The future of User Interfaces
Challenges and new paradigms for enhanced digital workplaces
The fundamental changes that humanity has faced in the last two hundred years are staggering. Continuous change is an essential law of nature, driving evolution and enabling species to adapt to their changing environments. And as humans, we are not only experiencing this process of change, but we are in part also driving it.

Great paradigm shifts are no longer typical, instead we can experience a continuous stream of ‘micro-changes’, occurring at an exponentially increasing rate. Our entire ecosystem is subject to these hidden and irrevocable changes that may lead to economic, political and social revolution. Digital technologies, especially artificial intelligence (AI), have profoundly changed the way in which we live, and also the way that we work. In the case of the workplace, once defined only as the physical location where the employees work and which contained all of the infrastructure needed for performing their tasks, but today the workplace has moved far beyond this concept, becoming more flexible, diverse and decentralised.

“Cognitive Hub is the platform powered by Konica Minolta to manage other intelligent platforms for data analytics, environment sensing, semantic understanding of data, and for management of distributed robotics.”

Within a digitally evolving environment, Konica Minolta is defining Cognitive Hub as a federated system capable to orchestrate AI services and agents. Cognitive Hub is an umbrella platform that manages other intelligent platforms providing data analytics, environment sensing, semantic understanding of data, and management of distributed robotics, all of which will enable us to enter the Workplace of the Future¹.

Eight challenges for wellbeing in the workplace

Recently Konica Minolta conducted internal research based on a user-centred design approach and performed a set of desk analyses, design-thinking workshops, and interviews with end-users about problems and needs in current workplaces. These pain points have been clustered in eight categories that represent a set of challenges; with Cognitive Hub, Konica Minolta aims at overcoming these difficulties to provide opportunities for employees to increase their efficiency and satisfaction within the workplace and their overall wellbeing.
**Task management.** Tasks can originate from both structured (e.g., Microsoft Project) and unstructured sources (e.g., e-mail and chat conversations). People invest significant effort in maintaining an overview of their tasks and often spend considerable time performing administrative tasks. An augmented intelligent system enables employees to focus on tasks that are more relevant for their company’s overall objectives rather than on those which they perceive themselves as more urgent.

**Integrated overview of information.** When information is channelled through multiple sources (e.g., e-mails, passwords, chat conversations, newsletters and web page updates) it is increasingly challenging to monitor, organise and integrate it. Rather than organising data in multiple folders with the consequent duplication of information, an automated system that focuses on a task centric approach enables teams and individuals to achieve a more integrated and efficient management of data.

**Information overload coordination.** Overload of information will become an opportunity for employees. The coordination of many sources of information, including management of documents, e-mails and chat conversations, will leverage an optimised organisation of tasks, and their deadlines and processes and will enable a deeper understanding of the context in which teams and individuals collaborate.

**Transparency of information.** Transparency of information and sharing of knowledge must become a common practice among different teams, colleagues and departments within a company, so that gathering information becomes easier and faster. Thanks to information sharing practices, searching for information will become easier among the many sources of data used by different working teams within the same environment.

**Productivity Increase.** When employees are aware of the final objectives and able to exploit an improvement in the coordination of information they will be able to increase their productivity through focusing on relevant tasks at the right time. Unplanned interruptions can be managed in a similar way: by delegating repetitive tasks to automated systems. Creativity can therefore be fostered by: increasing social interactions; taking part in heterogeneous work activities; being part of distributed teams; living in a dynamic environment; and having opportunities to take part in recreational activities.

**Fostering collaboration.** Even though collaboration helps people to balance workload and build team spirit, the proper organisation of meetings is perceived as a critical task. To improve collaboration and conduct effective meetings there is the need to define an agenda properly: the structure; the time allocation; essential participants; keeping the discussion on topic; and obtaining a suitable meeting room with appropriate equipment. Another key element is to develop more natural and intuitive approaches through user interfaces that can support teams and individuals when collaborating in meetings.

**Fostering communication.** Standard and automated communication methodologies will improve comprehension and enable successful execution of tasks. A clear allocation of employees’ skills and responsibilities is also needed for successful task delivery.

**Increase motivation and satisfaction.** Even if work takes lower priority than personal life, professional growth holds high value for personal satisfaction and many factors influence this such as: the acknowledgement of one’s own work and skills; reduction of routine work and flexible work hours; and a healthy work-life balance. Social interaction and a comfortable office environment can also influence motivation and satisfaction of employees.
A new metaphor to interact with AI systems

Many of the challenges related with information management can be partially attributed to the so-called desktop metaphor approach, which has dominated the way that computers work for more than half a century\(^2\). Within the desktop metaphor the overview is file-centric: the computer monitor is used as a desktop with stacks of files and applications that are organised into a folder system. When a user wishes to perform a task, they often need to manually retrieve files from multiple folders and switch between multiple applications. In the era of information overload, the desktop metaphor becomes a limitation that can no longer optimally support our work.

