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AI, Making Software for Humans

Mika Yasuoka [*1]   Rune Møller Jensen [*2]

[*1] GLOCOM   [*2] IT University of Copenhagen

Artificial Intelligence (AI) algorithms are expected to have substantial impact on high-end white-collar jobs like lawyers, physicians, and financial advisors in a near future. A non-technical challenge of this development is that advanced Decision Support Tools (DSTs) often are rejected by practitioners or have low uptake. This paper proposes Living Lab as a design approach for developing human centered AI-tools. First, the paper exemplifies the use of AI in the current society with cases the authors are engaged in, and then show two design approaches for social implementation of AI. Based on the presented cases, the paper argues for the benefits of utilizing the Living Lab approach for societal AI.

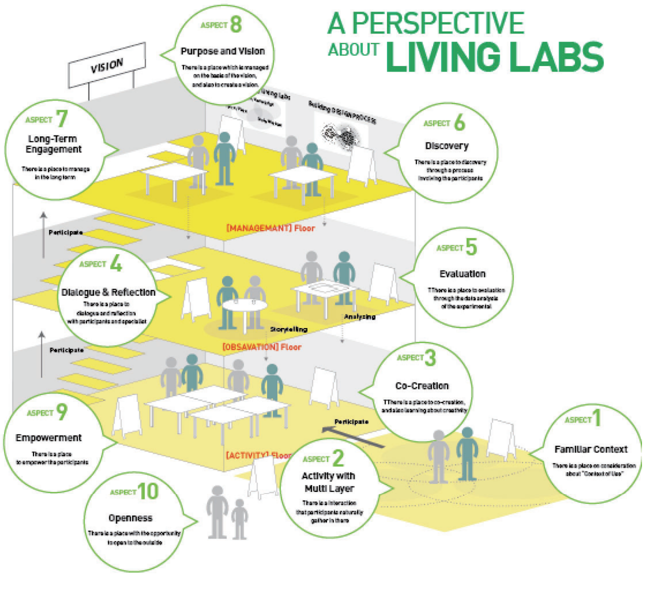
1. Introduction

Artificial Intelligence (AI) has attracted attention as well as raised uneasiness globally in the last decades. The advent of singularity, exceeding human intelligence, goes far beyond the comprehension of ordinary minds. The legendary forecast of human work in the future is that AI will steal work from humans. This has brought many ordinary people to the conclusion that they have no choice but to think about how AI will impact their lives. It is certain that AI changes the future of work, however, with which consequence is less agreed. As Hori argues [Hori, 2018], in our society, AI has been gradually embedded and melted into the society than ever and has become invisible to ordinary eyes. Liquid modernity [Bauman 2000] is happening to reality. At the same time, AI-based systems in high-end jobs comes in the form of Decision Support Tools (DSTs) that already since the expert system era in the 1980s have been known to be hard to integrate in work processes.

Based on four cases that the authors have been involved in, this paper portrays the present situation as well as near future scenarios, where AI enters every corner of society and blends into our daily lives. By presenting the application of two typical design methods of utilization of AI in society, this paper argues for the importance of social implementation through Living Lab approach by exemplifying presented cases.

2. Living Lab

Living Lab is a demonstration space in daily life context [fx. Ehn 2014; Yasuoka 2018]. In Scandinavia, it is generally regarded as a part of participatory design, and co-creation (Co-Design) approach for solving social problems with complex and high uncertainty. It can be used as innovative test bed in organizational context of IT development [Leminen 2013], and as a social innovation space [Bergvall-Kåreborn et al. 2009]. Ultimate goal of Living Lab is to design socially embedded IT systems in real life context with wider stakeholders. Bergvall-Kåreborn and colleagues define living lab as "a user-centric innovation milieu built on every- day practice and research, with and approach that facilities user influence in open and distributed innovation processes engaging all relevant partners in real-life contexts, aiming to create sustainable values.". In a conceptual model authors proposed (Fig 1), ten critical aspects for Living Lab is depicted; 1. Familiar Context 2. Activity with multi-layer 3. Co-Creation 4. Dialogue and Reflection 5.Evaluation 6.Discovery 7.Long-term Engagement, 8.Purpose & Vision 9 Empowerment 10.Openness.



<Fig.1; Conceptual Model of Living Lab>

The infographic utilizes a building metaphor with three floors, indicating community structure and its user involvements. Three floors consist of activity floor, observation floor and management floor. In this building metaphor, one user enters the building (community) and views each floor (aspects) step by step. This presentation indicates importance of; 1) widening view to understand current activities and plan future activities, and then acquire holistic view; 2) recognizing a progressive involvement process to the community; 3) categorizing and organizing activities with certain perspectives.

3. Applied AI Cases

In this section, exemplified with four projects that the authors are involved in, this section portrays how an AI embedded society and its future scenarios can be.

Contact: Mika Yasuoka, GLOCOM Address, Phone number, mika@yasuoka.dk.

3.1 Knowledge Transfer

Due to the advancement of describing human tacit and explicit knowledge in varied modes of data, knowledge management empowered with AI becomes a reality.

In our knowledge management project with a metal casting industry [Hirata 2018], we designed a knowledge transfer system *T2S2*, which captures and passes on distributed knowledge of metal casting experts. Traditionally, it was believed that the knowledge of expert craft practitioners was transmitted only through demonstrating practice in master- apprentice relations, and intuition accumulated based on their long experiences is indispensable. Thus, many companies including the company we worked with, had believed designing an intelligent knowledge management system was not possible.

Our achievement became possible only because we worked together with traditional skilled crafts practitioners at Living Lab. The longitudinal interactions with craftsman clarified that some explicit and tacit knowledge were describable intelligence while other knowledge remained at human hands, but supported by digital means. This field project implies human knowledge benefits from being described with different external representations.

