by a person or unit, whereas tightly coupled activities are those where interdependent workers must co-ordinate and negotiate their activities in order to produce the required result. We are all to some extent dependent upon others in our work and even the lonely taxi driver who owns his or her own London black cab depends critically on the garage for petrol and servicing of the cab, as well as on other firms. However, the work of a cabbie is much more independent than that of a member of a project team that is engaged in innovation.

We can, furthermore, distinguish between collocated, remote and mobile work activities. Collocated work is conducted within the same office or building and generally allows the participants to engage in face-to-face interaction on a frequent basis whenever needed. Remote working denotes permanently separated individuals or groups for example people tele-working from home or distributed branches of the same firm.

Combining the distinction of loosely and tightly coupled activities with collocated, remote and mobile modes of working, we see, as illustrated in the figure a great variety in configurations of work.

REMOTENESS

	Co-located	Remote
Coordinate and cultivate	Locale working Medical professionals doing rounds	Mobile working Repair engineers
Command and control	Office working Call-centre worker.	Remote worker Virtual team / teleworker

Mobility (label on vertical axis, left of table)

Figure 2: Distinguishing remote and mobile working.
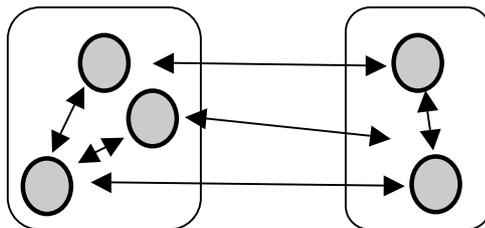
CO-LOCATED
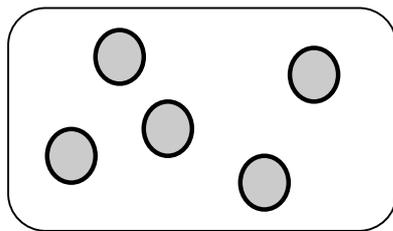
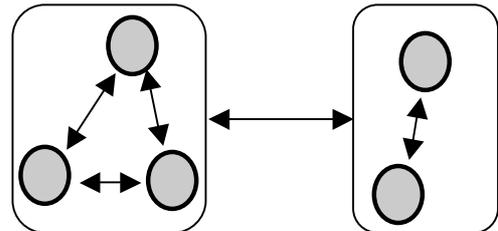Co-located loosely coupled workers
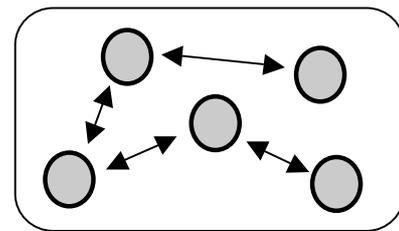
Co-located strongly coupled workers
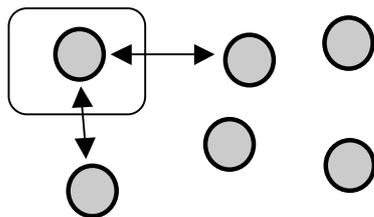
REMOTE

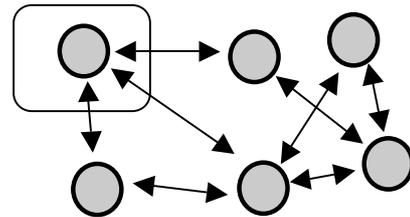Strongly coupled virtual or remote teams

Loosely coupled virtual or remote teams

MOBILE

Loosely coupled mobile workers

Tightly coupled mobile workers

19

ORGANISATIONAL INFORMATION SERVICES

ENCOUNTERS AND RELATIONSHIPS

How can we explain the technologies supporting mobile information and communication workers in their daily activities? Let us look at them in terms of the kinds of services they provide. There are two fundamentally different types of services in general, namely those that provide encounters and those that fosters relationships [19]. An encounter is a straightforward service that spans a short period of time and has a predefined context. We engage in an encounter when we enter a shop and buy a newspaper and a chocolate bar. Encounters ensure efficiency, speed, and uniformity of services. Opposed to the encounter, we find the relationship characterized by context and duration and aimed at more complex service needs. Relationships serve the purpose of creating bonds of trust in evolving interactions between service providers and consumers or between people working together. Most people have a relationship with their doctor or their solicitor. Some people also have a relationship with the hairdresser, while others use encounters for that purpose.

NETWORKING AND COLLABORATIVE SERVICES

If we characterise the technologies according to what services they support then we can distinguish between information and communication technologies that support encounters and those supporting relationships. Networking services provide support for encounters through infrastructure technology standardising connections [34]. These are, for example, the telephone, email, SMS, and instant messaging. Collaborative services support relationships through workspace technology standardising the shared material. This can manifest itself as a combination of three types of technologies, namely 1) shared workspaces allowing collaborators to store and retrieve documents or other work-objects, 2) co-ordination mechanisms supporting distributed co-ordination of who is doing what and when, and 3) awareness support providing co-workers with partial information about their colleagues' activities. Instant messaging provides a shared space for writing messages as well as partial information about the participants. As such it can be viewed as providing a collaborative service, although

one that only supports 'discussion-work', whereas a collaborative service typically supports distributed workflow management, the joint development of blue-prints, system specifications, reports or Microsoft® PowerPoint® presentations.

