

Makes Digital Sensemaking Sense?—A Roadmap for Digital Humanism in Increasingly Transhumanist Settings

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Keeping humans in the loop or bringing them back into the loop in dynamically changing socio-technical or socio-hybrid systems requires the human-centered arrangement of system designs and the adoption of digital artefacts according to human capabilities and needs. When transhumanist developments increasingly propagate through society, digital sensemaking could support their co-evolution in a sensible way. We discuss sensemaking to that end, and provide a roadmap on how to integrate sensemaking processes into capacity building processes and digitalization initiatives.

Introduction

Transhumanist researchers aim at overcoming human limits, mainly defined by biological constraints, thereby creating a species of its own kind (cf. Bostrom, 2005, Kurzweil, 2005). Carriers of transhumanist developments are the latest technologies. According to their proponents and current understanding of developments, these should merge with humans whenever possible, extending human capabilities and life (cf. <https://www.humanityplus.org/about>). Alongside artificial extensions or components that become part of human physical systems such as the carbon prosthesis for the runner Oscar Pistorius (cf. Marcellini et al., 2012), transhumanists design neuroprostheses to improve mental processes. Brain-computer interfaces are developed to transfer information from computer chips to nerve cells and vice versa, as cochlear implants already do for deaf and hard of hearing people (cf. Lee, 2016).

Once a transfer of information is established neurobiology, computer science, and nanotechnology can be further integrated to optimize brain activities based on memory chips using digital technologies (Kurzweil, 2005).

The more that human capabilities and behavior patterns are replaced by increasingly complex AI-based algorithms, the more likely fundamental societal change becomes. Algorithmic thinking and simulations by computer models will not only influence human decision making and thus, behavior (cf. Shin, 2021, Barachini and Stary, 2022), but should finally allow human consciousness to be transferred to another medium. The effect of such hybrids of machine and organism in shaping society has already been considered by Haraway (1985, 2016). Recently, Derrick de Kerckhove (2020) studied the impact on decision making when humans start

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depending on systems that are external from us. He concluded the more cognitive functionalities, including memory, planning, and judgement, are mapped to digital functionalities, the more human decision-making processes move to digital functions. Human-computer interaction then propagates to brain-computer interaction.

Such shifts and transformations could be guided and facilitated by artists: ‘Our self is emigrating’. “For sure, we know that the self acts simultaneously as the separation and meeting point (between the subject and the outside world), and as such it allows us to establish relationships (between the I, the others, the world)” (Iaconesi and Persico, 2017). “Indeed, while we may still believe that we have a self that is situated somewhere inside our body, the origin of all our decisions and movements, not to say our thoughts and our self-image, the reality is that we are already delegating our memory and our judgement to our smartphone. Next on the way out will be our power of decision that will find our twin better informed and wiser. The good question is where will our self be then? One thing for sure is that it will be outside somewhere and somehow, maybe in our smartphone. And it will make and soon implement decisions for us.” (de Kerckhove, p.6)

This ultimately then presents the question of how we can make sense of situations in such future scenarios and how this can be understood from experiments that we can perform now. It should help concepts and anticipated results of future research into current living spaces, in particular closer to human experiences, and thus, contextualize the upcoming duality of components in cyber-physical settings. The epistemological question thereby is not only the embodiment of digital objects into human materiality, and the resulting assignment of meaning of those objects, but rather the process of how artefacts are developed and meaning is assigned along evolving sensemaking (structures) (cf. Hui, 2016).

This already implies an important aspect: much of the ongoing discussion is focusing on the body as biomaterial and technology that can be augmented by other technologies that are developed by humans, and the mind as something rational – thinking – that is cognitively processing experiences will be either augmented or transferred in the framework of the new technologies. Nevertheless, referring to human-centered developments, we need to go beyond the ‘mind’ and ‘body as technology’ duality in order to understand how humans can make sense in the context of cyber-physical systems. The human body and knowledge is also defined by environmental, social and cultural contexts that influence behavior, shape explicit and tacit knowledge, and bodily sensing: knowledge and emotions mediated through bodily experiences. Instead of leveraging the human capabilities, the effects of the implementation of cyber-physical systems might end up rendering the human puzzled and with less agency as some examples in work settings show.