The decision about which knowledge should be digitized relies largely on a deep understanding of the professional activity. For designing the knowledge management system, understanding of associated human cognitive activity in the field for a long duration was very important.

3.2 Big data and deep learning

The expectations of what we can do with large amounts of data have increased surprisingly. By collecting and analyzing human behavior data from sensors, AI deep learning might identify outliers in human behavior and improve quality of life.

The REACH project[1] is a five-year EU Horizon 2020 project [Schäpers 17], conducted by a consortium consisting of academic institutions, medical and healthcare organizations, healthcare IT companies, insurance companies, municipalities, and citizens from Denmark, Switzerland, Netherlands and Germany. The objective of the project is to develop REACH health eco system for senior citizens, which detect outliers and intervene in daily activities through monitoring and big data analysis of health conditions based on real data from installed and wearable sensors.

To achieve this goal, REACH applies the Living Lab approach for collecting the feedback and input from users. By developing the system together with stakeholders, the REACH experienced various changes in data collection methods, data utilization, implementation of field inputs to eco system design in earlier stage. For example, personal health data through wearable sensors was originally regarded too sensitive to collect. However, our study showed that accumulation of trust in the systems could easily overcome this sensitivity challenge. A good balance on adequacy of behavior advice, ethics towards implicit motivation push (nudge) is another challenge to be negotiated along the way.

This project implies that interaction with users at stake can clarify which data is usable and what data granularity is needed for analytics.

3.3 Network

The possibility of discovering relationships among humans, between humans and things is expanding as the relations can be visualized in more detail.

This project with KDDI aims at designing better communication support systems among family members. Starting with a field study and a qualitative data collection in 2017, the project conducted a long-term Living Lab experiments with test system, by inviting ordinary households and its family members. Together with target families, the project also conducted a few concept development workshops, using a typical concept design methods. While the majority of proposed ideas at the workshop were novice and creative, many ideas focused only on either convenience or efficiency in communication. Interestingly, quantitative fields data from long-term Living Lab experiments, and interviews showed the importance of "role play" among family members and interaction on family role communication. All families with own roles (37% of all target families) tend to successfully utilize the system for longer periods with higher satisfaction rate.

This project implies that it is critical to understand values acquired in real-life contexts to get design implications. Given the support of social networks in the future, closed laboratory settings or innovation workshops can only offer limited understanding of real of social relations and networks.

3.4 Planning

Planning algorithms are changing the actual business. In the stowage planning of container ships, skilled workers usually spend 2-3 hours to allocate all containers for each port. For a long time, stowage planning is regarded as a field of experiences skilled workers as in traditional crafts, and untouchable for AI researchers. Typical academic stowage planning system has often been made based on the fictitious data and unrealistic contexts.

SAM, the stowage planning system designed based on the detailed field observations on stowage planners work process, in collaboration with stakeholders, achieved a record stow in 2018. At the present stage, it is indispensable to understand and reflect the detailed process of stowage experts for the algorithm. The result indicates that the stowage system is a system not for replacing humans, but for supporting decision making. At least now, the world record stowage system does not reach to the conclusion that all stowage process is to be automated.

This project implies that current DSTs require in-depth understanding of the work process of professionals to be used in a real-world context. With high probability, future DSTs require that human experts take final decisions due to their responsibility of the solution. Interleaving automated decisions carried out with AI tools with decision points of responsible humans in a seamless work-process is a major challenge for many white-collar applications of AI. Research on DST uptake in other fields [e.g, Rose, 2016] summarize bottom-line performance, ease of use, trust, cost, and work process compliance as some of the key success factors for DST uptake.

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[1] http://www.reach2020.eu/ REACH (*Responsive Engagement of the elderly promoting Activity and Customized Health care*)

4. Two Design Approaches for AI

If AI is to be used in society and to be positioned to support humans, it is essential to understand situated human behavior in depth. There has been, largely speaking, two approaches to design AI in society from human centered perspective. The first is a conventional technology driven approach, which adjust architecture to fit to the societal needs. For example, current work attempts to make machine translation available for daily life [Ishida 2011]. The machine translation receives particular context based knowledge by defining contexts of use such as hospital situation and sightseeing situation.

The second is a usage-need driven approach. It first investigates situated human behavior and then realizes human needs for advanced intelligent systems. The co-design approach as well as stakeholder involvement approaches such as Participatory Design [e.g. Ehn 2014 & Yasuoka 2018] and Living Lab are typical examples.

5. Why Living Lab for AI

Living lab is particularly relevant for the AI community. AI is an exploration of human intelligence, but still discussion for application of AI in society and socialization of AI has been quite limited for a long time. Today the situation is changing drastically. AI in society is more obvious, thus cognitive support becomes indispensable when considering AI. AI will soon produce intimidating software, if it not already is. As shown in Case 1 (Knowledge transfer) and Case 4 (Planning), craftsmen and planners are hesitant towards intelligent system because of their fear of AI invasion to their territory. For them, it is difficult to judge what to compromise and to understand the limitations of AI. It was hard for them to appropriate AI as supportive for their expert activities.

In Case 2, the senior user may not define their behavior change is based on self-decision or their motivation is manipulated or nudged. Thus, people probably conclude that they will not want to use AI. However, when trust is granted, and when tacit knowledge and its visualization in system actually helps further refinements of their casting skills (Case 1), and when visualized foot step records became a trigger of taking a walk (Case 2), the advantage of incorporating human activities with AI can be positively recognized.

This paper is an initial attempt to bridge current AI and society from Living Lab perspectives. It first introduced four cases that the authors were involved in to exemplify the challenges of adopting AI in society. Living Lab can be one of the indispensable instruments to consider future socially embedded AI design.

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