Inspired by the ‘lifestream’ concept\(^3\), Cognitive Hub goes beyond the desktop metaphor to define an agile and intelligent workplace. In today’s world everyone, no matter the job role, performs activities belonging to three layers termed as: strategic, tactical and operational, with the worker dynamically switching between them. We are explicitly unaware of these levels and so move between different activity-types without conscious decision. Cognitive Hub provides a framework to support people to both visualise and improve the management of their work tasks at the three different levels.

The significance of strategic work is that it provides a link between what users do (tasks/activities) and what they want to achieve (goals). These links are of the utmost importance to identify the ways a the user works that are captured in a map that we call SELF (Semantic Enrichment and Linking Framework). Within this framework, different channels and sources of information are unified and analysed by the Semantic Platform\(^4\) within Cognitive Hub to generate an activity stream. Tactical work refers to the short-term, fast actions that once efficiently solved, enable users to focus on more significant tasks. Operational work requires the user to spend a longer period of time when focusing on these larger tasks. The operational work process is enabled through a full-screen mode, in which all of the digital contents associated with this activity are available, including relevant previous activities (meetings, communications, emails, chats, other people involved, documents, images, videos, etc.). Automated filtering between these activities enables people to focus on particular goals and achieve more successful results.


\(^{3}\) Ibidem

Interfacing with Cognitive Hub: our vision

To support Konica Minolta’s vision and improve the user experience, Cognitive Hub features innovative modalities that interpret emotional and cognitive states of individuals and exploit multimodal interfaces.

Mediating with humans’ emotional and cognitive states

Human-beings’ capabilities are influenced by emotion and cognition; in an open office environment, a non-intrusive and feasible way to detect a user’s emotional state is to analyse facial expressions based on camera data input\(^5\). Similarly, an eye-tracker is a non-intrusive sensor that can enable the recognition of cognitive states, such as arousal, fatigue, and overload\(^6,7\). Another approach to monitor physiological signals connected with emotional and cognitive states is to use a smart wrist-band; and in private office rooms and meeting rooms the user state can also be detected via speech input\(^8\).

When a user’s state is recognised, the system can adapt to it in two ways to provide either an immediate response or engage in a longer-term interaction. The immediate adaptation is mostly applied to negative user states (e.g., fatigue or anger) so that the system can propose corrective actions to improve the user state. The longer-term adaptation is more often applied when recognising positive user states, where the system can then learn what makes the user happy over a longer period of time and registers this information as a personal preference.

Multimodal interfaces

The traditional keyboard and mouse are the earliest developed input modalities for human-computer interaction. After the turn of the century novel modalities such as touch, voice, gesture and gaze have made their way into applications in several domains including consumer electronics, automotive, gaming, advertising, manufacturing and entertainment\(^9\). However, in the office environment, human-computer interaction is still solely based on the keyboard, mouse (or trackpad) and the conventional windows-icons-menus-pointers (WIMP) interfaces.

A Cognitive Hub workstation will be equipped to support voice, touch, gaze interaction and multimodal interaction so that multiple modalities are available at all times allowing users to choose between modalities based on the task characteristics, the environment and their personal preference. They can select different modalities for different tasks, or even switch between modalities for different steps within a single task and combine multiple modalities into a single input.

Multimodal interaction presents a paradigm shift from the conventional WIMP interfaces towards providing users with a more natural interaction and greater expressive power, flexibility, efficiency and robustness\(^10\). Multimodal interaction is natural, it provides users with flexibility, and improves efficiency of memorising processes and the robustness of the interaction, reducing the occurrence of errors\(^11\).

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\(^6\) “Automatic classification of eye activity for cognitive load measurement with emotion interference”, Chen and Epps 2013.
\(^7\) “Fatigue Detection Based on Eye State Recognition”, Zhang et al., 2017.
\(^8\) “Emotion recognition in naturalistic speech and language – A survey”, Weninger et al., 2015.
Shaping together User Interfaces of tomorrow

Building upon Cognitive Hub capabilities to accommodate individuals and teams within different cognitive and emotional conditions, we are developing more intuitive and natural approaches to collaboration and information management. User interfaces have the ability to have a profound impact on future developments of AI-based systems that will be part of our workplace of the future.

Konica Minolta is committed towards creating new modalities to interact with Cognitive Hub’s multiple platforms that are currently under development in our laboratories in Europe, Japan and the United States. Get in touch if you are interested in further discussions around designing and using new paradigms for AI solutions.

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