The evolution of artificial intelligence in workplaces

Artificial Intelligence series

Cognitive hubs for future workplaces

In the last decade, workplaces have started to evolve towards digitalisation. In the future people will work in digitally connected environments where personalisation is enabled, collaboration is improved and data sharing and information management are automated. Ultimately, these future workplaces will provide context-aware artificial intelligence (AI) and decision support that leverage both localised information and broader community knowledge whenever needed. Such digital workplaces will rely on the availability of data and, more importantly, on the ability to analyse and produce meaningful and valuable insight from it.

The workplace of the future has become a key focus area for Konica Minolta. We see it as a network of people, sensors and devices that, when combined, create a digital cortex[1] by understanding the world around it. The emergence of AI, combined with deep learning technologies and new business models, is already enabling Konica Minolta to manage information flows in these digital workplaces.
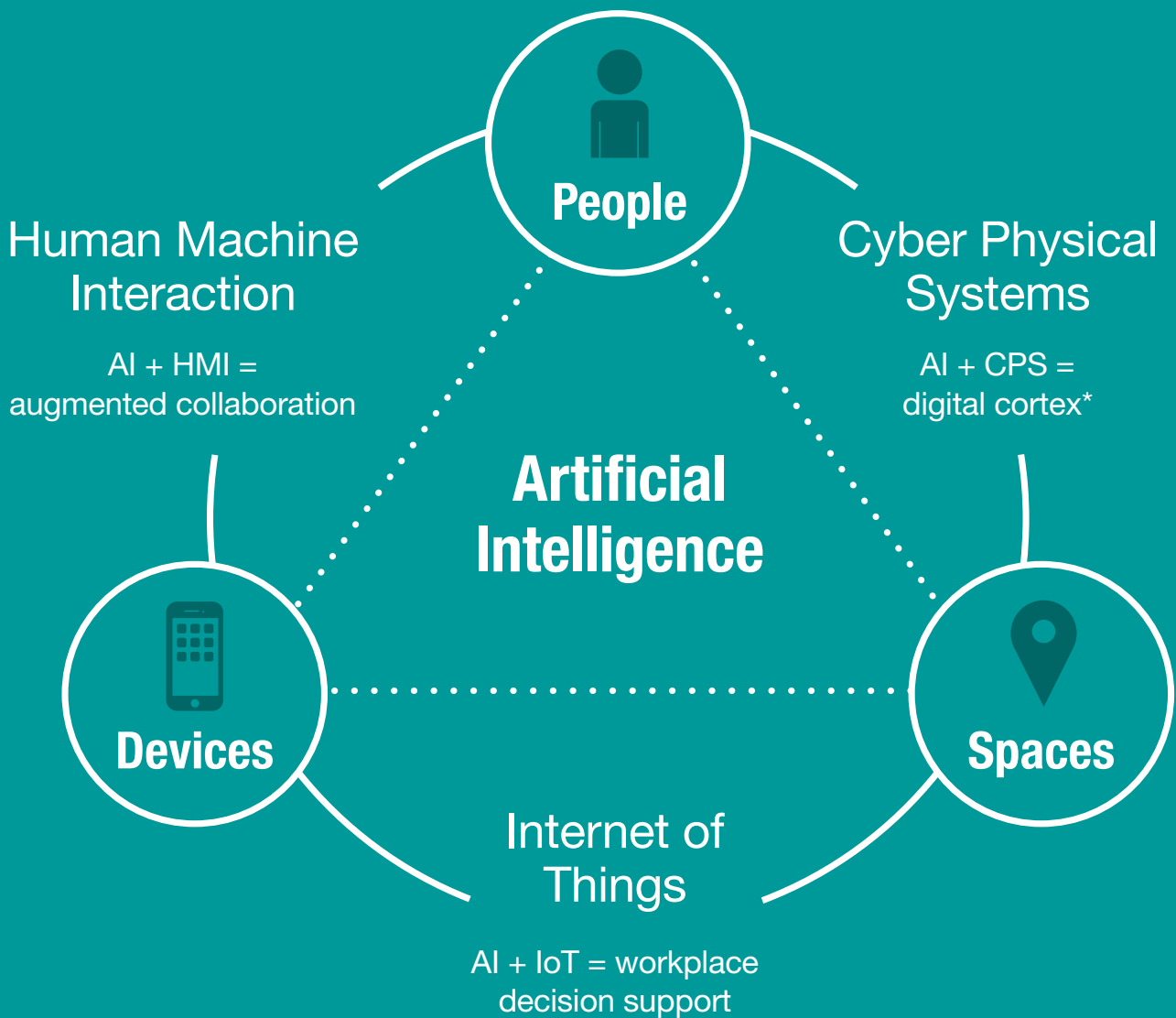
In the future, workplaces will be the natural environment in which the evolution of cognitive or intelligent hubs will lead to a paradigm shift in the creation of AI.

We believe there should be a transition from the traditional approach of engineering AI based on a designed-by-logic methodology to one that is initially more chaotic in nature, but ultimately results in the generation of self organisation[2]. This is a challenging transition that will play a small but significant part in the evolution towards a real AI that will unleash an intuitive understanding of the world around us and will enable people to make better decisions about their business and life.