MODELLING WORK IN TECHNICAL SYSTEMS

Engaging in virtualised interaction, that is working together or engaging with clients in a virtual setting and while not collocated, of course critically relies on information and communication technologies. One defining characteristic of these are that they support our interaction through providing connections and through modelling aspects of the social world inside the technology [51]. Optimising the knowledge supply chain relies on utilising the modelling of social relations in technological systems in much the same way as physical supply chains have gained efficiency from much more detailed and explicitly modelling the physical parts and their associated processes in JIT or MRP II systems. Networking and collaborative services both model aspects of the work in technical systems. The mobile phone contains names and phone numbers of people we may want to call and the infrastructure generally provides standardised connections through representing names, addresses and phone numbers. Collaborative services provide more fundamental models of the work context, the people engaging in collaborative activities, as well as the activities themselves. A workflow management system will typically model a standardised work process to be followed.

WORKFLOWS VERSUS CONNECTIONS

The strength of networking services is that they provide unobtrusive, generic and flexible means for interaction. The weakness is that they do not directly support or automate the knowledge supply chain but rather leave the main work to the participants. Collaborative services embed and can partially automate the knowledge supply chain precisely because they contain explicit models of the work system beyond simply listing names and phone numbers.

This implies that collaborative services in a much more radical manner address the issue of productivity in information and knowledge work. This is one of the reasons for the emergence of workflow management systems, scheduling systems and shared workspace

technologies such as Microsoft® SharePoint® Server. They allow us to set up collaboration across time and space and therefore support the organisation of collaboration in virtual teams or of highly mobile workers. However, **collaborative services are also much more problematic to assimilate into daily practices precisely because they attempt** **something potentially very difficult, namely in technical systems to represent and model social behaviour and even further to feedback from the system and stipulate human action.**

NETWORKING SERVICES	COLLABORATIVE SERVICES
Low degree of modelling work activities, context or participants	High degree of modelling work activities, context or participants
Standardising connections	Standardising the shared work material
Provide support for one-shot encounters aimed at efficient transactions	Provide support for ongoing relationships aimed at nurturing trust
Easy to implement. The consequences are only noticed with intense use (interaction overload)	Difficult to implement as they model social relations and stipulate the conduct of work and collaborative patterns
Can foster support when used over time to reinforce social patterns	Efficient exactly because they stipulate the distributed conduct of work tasks
Technology agreements only essential if data collected from the use of networking services are to be used in order to effectivise work	Technology agreements essential
Coupling and de-coupling technologies (present-to-hand, ready-at-hand, in-the-pocket)	Not so much coupling and de-coupling of technologies but rather the effects of embedding social relations in technological artefacts
Does not provide and stipulate structures but instead flexible networking possibilities. Structures and rules are exclusively socially defined outside the technology and therefore more flexible	Provides artificial structures and hence also a sense of stability if accepted and appropriate, but also a constant source of discontent if inappropriate

One of the major socio-technical challenges facing organisations seeking to change knowledge supply chains is to deliver support that balances distributed and mobile work with collaborative services and networking services that allow people to flexibly negotiate, connect and socialise. As networking has a low entry barrier - we can immediately see some benefit of using a mobile phone or email - they are easy to diffuse in the organisation. However, the real costs associated with networking services show up when they are most successful. The ease of connecting can lead to particular popular information and communication workers being swamped in interaction. Furthermore, as the services only provide a standardisation of the connection, they actually do not do anything in themselves in terms of supporting

work. People themselves still need to make all the notes, write, store and share documents etc. Using email to emulate a shared document server will easily end in tears when confusion as to what version of the document is the newest, and where it is on the messy hard drive. **So as the price of communication drops through advanced networking services, the organisational cost may increase as information workers spend their valuable time reading yet another semi-important email.**

Collaborative services on the other hand are often quite complex to implement in organisations. Standardising the knowledge supply chain may bring productivity gains but it may also impose too tight rules and regulations on how the distributed activities are carried out. Delivering services or innovating

together in projects is an uncertain business. People will frequently need to reassess the way things are done in order to deliver better results faster, and a too rigid system determining the conditions under which work is conducted and co-ordinated will feel like a straightjacket to the participants. This means that the initial hurdle for implementing collaborative services is much higher than those for networking services. This is one of the reasons for mobile phones and email gaining immense success with little or no organisational push, whereas workflow management technologies need constant push and attention to succeed [12]. However, once successfully implemented in the organisation, collaborative services can form the infrastructure of an efficient organisation and significantly help in optimising the knowledge supply chain. The ability to implement bottom-up de-central changes to workflows is essential for successful use.

BUREAUCRACY BY EMAIL

As the price of communication declines, so does the price of maintaining unnecessary bureaucratic rules and regulations through communication technologies. The easier it is to send off an email, the easier it is to communicate bureaucratic rules and regulation, and to over-burden colleagues with messages, management surveys, etc.

The danger of too extensive use of networking services is that organisations may get the worst of both worlds, that is, all the cumbersome bureaucratic management rules of the centralised hierarchies, but without being provided with the safe haven for interaction these organisational arrangements traditionally offer.

Although work increasingly consists of talk, emails, interaction, presentations and such, this does not necessarily imply that all interaction creates value for the organisation - far from it. **Although studies have shown the resilience of information workers in absorbing information overload [52], it should be the explicit aim of organisations to actively reflect upon their interaction culture.**

From the point of view of the information worker, the low barrier makes it very easy to be available and to demonstrate activity through ensuring on high level of interaction and responsiveness. However, as each act of interaction, however small a cost to produce, also can be viewed as taking up someone's attention, organisations must seek to establish cultures where

the need to demonstrate activities for the sake of it is minimised.

It is characteristic that the organisational innovation that happened because of communication technologies (e.g. email, mobiles and instant messaging) happened in a mostly uncontrolled and *ad hoc* manner. The innovation will typically be a result of strong organisational pull as opposed to many collaborative services that are subject of significant technological push or pressure on the members to adopt the technologies. Networking services are suddenly there as a part of the infrastructure and information workers find ways of utilising the technologies to their advantage. It is not until much later on, when they have proven highly successful through extensive adoption and use that the organisation realises the value of free interaction. Whereas we have found instant messaging to be an excellent tool in the right situation, it is by no means certain that it is an advantage for all information workers.

