Dashboards for Long-Term Productivity in Future Work

A position paper

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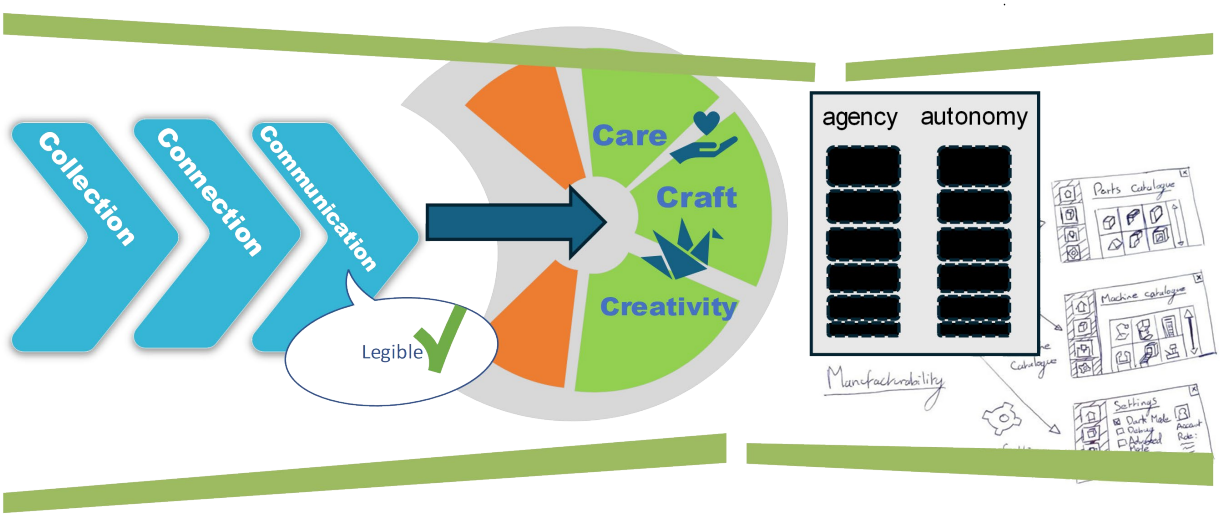

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Operating under Resource Scarcity

Future work processes are going to change in several aspects. The working population (at least in Western European countries) is decreasing, while average age of employees increases. Their productivity is key to continuity in sectors like healthcare and manufacturing. Health and safety monitoring, combined with prevention measures must contribute to longer, more healthy and more productive working careers. The 'tech-optimist' approach to increase productivity is by means of automation and robotization, supported by IT, AI and heavy capital investments. Unfortunately, that kind of automation has not yet fulfilled its full promise as productivity enhancer as the pace of automation is significantly slower than anticipated and what productivity is gained -for instance in smart industry and healthcare- is considered to be 'zero-sum' as flexibility is equally lost (Armstrong et al., 2023). Simply 'automating' tasks too often leads to 'brittle technology' that is useless in unforeseen operational conditions or a changing reality. As such, it is unlikely to unlock high added-value. In healthcare industry we see "hardly any focus on research into innovations that save time to treat more patients." (Gupta Strategists, 2021). Timesaving, more than classic productivity, should be the leading argument in rethinking the possibilities of human-technology collaboration, as it allows us to reallocate our human resources towards 'care', 'craft' and 'creativity'.

Rethinking Productivity

Having said that; due to this reallocation, certain jobs are bound to disappear while others must be recrafted. Clerks, secretaries and accountants are amongst the job profiles that are heavily impacted by technology, (robotic process) automation and prompt engineering (World Economic Forum, 2023). In manufacturing there is a shift from worker/operator to higher-skilled manufacturing engineers. In (health)care job profiles are expected to change due to bigger role of technology, still in this sector 'physical abilities' remain to be considered an important skill. In general though, also future 'care, craft, creativity' work is more information-intensive and requires a higher digital literacy.