"Our vision is to create a cognitive hub that is not simply a new device but an entirely new cyber-physical platform."

[1] The Genius of Things: Driving Real Value from the Internet of Things, 2015.

[2] Self organisation is the spontaneous often seemingly purposeful formation of spatial, temporal, spatiotemporal structures or functions in systems composed of few or many components.

People

Human Machine
Interaction

AI + HMI =
augmented collaboration

Cyber Physical
Systems

AI + CPS =
digital cortex*

**Artificial
Intelligence**

Devices

Spaces

Internet of
Things

AI + IoT = workplace
decision support

*Digital cortex is the combination
of sensors and edge devices with
distributed AI to form a digital
membrane enabling better and
automated decision making.

A brief history of AI

Since the first appearance of the words "artificial intelligence", usually associated with John McCarthy's 1956 Dartmouth Summer Research Project, interest in the topic and research into the development of intelligent machines has seen several ups and downs. Some of the most influential ideas related to AI came from Alan Turing, who imagined computers created for simulating intelligence. He investigated how intelligence might be tested and how machines might automatically learn. However, in the early age of AI, Turing did not have the computing resources needed to translate his ideas into action.

Since then, many successes have followed including heuristic search, the first applications in computer vision focusing on character recognition and then facial recognition systems, natural language processing, mobile robotics and the first examples of machine learning. And in 1957, Frank Rosenblatt's perceptron set the basis for the field of artificial neural networks.

By the 1980s, even though considerable conceptual progress had been made, very few significant practical successes had been reached. This gap between theory and practice caused what was then termed the "AI winter", when interest in this field greatly diminished. This state persisted until the mid-1990s, when advanced technologies started to enable engineers to build robots more easily, large amounts of data became available due to the rapid spread of the internet, and the availability of greater computing power and storage to process this data allowed statistical techniques that were able to learn from it. AI re-emerged, building upon the latest advances of other scientific developments.

Today, it has reached a climax and has the potential to have a profound influence on our daily lives. Currently some sub-areas of AI research appear to be more "crowded" than others[3]. Nonetheless, the impressive successes recently achieved by Boston Dynamics' walking robots, IBM's Watson and Deep Mind's AlphaGo have been enabled by the smart integration of different technological solutions developed within many of these sub-areas, all of them under the umbrella of AI.

We can see how this smart integration is evolving from a purely software-based AI to a progressive adoption of neuromorphic computing hardware such as IBM's SYNAPSE and Google TensorFlow Processing Unit, both of which are enabling impressive leaps in increasing computational power and decreasing electric power consumption.

> "Today, AI has reached a climax and has the potential to have a profound influence on our daily lives."

[3] Artificial Intelligence and Life in 2030." One Hundred Year Study on Artificial Intelligence: Report of the 2015-2016 Study Panel, Stanford University, Stanford, CA, September 2016. Doc: http://ai100.stanford.edu/2016-report. Accessed: September 6, 2016

What does AI mean today?

Today, due to the scale of the challenge, research scientists still lack a digitally federated environment in which to fully sustain AI. Because of this, they typically deploy several types of shortcuts (such as heuristic approaches) to develop algorithms that represent their best bet of localising and managing views of specific intelligent logic. This takes the form of a centralised model that attempts to represent the intelligent logic researchers would like to use, then connects as much information and data to that as possible.

Many large companies and universities are using more and more computing power and connecting to more and more data. However, this is strengthening their analytics capability rather than building what we understand as their intelligence; the focus is on automation, not autonomy. So far, the focus on hardwired algorithms such as semantic or logic representation or neural mimicking and learning has not derived a solution that best represents intellectual logic. These approaches do not replicate the natural order within the universe and they are unlikely to efficiently yield the expected benefit from AI, at least in the medium term. Of course, in time this will be achieved – a natural organisation will take place. However, we will get there faster if we understand the basic patterns of how intelligence evolves in nature.

"So far, the focus on hardwired algorithms such as semantic or logic representation or neural mimicking and learning has not derived a solution that best represents intellectual logic."

The beginning of intelligence

Human intelligence is not tied to a set of specific algorithms or a central place to which we all go to retrieve data. It is influenced by our own environment and how we socialise and connect with others to survive and prosper. Many researchers also now believe that human intelligence is not just the result of a fortunate evolutionary trick; it is also directly tied to self organisation.

In certain areas of our universe, complexity is increasing – our own planet is a prime example. Recent scientific developments suggest that the universe naturally produces complexities and that all systems will increase in complexity. As disordered states of energy originally produced molecules and atoms, which then combined to create stars and then planets upon which life has evolved, the evolution of higher intelligence is a consequence of both increasing complexity (at the individual and environmental level) and random mutations generated by the environment, from its complexity and following standard evolution theory. This idea can be confirmed by observing how primitive cell structures have the tendency to interoperate with their environment. Increased intelligence in humans is not just a result of natural selection; it occurs in combination with increasing complexity and the social organisation of our environment.