However, contrary to traditional systems, it is very difficult to predict exactly who will benefit (and in what circumstance) from using a new communication technology. The use of these must be cultivated in specific circumstances and the use will grow out of concerted individual and organisational reflection.

FLEXIBLE COLLABORATIVE SERVICES

It is a major technical challenge to provide collaborative services that both significantly model and support distributed and mobile working at the same time, as they are flexible enough to accommodate emerging needs to change the way work is done. In addition, establishing flexible workflow management systems is a significant technical and organisational challenge [51]. However, exclusively relying on networking services simply implies leaving the entire burden of optimising the creation and sharing of knowledge to the individuals. Lessons from research clearly demonstrate that the difficulties of implementing collaborative services depend on the need for the actors to collaborate remotely. A case of a high-tech innovation company [47] showed that the mostly self-managed experts within the company would reject systems restraining their ability to work flexibly when project participants were situated within the company. However, when projects relied crucially on close collaboration with experts abroad, the adoption of sophisticated collaborative services went smoothly. It was simply a necessity and therefore it happened.

TRUST IN MOBILE WORKING

EFFICIENCY AND EMOTIONS

Technological developments place more and more powerful information and communication technologies directly in the hands of information workers. Organisations deploy these technologies in order to mobilise organisational capabilities through enabling access to corporate infrastructures, colleagues as well as to clients and customers. The aim is to incentivise work and a mixture of networking and collaborative services accomplishes this. One defining characteristic of many of these new technologies is the fact that they are not only linked to an individual user, but often also follow that user throughout their working day, and in some cases off work as well. The stationary PC will engender user emotions as more and more of their working time is spent working on it. Technologies that follow the user wherever they are will even more so be associated with deep individual emotions. If the technology is one that plays an important role in quantifying work, then it may raise even more emotions. As uttered by a home appliances repair engineer when his mobile phone rang, "it's only ten past nine in the morning on my first day at work after two weeks of holiday and this phone has already rung ten times!" People easily end up with a highly ambivalent relationship to the use of personal technologies. They become an indispensable help in doing a good job at the same time as they may represent the ability of colleagues and managers to control and monitor work. Nuts and bolts do not care much for what is written and said about them in JIT and MRP II systems and the physical supply chains they are an integral part of can therefore be optimised radically. **The knowledge supply chain is, however, made up of people who do care considerably about what is written and said about them in systems and how their work is managed.**

TRUST AS THE BRIDGE BETWEEN INDIVIDUALISED TECHNOLOGIES AND ORGANISATIONAL EFFICIENCY

We are dealing here with a serious issue of combining the need for organisational efficiency with the need for individuals to feel that they are not unnecessarily monitored and controlled. Trust is the key concept bridging the emotional disposition of the individual and the organisational aims for efficiency. **The use of advanced networking and collaborative services in an environment of trust and clear objectives will enable the utilisation highly sophisticated functionality, whilst an environment of uncertainty and lack of trust can make even the simplest personal technology fail**. We will in the following examples, but let us first look at the essentials for the successful use of the technologies.

Information and communication technologies can weaken or strengthen knowledge supply chain optimisation. Equipping an information worker with a mobile phone and a list of numbers for potential collaborators does not really intervene significantly and will allow the information worker to flexibly arrange and participate in the exchange of knowledge. Other networking services such as email and instant messaging function pretty much the same way. However, even with these relatively simple technologies, the absence of trust can lead to misuse. For example, if the information worker does not fully trust the organisation and expects to have their decision questioned regarding the way work is done, then they may decide to carefully document all decisions to cover their back. They may decide to make certain decisions on the phone out of fear of subsequently being held accountable for discussions on email. If, however, there is a great element of trust, mutual understanding and benefit from optimising information work though technology support, then their may not mind the organisation using detailed information about the their interaction networks in order to optimise the knowledge supply chain.

Let us then consider collaborative services, which as opposed to networking services much more substantially model and represent the knowledge supply chain, for example through direct support for coordination of activities in workflow management systems. Here, the supply chain tying information workers together will directly be represented and at least partially stipulated through the technology. A train timetable leaves very little choice for either the train driver or the passengers and a workflow document landing on your table will have a built-in request for you to deal with it. We here see that collaborative services in a much more substantial manner represent and model the knowledge supply chain and as such embed the social relations inside technical systems.

MAKING INFORMATION WORK VISIBLE

As the timetable greatly aided railway transport [63], so has, and increasingly will, collaborative services such as groupware support the knowledge supply

chain. However, in even more dramatic ways than with networking services, the use of workflows, and other collaborative services critically relies on the participants trusting their concerns being taken into consideration. Once the supply chain is represented through systems, for example through shared workspaces or thorough distributed workflows, the information work is made explicit and externally observable. The example of a product development group in a European country using a collaborative system to document their design process offers good insight into this [12]. They were happily going about their work until one day the CEO of the corporation, based in London, posted a message congratulating the effort and applauding the progress. As none of the participants had considered the possibility that they were observed from above, they were quite nervous about the prospects of having all their detailed internal discussions observed externally through the groupware system. Consequently they immediately stopped using the system and could only be persuaded when the organisation ensured that the access to the system replicated the organisational arrangements where only people who were an integral and trusted part of the knowledge supply chain had access to view the detailed data in the system.