As Wolf (2010) already noted, “data-driven life” comes “into being”. In work contexts, software algorithms processing these data change the way people accomplish their tasks. For instance, Lee et al. (2005) showed for distributed human workers of Uber and Lyft how jobs are assigned, optimized, and evaluated through algorithms and tracked data. The impact on practices was substantial. Drivers used online forums to socially make sense of the algorithm features. “Drivers discussed the workings of the ridesharing systems’ algorithmic management. One of the successful online sensemaking examples was about improving and maintaining driver

performance in ratings and acceptance rate. ... On the other hand, sensemaking activities around assignment algorithms and surge pricing seemed less successful in terms of informational usefulness.” (Lee et al, 2015, p.1609).

Such developments could trigger a process to consider personal identities as arbitrary, malleable entities (cf. Hughes, 2006) which in turn would allow technology to shape humans, finally being controlled like warehouse workers exposed to robots and driven by their behavior (<https://www.latimes.com/business/story/2019-12-30/robots-warehousing-humanworkers>), lacking self-organization and understanding of the situation.

Although many technological developments are produced to optimize the organization of work, understanding situations and organizing affairs do not only refer to work-related contexts, but increasingly to everyday situations of life. The Vienna Manifesto on Digital Humanism addresses these aspects in widening the scope to societal relevance: “We must shape technologies in accordance with human values and needs, instead of allowing technologies to shape humans. Our task is not only to rein in the downsides of information and communication technologies, but to encourage human-centered innovation. We call for a Digital Humanism that describes, analyzes, and, most importantly, influences the complex interplay of technology and humankind, for a better society and life, fully respecting universal human rights.” [<https://dighum.ec.tuwien.ac.at/>]

When setting out for an update of humanism, Digital Humanism requires tools revealing threats and offering facilities for mastering upcoming challenges of human-oriented digitalization (cf. Barachini et al., 2022). As already indicated above, informational usefulness plays a central role. It can be addressed by sensemaking from the design to the use of information and communication technologies for a techno-eco-social transformation (cf. Nicholds et al., 2017, Munck et al., 2019).

In the following we detail essential elements of sensemaking as a fundamental concept for collective development and foundation for digitalization of sensemaking processes (section 2). Section 3 introduces the project DIGI-Sense, which aims to create novel human experiences in sensemaking for comprehensively informed cyber-physical designs. We describe the relationship between performance and aesthetics in embodying sensemaking through digital means. It addresses concerned individuals as well as developers and designers, either in the role of observer or performer. We finally present a methodological approach to the study of human experience in the direct loop with digital means. Section 4 concludes the paper by describing the potential of these methods in the light of transhuman developments.

Sensemaking

In this section we review conceptual and procedural foundations of sensemaking which provide a foundation for the design of informed human involvement in digital transformation processes and co-evolving socio-technical systems. We consider sensemaking as an integral part for digital transformation, as it not only refers to mindfully grasping the rationale when putting technologies into social systems, but also to bridging the gap between individual and collective guidance when technologies are drivers for transforming societal systems.

Constructs and Concept

According to Weick (1995), sensemaking is about patterns that enrich and develop conversations up to the re-organization of structures. An instance of sensemaking is understood as a set of event-related entities: Someone notices something in an ongoing flow of events, some form of a surprise or something that does not fit, some kind of discrepancy. Discrepant cues are spotted looking back over elapsed experiences in an act of retrospectiveness. Plausible speculations are offered for explaining the discrepant cues. The person making the speculations publishes individual experiences. In this way the experience becomes part of the environment – some object is created which was not there before but needs to become visible or tangible in order to be noticed.

The speculations do not generate widespread attention right away, since others do not have frequent social contact with the originator of the experience. Issues of identity and reputation are involved. Hence, sensemaking creates some kind of passive social intelligence, as previously hidden events are explicated. There might even be barriers to sharing the explicated experience.

