Trends of Knowledge Work and Needs for Knowledge Work Tools

Re:Know White Paper

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Introduction

In this white paper, we present our analysis of ongoing trends of knowledge work that are particularly relevant for the development of tools, methods and information systems for knowledge workers and knowledge work organizations. The identification of relevant trends was based on existing trend reports[1], workshops with knowledge work organizations (including law and management consulting companies), a participatory event organized on the theme of knowledge work information systems, and other forms of environmental scanning. This work is a part of the Revolution of Knowledge Work project[2] (Re:Know, 2013-17).

In our view, the ongoing developments in the general field of knowledge work can be divided into two categories: *trends* and *needs*. Knowledge work *trends* are indicative of large-scale changes in the overall knowledge work environment, in the practices of organizations or workers, or in the technologies that are employed in knowledge work. The trends we have identified are major in the sense that they describe processes that have a large impact on knowledge work, and relevant in the sense that they have implications for the development of knowledge work tools. These trends, and particularly interactions between the trends, give rise to *needs* of knowledge workers and knowledge work organizations. Whereas trends are abstract and long-term developments, needs are smaller-scale and concrete. They are also actionable in the sense that concrete tools, methods and systems can be developed to meet them. We think this division into trends and needs is fruitful and helps finding the issues to focus on.

The scope of the identified trends reflects our research agenda: we are interested in information-seeking and sense-making methods in the knowledge work context, and investigate ways to combine the potential of human creativity and the capability of computers to handle data. Therefore, we have purposefully not aimed at capturing all aspects that are relevant to the future knowledge work. Instead, we have focused on the aspects of the trends that are relevant to the development of tools and methods that can support the workers and work organizations. Societal and organizational considerations are therefore very much relevant, but approach to them is technological. Concretely, this means, e.g., that in the context of work automation, we focus on the ways to support the human worker to work efficiently and meaningfully alongside the automated tasks, instead of focusing on the pressing societal impacts of the changing demands for human labor.

This white paper is an intermediate product, and the analysis of trends and needs are based on our current understanding. The work will be continuous during the project, and the trends and needs listing will be updated as our understanding increases.

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[1] See the reading list section on the final page of this paper.

[2] We wish to thank the project members for their contributions to this work. More information on Re:Know can be found on the final page of this paper.

Trends of Knowledge Work

We have identified six major trends that affect knowledge work. *The Norm of Work* describes the emergence of knowledge work as typical, common, everyday type of work all around the world. *Diverse Knowledge Workforce* is brought about by the diversity of the people working even for a single organization, not to mention whole value networks. *Project Work & Freelancing* arises from how the boundaries within and between organizations fade as work is organized in temporary projects done by people with temporary affiliations *Bring Your Own Tools* refers to the urge the increased possibilities to use personally preferred tools as worker autonomy increases. *Work Automation* describes how automation is becoming a versatile and irreplaceable supplement for human labor also in knowledge work. *Data Diversity* describes how the availability of data, also about knowledge workers, transforms the ways of value creation.

The Norm of Work

Societies globally undergo a transformation from industrial to information societies. Knowledge work is starting to become the norm of work in the old industrial countries, and increasingly also in emerging markets. Generations with higher education enter the workforce, technology replaces manual human labor, and skill levels increase on the average. Accordingly, phenomena and practices related to knowledge work also become the norm. Work in general, not just in a select few occupations or places, is becoming independent of location, time and tools. When work is increasingly not tied to locations, work and free time are blurred.

Diverse Knowledge Workforce

ICT-enabled tools make remote work and offshoring a feasible option in increasingly many fields, and parts of the knowledge work labor markets are opened up globally. The retirement ages are on the rise in the old industrial countries and careers get longer. Often careers also get rebooted due to obsolete specialization or education. Consequently, the backgrounds and work experiences of knowledge workers are becoming diverse. These developments lead to differences in cultural expectations, work practices, education, and even cognitive abilities of knowledge workers.

Project Work & Freelancing

Knowledge work is increasingly organized around temporary projects, not stable job positions. Many knowledge workers are freelancers, but also the work inside organizations increasingly resembles freelancing. From an organization's point of view, in-house and external knowledge workers form a resource pool, and workers are assigned to projects based on required competences. Projects often become hybrids in the sense of being staffed with both in-house and external workers. At the same time, traditional hierarchies are deconstructed in many organizations. For individual workers, these changes mean constant marketing and maintenance of competences, and the precedence of reputation mechanisms over hierarchical positions.

Bring Your Own Tools

Unlike in industrial production, workers in knowledge production can often feasibly own the tools of their trade. Knowledge work tools include devices, software, applications, and the use practices such as workflows that combine several pieces of software. Common knowledge work tools are cheap and getting cheaper all the time. Many resources, such as computation time, are available as a service and can be used without large investments. Simplicity is beating sophistication and large monolithic systems are replaced by lightweight, purpose-built applications. Many individual tasks could be done using endless combinations of tools, but knowledge workers have personal and subjectively most efficient preferred toolsets.