80,000 STRANDED TRAVELLERS

If we trust the ones representing us in systems or if we have a natural interest in being represented in the system then it is generally relatively unproblematic. If the trust is broken or if it is uncertain what exactly the consequences of the representation will be, then people will resist fiercely as British Airways discovered this when 80,000 travellers were left stranded as check-in staff at Heathrow went on strike in protest against a swipe-card system they felt would be used as a tool for micro-managing shifts and which collected detailed data on check-in staff movements in a way that had not been negotiated and agreed [4].

SECURITY GUARDS AND RFID

In a study of security guards piloting a system with the relatively simple technology of RFID tags placed on the security route and read with handheld devices, the uncertainty about the use of the data for the detailed management of work resulted in significant discussions of the feasibility of the system, although with less dramatic consequences than 80,000 stranded passengers at Heathrow. The technology was, in terms of data transmission, a simple one, with the work relatively independent, but the fact that there was tight links between the security guard and the recording technology allowed the close supervision of individuals.

OPERATIONAL POLICING

Our study of mobile technologies used within the UK Police clearly demonstrated the opposite situation. Police officers use a variety of mobile services that give them access to national databases on persons and vehicles, detailed information about incidents [46; 56]. There is a long tradition of advanced use of mobile technologies within police forces [1; 33]. Police officers are keen on obtaining rich contextual information about an incident, the people reported to be involved and other contextual information in order to understand the risk imposed by the situations. We saw advanced use of collaborative services such as the Mobile Data Terminal whilst the police car was travelling at great speed with one officer reading out and the other driving the car.

	Command and control	Coordinate and cultivate
Coordinate and cultivate	Management will extend great operational freedom to members and seek to cultivate the organization. Risk of ineffective operations as management goals and expectations do not manage operational expectancies. Management requires detailed knowledge of operational activities and participant behaviour. This information not shared willingly due to suspicion as to its use for direct command and control.	New ways of working ensuring flexible working and the flexible delivery of innovative products and services.
Command and control	Traditional way of managing and conducting work. Operational aspects only controlled to the extent they can be directly observed. A challenge to innovate products and services.	Members trust that management of operations is conducted according to the principles of coordination and cultivation and operational details are hence sought shared. If management based on command and control the operational details may be used in ways violating the members' expectation of privacy in work.

(Left vertical axis label: Management approach to information work)

Figure 3: *Basic roles for supply and consumption of organisational information services. It illustrates the possible synergies and mismatches between a command-and-control perspective and a coordinate-and-cultivate approach.*

Even in this hostile environment a complex mobile technology found its natural place since it offered essential support for the job at hand. Operational police officers also accepted fairly intense surveillance of their activities as this provided them with an additional sense of security both in the eventuality that they needed backup from colleagues, or if the cause of events later on needed to be reported in detail to justify the officer's actions.

TRUST AND KNOWLEDGE SHARING

The issue of trust is generally quite difficult to pin down as it does not lend itself to easy characterisations without either resorting to our common sense understanding or submerging into lengthy philosophical deliberations. Trust has been defined as: "*a psychological state comprising the intention to accept vulnerability based on positive expectations of the intentions or behaviour of another, irrespective of the ability to monitor or control that other party*" [48]. This always depends on the specific context within which it happens [64]. We tend to trust people of the same profession as us more than those with different professions, and those from our own cultural background more than those with a different cultural background. Socialising and intense interaction over time has generally been seen as the main source of building trust as it allows us to form more precise expectations about the intentions of our colleagues. An important element of trust is also assessment of the risk and reward associated with our acceptance of vulnerability. The higher the perceived reward the higher risk we are willing to take.

If we are expected by the organisation to render the organisation more effective through sharing what we know with others in the organisation then it of course requires that we trust others to use what we know in ways that will benefit the organisation and in particular not in ways that will disadvantage us. Orlikowski's [44] classical study of the use of Lotus Notes in a global consultancy firm clearly demonstrates this. Here the use of the collaborative service was required in order to support the sharing of knowledge across projects. However, the underlying structure of partners with the interest of capturing and sharing cross-project data and non-partners who internally competed to become partners led to relatively poor use of the system. Non-partners efforts to share knowledge could advantage one of his or her internal competitors and therefore potentially disadvantage them. In any case, the effort would advantage partners who did not take direct part in using the system.

FRONT STAGE AND BACK STAGE WORK

Goffman [17] suggested in the 1950s, based on extensive studies of social behaviour that our interaction in everyday life can be characterised in

terms of the distinction between when we work front stage and when we work back stage. This theatre metaphor characterises the differences between how we wish others to see us and how we expect to engage in interaction with them.

A restaurant can provide us with a good example of this distinction. When waiters are located front stage they display certain behaviours such as always maintaining a pleasant disposition and taking customer critique with a smile and subsequent apologies on behalf of the establishment. When opening the door to the kitchen, the waiter enters the back stage where intense discussions may seek to distribute blame or issue blunt opinions of the behaviour of the guests. Once the restaurant is closed, the floor and kitchen is being cleaned, and the money is being counted, back stage behaviour may result in loud arguments over wages or quiet talks over a glass of wine with feet on the tables where guests previously were enjoying their meals.

The same physical spaces can serve both as front and back stage depending on the situation. In the exact definition of a concrete situation of either front stage or back stage depends critically on the relationships between the participants and how each of them perceives the situation. In some organisations there is an informal culture encouraging people to let down their guards and slip into the back stage where there is an atmosphere of mutual trust and issues can be discussed more unrestricted.

Collocated information workers have been socialised into understanding the careful and fragile negotiations of front and back stage situations. Our general social skills form an essential basis for assessing and acting in these situations. Socialising takes place in specific physical contexts where we as human beings can use all of our senses to help assess the intentions of others and it is in these situations we build the trust needed for us to relax back stage. Socialising back stage has been argued as a crucial element in transferring essential knowledge between colleagues, even between mobile workers who would only meet up to share a cup of coffee once each day [7; 45; 62].