The activities of sensemaking have something to do with reciprocal interaction of information-seeking, meaning ascription, and action. Sensemaking does not necessarily have something to do with immediate action. However, it is unique as it is some kind of translation, and grounded in both individual and social activities. These activities constitute a permanent tension in human environments.

“A crucial property of sensemaking is that human situations are progressively clarified, but this clarification often works in reverse. It is less often the case that outcome fulfills some prior definition of the situation, and more often the case that outcome develops that prior definition.” (Weick, 1995, p.11)

1. Sensemaking by justification, an idea that reflects an earlier emphasis on dissonance reduction by increasing the number of cognitive elements that are consistent with the decision;
2. Choice as the event that focuses sensemaking and justification, an idea that retains the emphasis on post-decision behavior;
3. Sensemaking by retrospect, an idea that retains dissonance theory’s emphasis that post-decision outcomes are used to reconstruct predecisional histories;
4. Discrepancy as the occasion for sensemaking, an idea that restates dissonance theory’s starting point, namely, action that follows from the obverse of cognitions held by the actor;
5. Social construction of justification, an idea that reflects dissonance reduction by means of social support and proselytizing;
6. Action shapes cognition, an idea that is a composite of Items 2,3, and 4 above.

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Sensemaking goes beyond interpreting a situation, as it refers to an activity or a process, whereas interpretation can be a process that describes a product or result. In addition, sensemaking is more tentative than interpretation, it addresses an earlier stage of experience, such as concerning body perception prior to cognition.

Sensemaking is also different to decision making, as it talks about reality “as an ongoing accomplishment that takes form when people make retrospective sense of the situations in which they find themselves and their creations.” (Weick, p.15) These situations are scanned and analyzed to discover individual inventions, as the seven properties of sensemaking reveal:

1. *Identity*: The recipe is a question about who I am as indicated by discovery of how and what I think.
2. *Retrospect*: To learn what I think, I look back over what I said earlier.
3. *Enactment*: I create the object to be seen and inspected when I say or do something.
4. *Social*: What I say and single out and conclude are determined by who socialized me and how I was socialized, as well as by the audience I anticipate will audit the conclusions I reach.
5. *Ongoing*: My talking is spread across time, competes for attention with other ongoing projects, and is reflected on after it is finished, which means my interests may already have changed.
6. *Extracted cues*: The “what” that I single out and embellish as the content of the thought is only a small portion of the utterance that becomes salient because of context and personal dispositions.
7. *Plausibility*: I need to know enough about what I think to get on with my projects, but no more, which means sufficiency and plausibility take precedence over accuracy.

They are applied up to recent developments, e.g., smart urban mobility settings (Matos-Castaño et al., 2020).

Sensemaking processes requires some carrier, the so-called Sensemaker. “The trap is that: Sensemaker is singular and no individual ever acts like a single Sensemaker.” (Weick, 1995, p.18) However, the idea of sensemaking is self-referential so that self rather than the environment is in need of interpretation. As such, it contributes to identity-finding of a person, targeting the provision of meaning - Sensemaker stands for a variety of mechanisms for self-conscious behavior, centering around an individual’s identity which is essential for shared experience.

Aside from grounding sensemaking in identity-construction, the period considered refers to historical events. Sensemaking is retrospective when building identity. The identified meaning helps to interpret one’s own history. Thereby, the creation of meaning is an attentional process referring to previous experiences. It is directed backwards from a specific point in time, while being influenced by the moment occurring in the specific here and now. Consequently, which meaning is assigned to a certain situation depends on the point in time. This constraint is of

particular importance when people share their experience as it is done in organizations as social systems.

Behavior and Process of Sensemaking

The process of sensemaking is considered as an enacting of sensible environments. Enactment in organizational contexts requires people as an integral part of this environment. They are not only the trigger of enactments but also causal elements of substantial change in the course of processing the cues. This understanding of teams or organizations may even lead to not talking about results of work processes but rather to talk about “relatings”, referring to a complex system that is underlying sensemaking processes.