In a similar way to the evolution of life on Earth, the internet can also be characterised by a disordered structure, a chaos from which self organisation appears. This concept of "self organisation" refers to the emergence of various kinds of social orders from a combination of self-interested individuals who are not intentionally trying to create order through planning. In contrast with "organisations", self organisations have no hierarchy: they are the result of human actions and not of human design. However, when we look at these emergent complex systems, fundamental patterns emerge. Two models in particular are of interest: tree-like structures (such as nervous systems, roads and rivers) and hub- and spoke-like structures (such as snowflakes, planetary systems and social systems). Here we can start to see the fundamental differences between biological intelligence and digital intelligence; digital intelligence is mostly built on discrete systems that are hardwired into our world and our own logic.

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The real challenges

In order to build a truly empowering AI we need to take a fundamentally new and broader perspective that builds a digital environment (including proposals for the infrastructure and social organisation) and enables digital intelligence to flourish. This means adopting the following set of resolutions:

- To build AI platforms that are additionally based on the laws of complexity and thereby exploit approaches linked to natural evolutionary models
- To evolve our existing cloud infrastructures to be more cortex-oriented
- To use the Internet of Things (IoT) as a consistent platform to create an interface that could work like a digital membrane in our physical world

Creating basic systems following these principles will bring us closer to the moment in which much more of our world can be better understood and even predicted, having optimised our capacity to be aware of the complexity of our world and our day-to-day activities.

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Both physical and digital worlds stand on the same fundamental building blocks: particles, atoms and matter. It is apparent that both will follow the same pattern of evolving to generate increasingly complex structures. Understanding and exploiting this will enable us to build AI in a way that is more efficient and empowering for the human race.

In order to build improved augmented intelligence or AI systems we need to leverage the complexity and natural structure of our own world and existence. We need to create more socially oriented and communicative systems that interact with us as individuals and groups in a more standard and universally structured way. We also need to build a supporting digital environment in which AI systems can navigate and operate separately and together in clusters.

With this in mind, by exploiting both digital content and the IoT we can build digital-like membranes in our own physical and human world. Of course this is not a trivial task and we therefore will need to build on what has already been discovered and created.

Workplaces are the environments in which we can develop digital membranes through which AI systems may evolve. The challenge is to start creating centred information points within enterprises where we can exploit AI in a more social setting. These hubs will work across the enterprise not only to leverage distributed intelligence in small groups, but also to exploit aggregated knowledge within the whole business.

Konica Minolta is progressing with the concept of intelligent or cognitive hubs within the workplace, which will provide not only localised insight and decision support but also enable these intelligent hubs to co-operate and collaborate to support both the workplace and the individual.

Our first steps towards cognitive hubs

Within this framework, Konica Minolta's vision is to create a cognitive hub that is not simply a new device but an entirely new cyber-physical platform. It will act as a nexus for clients' information flows within the digital workplace. By aggregating physical and digital data, Konica Minolta will provide intelligence-based services on top of it, which will be immediately and automatically actionable. In order to achieve this vision, we can describe our first steps with the following two examples of how we are developing new approaches to AI.

Firstly, we are developing systems that understand both data and the user. We see AI as the ultimate user interface, one that allows users to focus on their goal as opposed to the means to achieve it. To accomplish this ambitious objective, a smart system needs to understand the user's tasks, goals, needs and intentions, and even predict and connect with the relevant context. Our first step to achieving such a system is the concept of the semantic platform, the future technological basis upon which we will develop cognitive hubs. Currently, our focus areas for research and development are related to the management and processing of unstructured data, the integration of knowledge and reasoning and the evolution towards autonomy and AI.

Secondly, we are developing a platform that systematically correlates visual information about a user's surroundings with digital knowledge contained in an underlying enterprise database, which triggers the appropriate response depending on the context and the needs of the user. The platform will integrate multiple-sensor data with smart data collected at the semantic layer and information about the needs of the unique user.

We are also creating an industrial-specific operating system that can streamline information that will support users when they are performing activities in an industrial context. Acquiring, analysing and enhancing visual information leads to a verification process that will provide suggestions for users to create a seamless experience in the workplace, whether that be a factory, an office, a hospital – or the employee's home.

"Konica Minolta is evolving to become a problem-solving digital company by creating new value for people and society and using cyber-physical systems. We combine our core technologies with sensors that can convert visual and analytics data from the physical to the digital world. Data can then be converted to intelligence, which we provide to our customers as services and solutions."

Hirohiko Yamazaki - General Manager of Corporate R&D
Konica Minolta, Inc.

Talk to us

Exploiting Konica Minolta's long history of innovation, we have recently commenced research projects at our laboratories in Europe (KMLE) and in the United States (HLUS). We aim to elicit a transformation process for improving and developing new products and services in the smart systems domain and in digital workplaces, keeping customers' needs at the heart of our focus. We validate these new ideas through experiments, proof-of-concept and demonstration. The results of our activities provide us with a base for the development of new solutions.

Konica Minolta is working hard to make business better for its clients through innovations in artificial intelligence. We believe in the power of many, so we would like to hear from others who are also exploring and developing technologies and services in this area.

konicaminolta.eu
research@konicaminolta.eu