When all or a significant part of work is conducted remotely, there may be much less or virtually no opportunities for information workers to establish the necessary trust enabling them to interact and share knowledge back stage. This can result in mismatches where some information workers will perceive the situation as a clear back stage activity whereas others may perceive the activity as a central aspect of their front stage work where it is important to carefully assess ones actions. They may not be ready to trust their colleagues to the extent needed for intense sharing of knowledge among peers [61]. Whittle [61] demonstrates how mobile workers used their virtual presence as a means of conveying commitment and ability. They used the mobile phone and email as means of informing their managers of work activities and the information workers would carefully orchestrate this interaction in order to design the right impression. The study also showed that during the sparse face-to-face meetings, some participants felt part of a front stage activity aimed at critically assessing their abilities whereas others considered the meeting a back stage activity where knowledge could be shared in a relaxed atmosphere.

Organisations relying critically on information workers actively engaging in mobile working must support the fostering of trust through enabling back stage activities where knowledge can be shared in a relaxed atmosphere. Although physical presence and socialising is a key element in this, frequent and instant contact between members clearly supports the process of cultivating a trusting environment.

Critically we saw in the study of UK police officers how frequent interaction among mobile units through a technology similar to instant messaging was used along with mobile phones to ensure both efficient coordination of activities as well as socialising and sharing of knowledge. In this environment the tightly coupled work due to the safety and time critical nature of operational policing also forced through the need for mutual trust. Socialising was, however, critically supported by the essential daily back stage activity of the briefing where officers would go through the previous days incidents and plan the upcoming shift. Here, the mood was one of humorous commenting on the events of the previous day in an open and candid manner that facilitated knowledge sharing and the cultivation of norms.

TRUST AND REMOTE WORKING

When people work in remote and mobile teams the issue of trust becomes even more thorny and problematic to understand. Remote working requires a high degree of virtualised interaction and it therefore leads to significant difficulties in establishing a clear picture of what the others are doing or indeed what specific reasons there may have been if they do not deliver what we expect them to. In the traditional understanding of trust a colleague is perceived as trustworthy if he or she delivers on work

commitments. Studies of trust in remote and mobile working indicates that here trust can be explained the other way around, namely that people who are perceived as trustworthy also are more likely to be perceived as delivering on work commitments [64]. It is also indicated that in remote and mobile working first impressions form an important part of a lasting assessment of a person's trustworthiness. This can simply be explained from the fact that mobile and remote working colleagues, depending critically on each others efforts simply will not have the same ability to evaluate the detailed performance of colleagues and therefore will have to resort to making decisions on less experience.

If we wish to foster trust and open knowledge sharing in mobile working it is therefore essential that we allow for proper assessment of the performance of all involved. This can prove very difficult without the use of mobile technologies, as it then would require some element of collocated working and socialising. Socialising can play an important role in transferring essential knowledge between colleagues, even between mobile workers who would only meet up to share a cup of coffee once each day [45; 62].

The possibility of more precisely monitoring and measuring work performance is an integral possibility of the application of networking and in particular collaborative services. This can both make detailed performance visible and render it open for negotiation. It can, furthermore, support the sharing of knowledge across mobile workers and teams. For this to take place it is essential that there is extensive trust between the involved parties in the kinds of uses the resulting data from the system will be put to. The traditional assumption is that detailed information about the work process in many professions is the private property of the information and communication worker. This also used to be the case amongst factory workers who through the emergence of Scientific Management saw their activities increasingly being monitored and controlled.

Effectivising the knowledge supply chain critically depends on communities of practice sharing knowledge and in remote and mobile working this requires mutual awareness among participants as to the state-of-affairs.

REPRESENTING THE SUPPLY CHAIN

If we are to successfully optimise the knowledge supply chain then it is not enough to just establish connections between participants through networking services. As the proper coordination of collocated activities critically rely on the participants' ability to assess and influence the status of their colleagues' activities and whereabouts.

As the optimisation of manufacturing supply chain happens through representing, modelling and optimising its systems, the optimisation of the knowledge supply chain relies critically on the awareness and understanding of the social arrangements carrying out the activities needed. When the participants are all situated in the same office, this is fairly straightforward in the sense that the participants have immediate access to inquire about the state-of-affairs and of the whereabouts of individuals. This can foster communities of practice where participants share knowledge on best practice.

However, when work is mobile and distributed, for example as in virtual teams, then it is associated with a significant interaction overhead to establish a picture of the state-of-affairs. We have evidence from a manufacturing innovation case study that the intense interaction needed in concurrent engineering projects went much smoother when the engineering designers were situated right next to the production planners. When engineering designers were situated across the road from the factory and the production planners, the participants complained that the process of designing integrated easy-to-manufacture components was much more troubled [8].

Establishing a picture of who is doing what, where they are and how it all fits in with my current activities requires that mobile and remote working that information workers have access to data representing current activities and whereabouts of colleagues. They are often now restricted to using mobile phone conversations as means of investigating what is going on and where people are. The mobile phone in this sense is appropriated to simulate the functionality of a location-based service through the frequent conversations concerning where people are and what they currently are doing. It can of course be seen as a case of misused technology, but as our ability to ascertain the whereabouts and activities of colleagues is essential, we will naturally wish to obtain this kind of information even when it is not immediately available to us.