Work Automation

The boundaries of technological capability continue to expand. In the long run, any repetitive or routine work, be it knowledge work or manual labor, can and will be automated. The algorithms and machines performing this automation will create wealth due to significant efficiency increases, but will also replace human labor. Human knowledge workers' strengths are in complementing the machines by creative thinking, intuition, collaboration, empathy and contextual adaptation. Currently, knowledge work automation is often "black box automation," where no transparency is offered to automation processes, which makes understanding the outcomes and limitations of automation difficult.

Data Diversity

Data is an important source of economic value and increasingly permeates all sectors of society. Converting the volumes of increasingly complex and heterogeneous data from diverse sources into meaningful results becomes an important part of knowledge work. While not everyone needs to be an analyst, many roles benefit from an understanding of possibilities and limitations of data analysis. Possibilities for data collection affect knowledge work in other ways also: as work organizations look for ways to leverage data for productivity increases, also knowledge workers become a source and subject of data.

Needs of knowledge work

From the point of view of knowledge workers and knowledge work organizations, the identified trends pose requirements for knowledge work tools, processes and organization of knowledge work. We call these concrete, actionable requirements the *needs* of knowledge work. Even though we realize these issues are not only technological, we focus on the needs that can be responded to with development of better knowledge work tools.

As such, the identified trends give rise to needs. However, in our view, the most interesting requirements for tools actually arise not from the trends as such, but from interac-

tions between the trends. Two specific interactions were identified as important primary sources for needs:

- The interaction between Bring Your Own Tools and Project Work & Freelancing;
- The interaction between Work Automation and Data Diversity.

It should be stressed that the needs arising from these interactions are also to some extent affected by other trends. In addition to these specific interactions, we identified needs that arise from the interactions between The Norm of Work and Diverse Knowledge Workforce, but are more clearly affected by various other trends also. The interactions between the trends as a source of needs are visualized in the figure.

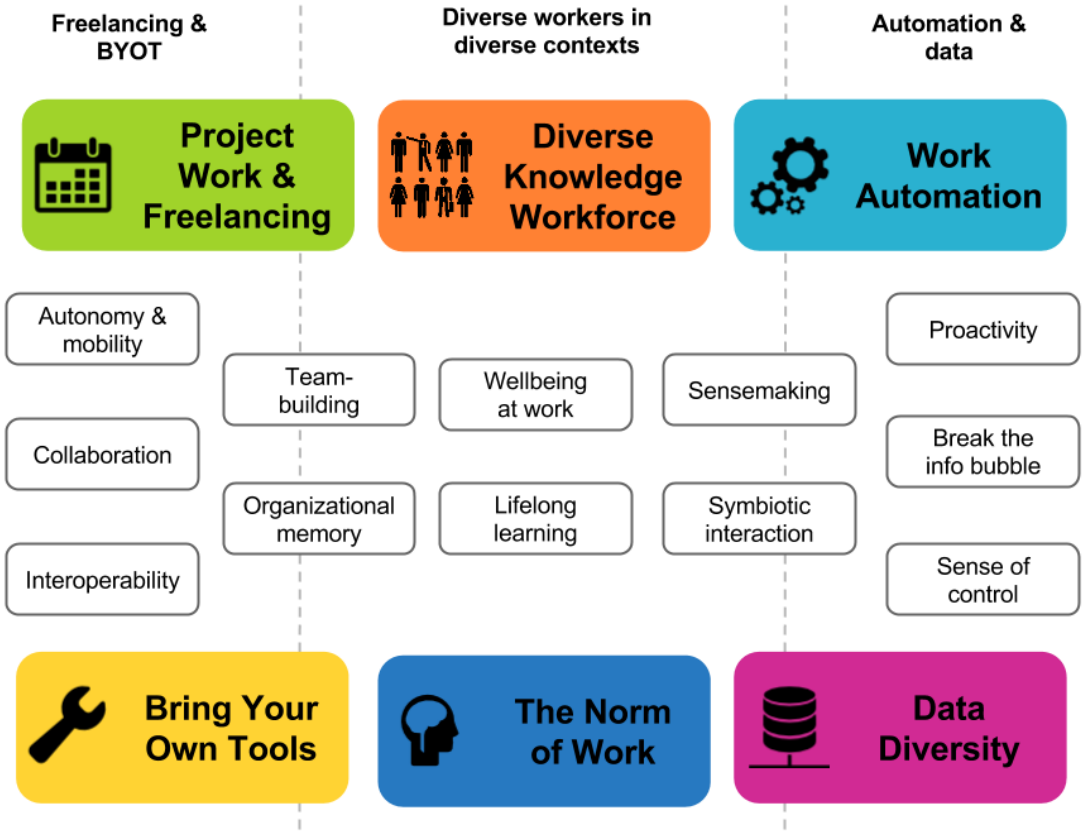

Figure. Interactions between knowledge work trends give rise to needs of knowledge workers and work organizations

Below, we describe in detail these relevant trend interactions and the needs for knowledge work tools that arise from them. Some of the identified needs can be interpreted as requirements for certain tools or functionalities, but more often they are general principles of how systems should operate.