Historically, productivity increase has been driven by technology and 'trading work with machines'. The new paradigm is to empower workers through the use of digital devices endorsing a human-centric approach to technology (EC, 2022) hence 'share work with machines', and equally important: 'trade & share with clients'. This self-service by clients for instance helps to release the burden on healthcare professionals, such that more time remains for tasks that benefit from truly human interaction. When designing for optimal 'trade & share' two criteria are important: 1-How does this help to save-up time for work where 'human contribution' is most fit, meaningful and value-adding? 2-Is this distribution of work contributing to health, safety and wellbeing of the workers during their career? Productivity is classically defined as real economic output per hour produced. We argue to look beyond economy alone and include the 'fitter, healthier' criteria, hence define productivity based on long-term societal output.

Connectivity and real-time monitoring of machines and workers play an important role in the future of work, for two obvious reasons: -To optimise allocation of work between human and human-centred technology (like cobots, extended reality, decision-support systems) process and -for manufacturing- product statuses have to be tracked real-time, and compared to available resource capabilities and capacities. -To assist workers to execute their jobs in a safe manner and to keep exposures to harmful agents as low as possible. This can be achieved by employing smart sensors such as wearables and prevention by work protocol improvement.

A central role for 'Information Instrumentation'

The key statement of this paper is that 'Information Instrumentation' like dashboards will play a central role in realizing this 'long-term-productivity'. Why? Two main arguments are: 1-By offering 'self-service' and monitoring instruments to clients these services become less time-bound, a client's autonomy is enhanced and as a welcome side-effect less time is demanded from caretakers, maintenance engineers or other scarce resources, rendering them more efficient. 2-By augmenting worker capabilities and capacity, by means of assistive technology their agency is increased (Jong et al., 2024; Romero et al., 2016).

A dashboard is an information management tool that tracks, visualizes, and demonstrates indicators. (For the sake of argument: an Human Machine Interface (HMI) is a subtype of dashboards, while a digital twin

can be used as a dashboard.) Dashboards should be intelligible and constructive to their end user (Robbins et al., 2021); This so-called legibility is an important design principle dealing with interpretation, communication, usability and transparency. As such, dashboards may enhance agency of clients and professionals, by increasing perceptiveness, awareness leading to ableness to act and autonomy. No need to say that this requires good, legible dashboards but also, no less important, trained users with sufficient digital literacy. Good dashboard design takes user's cognitive limitations (under the circumstances the dashboard is used!) into account; digital literacy refers to capabilities as using the offered functionality in the digital environment (like filter and search, using hyperlinks), content evaluation and knowledge assembly from the screen. A good dashboard is customised for a specific audience, and user-centred.

Changing Nature of Information Instruments

(Purich et al., 2023) explains how "Dashboards are used broadly to visually explore, monitor, and communicate with data." While their original focus was on monitoring of current conditions, they are now employed as well for "supporting decision-making, persuading, or learning". Dashboards (Setlur et al., 2023) increasingly take up the role of support-systems, but with a relatively low 'level-of-automation' that varies between offering a set of action/decision alternatives and offering suggestions for the best alternative (following the taxonomy of (Sheridan, 2011)). They are more flexible than 'high-level automation', can contribute to higher output, measured in potential timesaving and stimulating wellbeing at work capability. By the way, it is expected that in the (near) future AI will play a role in this alternative offering of suggestions for actions, both in the field of manufacturing and health care (World Economic Forum, 2023).

An example is home diagnostics in healthcare and prevention. Digital information to monitor health condition and decide on correct actions is used by both caretakers and patients. Relevant information for the treatment of COPD patients entails bio parameters like exercise, medicine use and exposure. But this information should be processed and represented in different manners to different end-users, as the patient, physiotherapist, nurse and pulmonologist all require different types of information and can deal with a different level of complexity.

Another example relates to operator support for refurbishment and repair. Work that (still) lies outside the capabilities of an employee, for instance because this person is reskilling from another background, could be made accessible by means of (adaptive) work instructions that augment the operator's skills. This makes a clear example of how dashboards are stretched towards decision-support systems. The information not only needs to be offered adaptively to the user in a way that is befitting to her/his level of skill but also requires to break-up differentiated tasks in an 'object-oriented' manner as repair work is characterized by high product variety.