ACCEPTING SURVEILLANCE WITH A PURPOSE

A good example of a successful implementation of a system tracking the behaviour of individuals can be found in the study of GPS equipped long-distance lorries in Denmark. Here each lorry was equipped with satellite tracking and a dedicated email communication system. At the central dispatch station the controller could observe the exact position and movement or each of the fleet lorries. They could contact the driver through the satellite email system, and the driver could contact the controller. The drivers were all independent contractors paid according to the loads they shifted and they therefore had a natural interest in being monitored. Since the lorries mostly drove fresh and salted fish from Norway and Denmark to the south of Europe, the challenge was to respond to available return loads from or within France, Italy, Spain, Germany etc. to Denmark, Norway or Sweden. Any technology that could enable the controller to convey emerging details of a possible shipment allowing the lorry driver to make more money through a transport contract for parts of the whole return trip was seen as beneficial and not a violation of the drivers privacy. The email system was also seen as a reliable means of getting help in case of errors in the paperwork, for example as in the case of a shipping note carrying the wrong address. This was only noticed when the lorry reached the wrong address. After an email to the controller, the right address could immediately be transferred and the load could be delivered to the correct address.

NEW PERCEPTIONS OF PRIVACY

Representing information workers' behaviour and physical location in technical systems and making this information available in real-time or near-real-time to members of the organisation is potentially highly controversial. It will bring with it associations of Big Brother monitoring every move with the purpose of controlling behaviour. There is, however, not a lot to do we can do about this problem other than attacking it head on and dealing with the issues, which are complex and difficult but also essential for the mobile organisation to more effectively organise its knowledge supply chain.

As we see initial developments in the kind of systems and services supporting coordination of mobile and distributed activities, we also see the emerging need for all involved to cultivate and negotiate new perceptions of privacy and surveillance. This is essential to avoid endlessly repeating the Heathrow conflict. **Mutual trust is not an added bonus of the mobile organisation, it is an absolute core property. Without mutual trust it is impossible to effectively coordinate the distributed activities. Mistrust also results in the perceived need to engage in activities only serving the purpose of demonstrating ability internally and not generating business value**. It has been reported that mobile phone users frequently don't divulge their exact location, instead giving out the location that will best serve their purpose [25].

Representing the social arrangements and activities in technical systems for example entails selective access to people's location, access to data representing aspects of their activities as well as reciprocally providing others similar access to information. Providing this information in an environment of trust can greatly facilitate the coordination of work [8; 51]. In the case of the police, there is from the officers a keen interest to be able to document their whereabouts as well as ensuring the ability to coordinate back-up and support. They therefore willingly allow colleagues to be aware of where they are.

Allowing others to know where they are will enable colleagues to exercise informed judgement on how they may wish to be contacted, how urgent an issue has to be before they will prefer mobile phone calls, it reduces misplaced interaction and generally provides the background for assembling and coordinating work-products.

In the interesting case of a bespoke instant messaging system reported by Nardi and Whittaker [37], the system would transmit to the buddy-list a measure of the typing speed of the user. Initially people were outraged and felt this was a tool to monitor their productivity. It, however, did not last long before people trusted that the data was not misused and found the facility highly usable as it meant that people would not initiate discussions on the system with members of their buddy list who clearly were typing frantically to meet a report deadline. Conversely, a very low typing-count would clearly indicate absence from the workstation, making it easier for people to assess the likelihood of reaching the person they were seeking to interact with or perhaps be a sign of intense reading activities. A low typing count could indicate a person was willing to engage in instant message interaction without feeling disturbed and thus facilitate impromptu socialisation through the technology.

MANAGEMENT AND THE KNOWLEDGE SUPPLY CHAIN

If creating an environment of mutual trust between all stakeholders in organisational life is essential for us to be able to work together using mobile and remote working practices, how can we then understand the essential aspects of fostering this trust? How good are we in the UK at ensuring that we trust each other when we work together?

If we assume at least partial correctness of the studies showing that UK productivity is significantly lower than that in the countries we normally compare ourselves with, and also consider that the average working hours in the UK are higher than in the rest of the EU [35; 59], then it becomes clear that British organisations are devoting time and effort to non-productive activities. One such type of activity is of course tea-breaks, but they probably also have those on the continent. Another type of activity that does not directly produce value is *management*, and that generally concerns activities that serve the purpose of managing work activities. There is a difference between activities necessary for people to coordinate the knowledge supply chain and general management of the supply chain. Management activities are typically seen as concerning the overall performance of the knowledge supply chain and as a mechanism for solving problems. Whereas the knowledge supply chain defines the operational level, the tactical and strategic levels are the concerns of management. Although management activities are essential, they can also be conducted unnecessarily. In the traditional functional hierarchy, the role of management was clearly defined as providing strategic leadership through innovation. However, in network modes of organising activities where knowledge supply chains cut across organisations in ever-changing patterns, the role of management and strategic leadership is less straightforward. Here detailed operational knowledge is essential in order to formulate the strategic potentials [13].

Since the British economy has remained strong despite lower productivity and longer working hours, perhaps the productivity-gap can partly be characterised in terms of the efforts spent on managing the knowledge supply chains in British organisations? Comparing, for example Scandinavian countries with the UK, then day-to-day knowledge of organisations across the two cultures can clearly confirm that for example in Sweden with high taxes on employment, one frequently meet automats and robots where in the UK there are real people. People

are most often preferable to robots, but in Sweden one relatively rarely seems to encounter as much *management*. Here the rationale seems to be that since employment expenses are high, organisations can ideally only afford employees who can largely manage themselves. Therefore trust can be seen as the result of economic necessity. **Conversely there is perhaps in the UK with significantly lower employment costs a tradition of employing one person to do the job and two to check the job is done.**

So, although there have been large restructuring efforts in British business to reduce layers of middle management and introduce leaner and flatter structures, the main issue is one of culture. Let us for the sake of argument assume that British organisational culture is still significantly shaped by the norms of command and control. Then this will naturally form a clash with attempts to foster trust in mobile and remote working when knowledge supply chains become flexibly reconfigurable and highly distributed.