“As we perform a certain action our thought towards it changes and that changes our activity.... You say, “When I talk with Mr. X, he always stimulates me.” Now it may not be true that Mr. X stimulates everyone; it may be that something in you has called forth something in him. That is why I said above that we must give up the expression

“act on”, object acts on subject, etc..... I never react to you but to you-plus-me; or to be more accurate, it is I-plus-you reacting to you-plus-me. ”I” can never influence “you” because you have already influenced me; that is, in the very process of meeting, by the very process of meeting, we both become something different. It begins even before we meet, in the anticipation of meeting. We see this clearly in conferences. Does anyone wish to find the point where the change begins? He never will.” (Weick, 1995, p.33)

Organizations or communities understood as sensemaking entities are socially created environments that constrain actions and orientations. “Sensemaking is the feedstock for institutionalization” (ibid., p.36) Therefore, enactment is about action in the world and not about conceptual pictures of that world. Consequently, enactment goes beyond action and is some kind of forewarning for sensemaking. It refers to some kind of interpretation for orientation.

This interpretation for orientation is a social process. Requiring some cognitive capacity to create and share meaning. It can be considered as a person-centered approach as defined by Rogers (1959) with a deep understanding of meanings (which he termed empathic understanding). Any meaning should be sustained in social structures like organizations, with sensemaking as a social process shaping interpretation and thus, orientation (Weick, 1995).

As sensemaking has no explicit start and no explicit end, flow is the only constant of sensemaking. This makes it similar to hermeneutic understanding of situations (Weick, 1995). This process refers to individual sensemaking as well as to alignment on the social level. Several characteristics of this observation have been identified: There is no stable representation of a situation. Not only every representation is an interpretation. It is neither wrong nor right, so there is no objective analysis of the situation. In addition, the effects of action cannot be predicted.

Emotions are considered by sensemaking in the context of relationships among people. It depends on the distance of relationships and whether there are sufficient resources to handle unexpected behavior such as interruptions. This information influences the capabilities of

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groups to achieve common goals and accomplish collaborative tasks. We know that positive emotions lead to more predictable behavior as a close relationship between persons influences expectations and thoroughness (cf. Diener et al., 2020 - positive emotions influence vital factors for workplace success, including positive beliefs, creativity, work engagement, teamwork and collaboration, customer satisfaction, leadership, and performance).

Sensemaking as a process is focused on and by extracted cues, not excluding any experience of the participants. However, it required some effort to identify patterns for organizations to work with extracted cues. It seems that reasoning on extracted observations plays a crucial role in interpretation and sharing of experiences. When extracted cues are used, they are some kind of “seed” to influence the quality of sensemaking. Seed is understood as a “form-producing process” that captures much of the “vagueness and indeterminacy of sensemaking” (Weick, 1995, p.51) – what will become an extracted cue depends on context (local contingencies). The context affects which part of the environment constitutes the cue, and the way it is extracted and interpreted.