Project Work & Freelancing + Bring Your Own Tools

The trend to organize work around projects, and the tendency of projects to have team members and participants with various organizational backgrounds highlights the role of interoperable knowledge work tools and environments. Since the participants are often not under the same organizational umbrella and generally do not have standard toolsets, various kinds of tools need to interoperate to make collaboration possible. Tools that lock the users in proprietary data silos can become a significant hindrance to collaboration and autonomy of the workers, whereas properly designed tools can facilitate collaboration among project members and can make work in various and varying contexts possible and efficient. The specific needs arising mainly from the interaction of these two trends are:

Collaboration
Tools can provide help in enabling sustained engagement and improved interaction in collaborative situations.

Interoperability
Making the use of preferred tools possible increases efficiency. Interoperability between tools also facilitates collaboration.

Autonomy & mobility
Support for working in many roles, projects and organizations. Access to key resources anywhere is important, independent of organizational affiliations.

Work Automation + Data Diversity

The interplay of the trends of work automation and data diversity together describe a situation where knowledge workers try to cope with information overload by employing different sorts of search, recommendation and filtering systems, but have limited capacity to understand and see through the different ways these computer-aided processes affect and limit the information they actually receive. The specific needs arising mainly from the interaction of these two trends are:

Break the info bubble
Workers need to reach outside their information bubbles. The black boxes of automation need to be opened for evaluation.

Proactivity
Workflows can be improved with pro-activity, such as providing recommendations for actions without explicit request.

Sense of control
Amidst the automation, workers need to understand why things happen and how the outcomes can be affected.

Diverse workers in diverse contexts

As a summary of all trends described above, we conclude that the knowledge worker population is getting increasingly diverse, and simultaneously the work situations get more complicated. Workers with various backgrounds, skills, education and abilities need to be able to interact using a multitude of tools and collaborate across organizational boundaries and geographical distances in varying roles and contexts, all the while adapting to different requirements and expectations. Tasks are in many cases fragmented, and the workers need to constantly switch between different tasks. In addition, every task and all working styles will not change in the same way, and some specific jobs and organizations can also be very resistant to change. The specific needs arising from these interactions between the trends are:

Teambuilding
Complementary team skills are crucial. Tools can match skills and abilities with projects and optimize team composition.

Sense-making
Tools should increase the human ability to find meaning from information and to combine information from different sources.

Symbiotic interaction
Human workers need to work with the machines, not against them. Let the computer do what it does best and the humans what they do best.

Organizational memory
With proper tools, tacit knowledge can be first turned into an organizational asset and then managed efficiently.

Wellbeing at work
Knowledge worker well-being is a competitive edge. Cognitive capabilities and limits need consideration from the outset.

Lifelong learning
Tools can help adaptation to new demands by supporting continuous and self-directed learning in the work context.

Conclusions

Looking at the identified needs, it is clear that some of them are contradictory. For example, from the worker's point of view, the need for more proactivity can conflict with the need for sense of control or the need to break the info bubble. Also the needs of workers and work organizations can be at times conflicting, e.g., on the ownership of the knowledge created during freelancing projects. These friction points – between the worker's conflicting needs, and between the needs of workers and organizations – raise interesting issues for tool development and organizational and process setup. Balancing with the contradictory expectations is something that tool development has to consider.

The organization of knowledge work, the ways of working, and also the workers are becoming increasingly diverse. The constant in the changing knowledge work landscape is the individual who needs to adapt to different scopes of knowledge work, situations, collaborative environments, organizational contexts and specific tasks. The individual knowledge worker, therefore, should be placed in the center of the tool and method development. Ways should be found to support efficiency, cognition, health and wellbeing

of the knowledge worker. In other words, tools and methods should be knowledge worker centric instead of being organization centric.

The role of this white paper is to summarize the work done so far, and to highlight the issues we currently find to be the most relevant. The work is ongoing, and we will continue to use the same framework of identifying relevant trends, their intersections and needs that cut across several trends.

Reading list

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Revolution of Knowledge Work (Re:Know)

A huge amount of information is spread out in various data silos. The current systems and search engines have inflexible views to the data and they have only a limited ability to study the large data masses, leaving knowledge workers trapped in individual information bubbles. Current systems constrain the work instead of supporting the combined potential of human creativity and the capability of computers to handle big data.

The project combines the multidisciplinary world-class expertise in machine learning, human-computer interaction, distributed computing, cognitive neuroergonomics and human factors at work, available within Helsinki Institute for Information Technology HIIT and the Finnish Institute of Occupational Health. Our objective is to develop symbiotic human-information interfaces, which pave the way for a revolution of knowledge work.

Symbiotic human-information interfaces combine heterogeneous data sources and utilize the context of use and user actions to jointly with the user determine what information is most likely relevant, and provide the user with a new type of interactive and proactive interface to the data. In the context of knowledge work, we use our know-how on both computational principles and how humans process information to develop a new information management and utilization paradigm, enabling humans and computers to support each other optimally.

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http://www.reknow.fi/