FOSTERING NEW MANAGEMENT PRACTICES

A command-and-control mentality where there is more status in telling people what to do than to do it well oneself is not conducive to fostering trust at the operational level of the knowledge supply chain. As we saw in the product development example earlier, in such an environment having "Big Brother" watch work from above can have devastating consequences and the only solution is to embed hierarchies in the technologies, which defies the whole purpose of the exercise, namely to ensure flexible and agile knowledge supply chains through emancipated information workers.

The UK with its service economy is in many ways well equipped to meet the challenges of the mobile society and of individuals increasingly requiring essential fulfilment of their needs [66]. However, there are also pitfalls. Over emphasising the codification of services as a simple mechanism of ensuring standardisation is not a viable strategy in the long run. Codification of services is the approach of managerially setting explicitly codified standards for services and acceptable behaviour. For example, call-centre staff's highly scripted interaction with customers.

A very good example is provided in one of the Finnish municipalities where the provision of home care

services has been completely codified in the name of service efficiency [60]. Here the home care assistant carries a laminated sheet with bar codes on the front and on the back. Whenever the assistant provides a service he or she scans the corresponding codification of the service on the laminated sheet using a PDA with a barcode reader. When the PDA is docked, the central database is updated with the information. This illustrates a system that is properly managed and very clearly defines the space of possible services. It does, however, not leave much room for some of the activities home care clients normally are most eager to receive, namely un-codified socialising.

The systems itself can, however, work well internally if there is substantial trust between the home care assistants and their managers. The assistants specify exactly what they do and the activities are recorded and can be subjected to negotiations of workload and performance-related pay.

It is, however, clear that in most cases the provision of services or the work in distributed teams innovating requires activities that cannot be codified beforehand and the organisation must rely on information workers making crucial decisions wherever they are. As the services and collaboration are increasingly conducted out of sight of any manager the management of this is increasingly virtualised. The managers can then choose to rely on technology-mediated command-and-control and for example seek to codify as much of the work as possible and then directly monitor the supply chain when the technology records the categories activated. On the other hand, the manager can seek to cultivate proper coordination within the supply chain and foster mutual trust enabling the information workers to exercise a high degree of discretionary judgement and apply much more supportive management techniques where recording of actual behaviour primarily is used to support the development of best practice.

RESHAPING ESTABLISHED INSTITUTIONS

The use of new networking and collaborative services to foster more effective knowledge sharing across mobile and remote information workers challenges deeply rooted institutions. Mobilising the workforce to render the organisation more effective is much more than merely making minor adjustments. These changes are fundamentally challenging core 'institutions' such as our

expectations that work is mostly being carried out in co-located settings and that our activities will not be constantly scrutinised. It is potentially as radical a move as when people migrated from rural areas into the cities of the industrial revolution and were hired for factory work and here subjected to radical changes in the way they perceived the temporal and social aspects of work. Moving from the farm to the factory challenged the fusing of family and working life, creating a temporal and geographical split. It challenged the notion of time, replacing a sense of time largely determined by the seasons to one being determined by the pace of the machinery.

Now mobile and remote working in the service economy now challenges the institution of work as a collocated activity where through detailed observation and socialising can generate trust. Working remotely challenges the individual's perception of the performance of others and will also challenge the notion of organisational privacy and surveillance as people engage in detailed monitoring of each other's performance.

From the flipside, office work is now redefined as out-of-office work and workers give up working side by side with colleagues precisely because they are needed in other contexts. In that sense we can explain socialising as the capital of the mobile organisation. The mere institutional ability to extend the reach and full might of the organisation to where the customer represents a primary strategic challenge.

VIRTUALISATION LEADS TO POLARISATION?

Trust is highly dependent on the specific situation. When people are all in the same room, doing similar kinds of work and are all from the same cultural background, it is likely that that they can build the common understanding necessary to trust each other to deliver promised work and to generally behave in a manner according to shared expectations. When work moves away from these simplistic assumptions about working situations, it can become difficult to establish sufficient common understanding to ensure trust within a group of information workers. When groups of people from different disciplines, national cultures or time zones all have to work together across work contexts either because they form a virtual team or because several of the team-members are highly mobile, then the natural development of shared understanding is challenged [64]. In these situations it can be very difficult to ensure group trust based on direct observation of and experience of performance.

This implies that team members may have to rely extensively on first impressions instead of past experiences in their evaluation of the likelihood of a colleague delivering the promised work result. Whereas collocated teams build trust based on experiences with team member delivery of results, remote and mobile teams may reverse the relationship and use trust in a colleague delivering as a measure of whether or not they actually do deliver [64].

This shows us a scenario where the importance could be much less on the actual performance than on peoples' perception of the person; "*He's one of us, so he's OK! There clearly must be compelling reasons if he has not done what he promised, but I am sure he has done the job*".

If it is the case that trust in virtual and mobile working will be much more based on initial assumptions and much less on actual experienced behaviour, then we are in for a difficult time. Subjected to increased globalisation, work transcends national, cultural, professional, religious and almost all other borders, and we are forced to reconsider some of our most basic assumptions concerning the family, the national state and religion [16]. If we then revert to stereotype and base trust on first impressions formed from prejudice, then we will simply experience ineffective working arrangements.