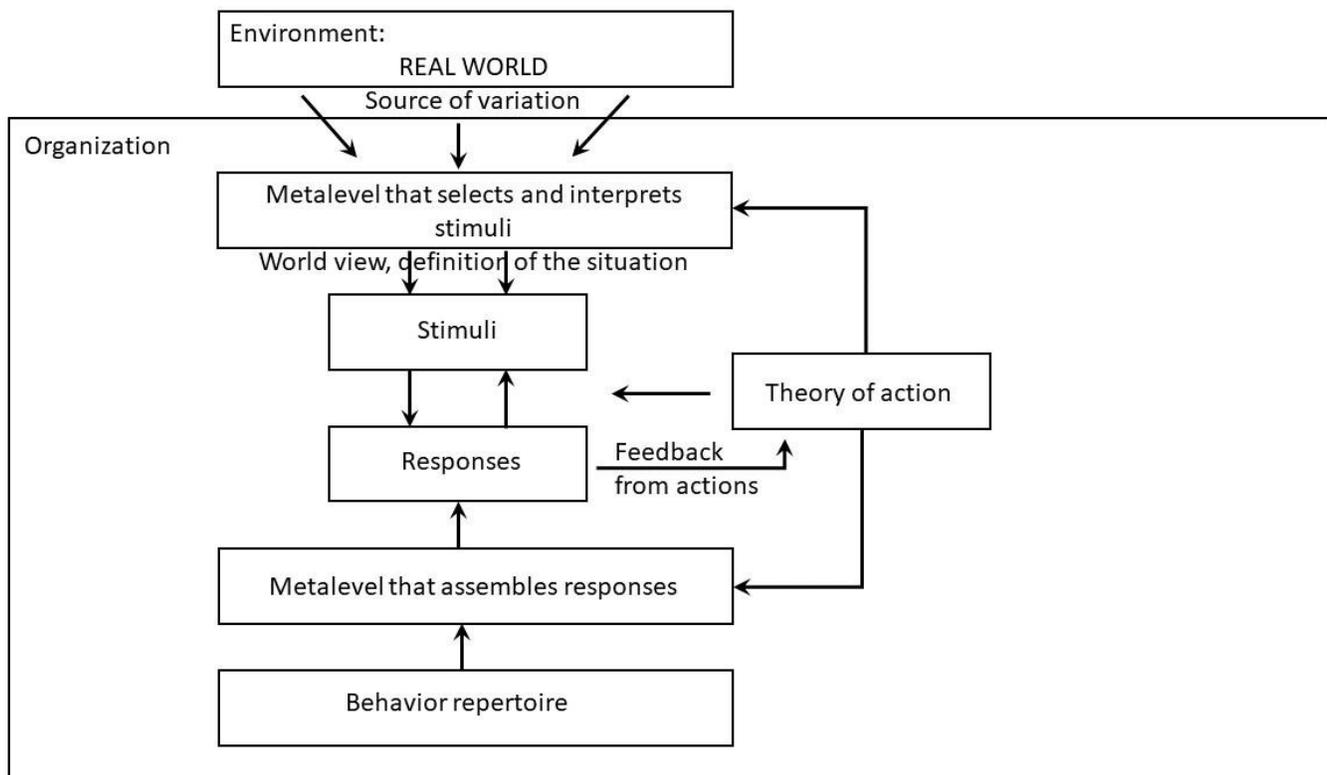


Fig. 1. An organization interacting with its environment according to Weick (1995, p.122)

Sensemaking is specified as “a micromechanism that produces macro-change over time” (Weick et al., 2005, p. 419) with action that “is always just a tiny bit ahead of cognition, meaning that we act our way into belated understanding”, and composed of “opportunities to incorporate meaning and mind into organizational theory” (ibid.).

When striving for plausibility, people should “articulate descriptions that energize. These are micro-level actions. They are small actions, but they are small actions with large consequences” (ibid.).

From an operational perspective, Jantunen et al. (2016) have identified four fundamental sensemaking strategies addressing individual and organizational concerns:

1. Context: Data is placed in the ‘right’ context.
2. Semantics: After the data has been contextualized, it must now be made meaningful. Data objects are stored so that humans can analyze meaningful data and can export.
3. Analysis: Humans can now analyze this data for the purpose of e.g. clustering.
4. Human interpretation: Direct feedback is now obtained from humans in order to determine whether the data collected makes ‘sense’.

Their identified process starts with team members deliberately sharing their ‘chunks of experience’ with other members of their organizational unit or team with the goal of identifying cues they have noticed and should be preserved for upcoming activities (collective cognitive work). The participants are asked to “consciously organize these experiences into emerging new understandings. This occurs largely by verbally articulating tentative understandings while simultaneously attempting to manipulate material artifacts to support concept formation in a nonverbal way (material classification). The articulating phase has been found to help team members organize their experiences and ideas on the basis of patterns of difference and similarity, helping them to detect commonalities and emerging themes.” (ibid., p.810)

Once new understanding emerges through articulation, the participants start the collective cognitive work, i.e. elaborating the cues in more complex contexts stemming from their task environment. The modality of interaction is text-based – the participants contextualize cues and share their documented relations until they have achieved a plausible interpretation of the situation described by the cues. The result is shared with other stakeholders as ‘preferred interpretation’. This data from the field on the process of sensemaking and finally, sensegiving reveals the cognitive boundary of interaction. Materialized cues are shared in verbal form and driven by cognitive processes and the language-based externalization of mental models through articulation.