Dashboard Dilemmas

With the developing discourse about the Work of the Future and Future of Work (what Kolade et al., (2022) coins as Employment 5.0) in the background, the importance of digital capabilities is eminent. Payback ratio of digital innovation may be less relevant than mitigating the impact of resource scarcity. Nevertheless, some hard dilemmas remain to be solved:

Accountability and responsibility in human-machine[1] teaming requires strong attention from developers. Overreliance on incorrect information, or wrong perception of in itself correct, but poorly presented information can easily lead to erosion of critical and ethical attitude of an end-user, with faulty decisions as a result. "One of the primary design dilemmas engineers and designers face is determining what level of automation should be introduced into a system that requires human intervention." (Cummings, 2006). When should a user overrule a machine-made suggestion? Driven by the recent developments in Large Language Modelling (LLMs), techniques for reducing overreliance are large explored and developed (Microsoft, 2023)

[1] The machine in this case the decision support algorithm behind the dashboard

Underutilisation and resistance

(Chiou et al., 2023) explains how trust is an important construct to understand if and why people rely on technology. Research has shown that (over-)automation can cause skill degradation and reduced situational awareness and can unbalance the workload (Parasuraman et al., 2000). Many incidents and accidents have occurred because of poor interface design. So users with reservations about dashboards definitely have a point. Developers hold a strong responsibility here to guard users' ability to analyse, understand, and control one's own (thought) processes and professional behaviour, as this directly ties into their autonomy and wellbeing.

Privacy & Security

Not only the ethical behaviour of users can be a concern, the same holds true for employers that stimulate employees to use dashboards. As the dashboards are fed with information from smart sensors or wearables, privacy violation is a risk. Employers are entitled to monitor productivity and have a legal duty of care to secure a safe and healthy working environment, but wearables do gather, combine and analyse a large amount of (personal) data using algorithms that may go well beyond the purpose for which these devices were deployed in the work floor. The European Agency for Safety and Health at Work (2023) states that: "use of algorithmic management and surveillance technologies at work affects workers' privacy and data rights". Monitoring data and the logging of actions gives opportunity to privacy breaches, even with the best intentions for health, safety and security in mind and could lead to discriminatory decisions when the retrieved information is misused (e.g. dismissal) (Marassi, 2023). Research by Townsend et al. (2011) suggests that home health-care users are willing to trade-off privacy for self-interest, like for instance increased autonomy. But, autonomy is also strongly entangled with the concept of privacy (as explained by Becker, (2019)). By giving up some autonomy in terms of decision-making and in control-of-information, the user gains better control over a home or work situation. Still this trade-off must be made in an utterly careful manner. Directly related to this is the aspect of cyber security, to prevent malicious intrusion in private affairs.

Inequality in empowerment

A last dilemma arises from the potential future division between skilled labourers that are empowered by dashboards, leaving them more time for value-adding work; and the less-skilled that lose at best autonomy or at worst their job to assistive technology. So upskilling and life-long learning, particularly related to digital literacy, seems more important than ever (Autor et al., 2017) as the quality of jobs available to low- and medium-skill workers, with expected sectoral and geographical shifts, will impose a huge challenge on society.

So where does the Hague University of Applied Science come in?

In our view data collection, connection and communication are the three key ingredients for carefully teaming between clients, machines and 'workers', enabling your people to prioritize their time to tasks that matter most. This 'teaming' can be channelled through the use of dashboards, as long as accountability, autonomy and privacy aspects are carefully addressed. So how can we help? By identifying -together with professionals and users from the field- productivity loss points? By co-designing with users the possible (sensor) data collection and required communication interfaces? By implementing -together with your own experts- the required data processing and secure connections? Working with our Centre of Expertise brings you the advantage of a multidisciplinary team, with the ability to reason from different relevant perspectives and that draws on empirical evidence on what works under what conditions.

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