The long and hard process of political correctness can of course by the cynic be seen as a surface treatment of the issue in order to avoid dealing with the essential issues. However, from a more constructive point of view, political correctness can be seen as playing an important role in influencing the ways we make first impressions and to ensure that we can function properly in a globalised society where we will be expected to engage with and trust people from different backgrounds, religions, professions etc. If assessments of how trustworthy mobile and virtual colleagues are can only be based on highly parsimonious information and limited socialising, then people will naturally revert to stereotypes and this will not be conducive for a good working environment.

Organisations will naturally, as a counter-measure to the virtualisation of work activities, seek to employ new measures in order to manage their mobile, remote, and generally invisible members. This can for example be represented by a change of emphasis - from how work is done to instead a management of outcomes [6]. Creating increasing transparency in work deliverables can contribute to increased trust among distributed members. However, a radically different approach may be to seek the ability to manage mobile workers through technologies recording detailed activities with the purpose of convincing managers and co-workers that a person is conducting the work expected. Such mechanisms can effectively be set up but will only add to the problems of lack of trust. If trust, as Rousseau [48] and others argue, is the acceptance of rendering oneself vulnerable because we expect positive intentions and behaviour of those we trust without having the ability to control this, then the ability to in detail observe and even influence work through mobile information and communication technologies certainly will place great stress on the mutual trust between the ones observing and the ones being observed.

Perhaps it is time to rethink the notion of control and influence in management? As suggested by Malone [32], we can consider balancing command and control with proper support coordination among mutually interdependent information workers who need to work together, and in addition cultivate the working environment to become much more decentralised.

CONCLUSION

This report has outlined some of the most important issues in conducting and managing remote and mobile information work. It has argued that technological possibilities beckon and market conditions force work to restructure and become mobile, distributed, remote and virtual. Such mobile work will enable the enterprise of the 21st Century to deliver better, more targeted and cost-effective services.

Now we are in the midst of the next major era, namely that of quantifying the work of the mind – information work. When manufacturing has been highly optimised and at least partly automated, and when what can be outsourced to low-cost regions is outsourced, then the attention naturally focuses on the next obvious place to improve.

Assuming that quantifying and monitoring information work is identical to that of manufacturing work is a dangerous mistake. Whereas the manufacturing supply chain can be ever tightly controlled and optimised through its essentially commoditised knowledge exchange [49], the knowledge supply chain intrinsically consists of people creating, communicating and refreshing

knowledge. Their ways of working can be subjected to rationalisation efforts with impressive outcomes. A central element in this rationalisation effort is the increasing virtualisation of work through virtual teams, remote and mobile working.

This challenges fundamentally our understanding of the conditions for working together and establishing environments of mutual trust as work relies increasingly on interpersonal interaction mediated through technologies.

Failing to realise the seriousness of the challenges facing modern organisations can have monumental consequences. The primary strategic challenge is balancing the traditional hierarchical command-and-control environments with decentralised environments, that have distributed coordination of activities and cultivation of mutual trust in distributed and virtual working. Getting it wrong on either account can be a serious mistake, but as Malone [32] argues, we are generally quite good at centralising decisions, so the important step is to focus on how to learn de-centralised decision making.

Global markets and employees demand the enterprise offers flexible, mobile working as a means of providing the needed flexibility to deliver enterprise services where and when they are needed. This trend is happening at the same time that employees are requesting flexible working arrangements more suitable to modern living. This circle can only be squared if the organisation mobilises and incentivises information work at the same time as it improves and re-invents the ways work is managed. This can for example be accomplished through allowing information workers to define their own more appropriate conditions for creating and sharing knowledge in self-organising networks of interdependent colleagues at the same time as there is sufficient management of work performance through the use of information and communication technology.

However, all of this can only happen if knowledge is created and shared in an environment of trust and fairness. If one group unilaterally benefits from another group's hard work, then it is highly likely that the system will be counter-productive [44]. The issue of trust turns both ways. Management will be forced to trust information workers as they can create more value by leaving offices and cubicles and venture into the marketplace where they can provide their services much more effectively through defining their own context of work. By doing so, management will relinquish some of the control of direct observation

and management through face-to-face socialising. This implies that lack of trust between the parties easily can result in the efficiency gains being lost multiple times as mobile information workers engage in bureaucratic activities in order to demonstrate efficiency and in order to cover their own back in a system they do not trust. In Goffman's [17] concepts, the lack of mutual trust could force information workers into a permanent front stage and one of the essential aspects of knowledge work is that it desperately needs backstage activities for open and free reflection, for experimentation *with* the risk of failure but *without* consequences. When all activities are front stage then there is no space for experimentation.

There are very few or no easy ways to shortcut the process of cultivating mutual trust in organisations. It is all about ensuring that information workers and managers apply appropriate ethics and reward mechanisms when re-defining the way work is done. Trust is at the best of times highly fragile in that years of good faith and trust can be broken relatively easily. Recruiting and retaining the best quality staff however depends on it.

Despite working shorter hours, the rest of Europe is more productive than the UK generally because these countries employ better skilled labour, and they are better at organising work and using information technology to promote efficiency [59]. This implies that UK businesses must invest more in its workforce and must re-define the traditional hierarchical order of command and control in order to become more productive.

UK businesses must learn to trust its employees to define their own working contexts and in turn they can request that employees trust that measurements and mechanisms of performance and effective coordination will be applied in a fair and ethical manner.

This leads all stakeholders into the unknown where there is everywhere to go and nowhere to hide.

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Tomorrow's Work

Tomorrow's Work (TW) is a long-term project and comprehensive study, initiated by Microsoft, to explore how UK citizens will behave, work and succeed in their professional environments in the information age. It is designed to identify and highlight the need to build IT infrastructures that will support changes in business and working practices, and in which the new features and functionality delivered by technology innovation can add value.