Nevertheless, sensemaking does not stop at the integration of experiencing the process and reflecting it, language and articulation, and that the process of sensemaking can be understood as constant flow and thus extends over time. As discussed by Sandberg and Tsoukas (2020) there is another core constituent added to these three: embodiment. In their meta study on the phenomenology of cases in sensemaking research they sum up these four core constituents as: sense-action nexus, temporality, embodiment and language. They show that an important component for sensemaking is embodiment which is connected to live through experiences, be in processes, and relate to the physical environment or objects that are part of the situation or

process. Something that scholars like Maitlis and Christiansen (2014) already pointed to in previous studies.

Towards Digital Sensemaking as Digital and Bodily Experience

In this section we advance the understanding of sensemaking introduced in the previous section with novel ideas, aiming at digital sensemaking as a bodily enriched capacity for building co-creative transformative change. We propose the extension of our understanding of sensemaking to include humans articulating cues in digital or digitally enriched settings, such as workplaces in cyber-physical systems. This requires an understanding of the mechanisms underlying artful articulation and sensemaking in digital transformation projects, recognizing the duality of representations in terms of physical and digital twins.

ARTiculation for Sensemaking

Our objective is to open up interactive design spaces by establishing intermediaries in socio-technical systems, including trans-humans as described in section 1, by means of performance and aesthetics. “The reflected look at the interrelationship of subject and object initiated by art allows aesthetic experience to become the starting point of utopian thinking, art brings to view what still eludes conceptual understanding.” (<http://www.ernst-bloch.net/owb/fobei/fobei25.htm>). These enrichments will help us better understand the process of sensemaking from the perspective of digital human-centered development in cyber-physical settings. The findings will also guide the design of digital twins as information spaces facilitating sensemaking processes.

The qualitative approach to analyzing locations of change, participants’ behavior articulation and sensemaking process in the course of digital transformation processes aims to better capture and understand the context of model building in transformation processes. Do participants with different conceptual understanding exhibit different patterns of activities in their work or living environment and conceptual changes during sensemaking? And, how might these differences be responsible for differences in outcomes of sensemaking (i.e., contextual knowledge outcomes)? With respect to previously described experiences of lack of self-organization, understanding of situations or negative effects on identity and motivation as described, for example, by warehouse workers who get exposed to cyber-physical systems including robots and untraceable software decisions, these questions will be important to explore.

Studies in organizational research show that sensemaking tools and efforts are fundamental for meaningful work² experience for individuals and organizations (Asik-Dizdar et al., 2016). Research also reveals that interventions for sensemaking need to go beyond information usefulness (Lee et al., 2015). At the same time, most recently within Human-Computer Interaction (HCI) it has been argued that there needs to be more in-depth work on meaningful experience in HCI, since previous work is especially lacking insights including embodied interaction (Mekler et al., 2019).

² We consider meaningful acting work as immersive perception and practice of doing in which cognitive, social, and bodily involvement is streamlined and thus coherent for the actor(s) when performing activities according to their intention and purpose.

Work psychologists argue that digitalization at the workplace can lead to an information overload which challenges decision-making and sensemaking at work. It is argued that there is still too little knowledge about managing the flow and amount of information in interaction with digitalization at work (e.g., Hacker, 2020). Current approaches mainly use qualitative approaches in social sciences (such as qualitative interviews and focus groups) to understand workers' needs in interaction with new workplace technologies. Nevertheless, it is essential to include dimensions of embodiment³, use of space, embodied knowledge, and non-verbal interaction into future studies.

Philosophical approaches to the impact of digitalization of work and robots in the workplace to meaningful work point to opportunities and threats by exploring 5 dimensions of meaningful work: purpose, relationships, skills & self-development, self-esteem & recognition, and autonomy (Smids et al., 2020). Drawing from a wide range of examples of digitalization and robots at work, from order-picking work at warehouses, to delivery robots, self-driving metros, and robots working alongside teams, the researchers conclude that empirical studies of the interaction of individuals with new technology introduced into the work processes are an important next step. An interdisciplinary analysis of the impact of new technology on work processes helps to “safeguard the meaningfulness of work in an era of robotization that will affect all workplaces” (Smids et al., 2020: 519).

To address embodied elements, the use of space and different modes of interaction in digitalization of work and robotics; and the use of dance and choreography as metaphors, have recently been proposed as a beneficial perspective. This approach is thought to contribute to the understanding of “the embodied use of technology as (1) involving bodily movement, (2) social, and (3) taking place within, and configuring, a temporal horizon” (Coeckelbergh, 2020, p. 558). Further, Coeckelbergh (2020, p. 557) argues that this approach “promises to give us a more comprehensive view of what it means to live with technology and how our lives are increasingly organized by technology.”

Dance, but also arts in a broader sense, are argued to bring valuable insights into the aesthetic, sensory and embodied dimensions of processes and ideas in organizations (Strati, 2010). The inclusion of artistic exploration and learning from artistic research into interaction with new technologies are promising methods for technology development from a human-centered approach. Programs using this approach at leading R&D facilities like Nokia Bell Labs and Autodesk have presented promising results (Schnugg, 2019). The former Head of Experiments in Arts and Technology (EAT) program at Nokia Bell Labs, now Global Lead Cognitive Human Enterprise at EY (Ernst Young) Domhnaill Hernon repeatedly reports the important contributions artistic exploration and the sensory and human-centered approach of artists has provided for the technology development at Nokia Bell Labs. “From my perspective, I think the fusion of art and technology is a very strong leading approach to take if you want to consider our humanity in these future technologies,” Hernon (2020) states. The artist-in-residence program run at Autodesk 2012-2017 was successfully centered around future user interaction,

³ Embodiment refers to the highest form of contextualization, as cognitive, bodily and psycho-social factors are considered equivocally, either in knowledge or behavior.

user approaches to cutting-edge technologies and needs of users to create meaningful applications (Weinstein, 2019).

Digital transformation that also occurs along trans-human developments comes with the changes in people's mental representations of knowledge (i.e., knowledge structures) and behavior as a result of their interactions with information and studying behavior alternatives (Wilson, 1994). Despite taking into account individual cognitive viewpoints the challenge of the project is a methodological one, namely capturing such internal representations, and externalizing the representation of behaviors and mental states with sensemaking design activities. In the context of digital transformation, this project constitutes a start to studying the relations between the baseline representation and the evolution of system designs representations through articulation and sensemaking.

Dance and Digital Performance for Sensemaking, -giving, or -breaking

As already described in section 2, "sensemaking involves the ongoing retrospective development of plausible images that rationalize what people are doing" (Weick et al., 2005). The process of sensemaking is based on past experiences that can be triggered especially when expectations of how a situation should develop or how the environment should behave in a certain constellation of events are violated, in both: situations and outcomes of standard procedures. So, sensemaking is essential because "it is the primary site where meanings materialize that inform and constrain identity and action" (Mills, 2003: 35). Therefore, sensemaking also has to be considered in work process development, especially by digitalization and adding technological factors. Thereby, aesthetics and empirical interaction are important conditions for sensemaking in learning in organizational life (Vitry et al., 2020). Above that, two additional processes play an important role: sensegiving and sensebreaking. Sensegiving can be understood as the process to learn how sensemaking works in a specific organizational environment, and how meaning is constructed. New meaning can be added by active sensegiving actions, but individuals can resist these actions (Gioia et al., 1991). Sensebreaking on the other hand is defined as the opposite, which can be an important step in change or restructuring of work processes.

In order to understand sensemaking processes, methods to capture immersion from a variety of perspectives are required. Understanding can take a human-centered (Leach, 2020) or technology-oriented (Kade et al., 2013) approach. Methodological designs include logging, observations, interviews and questionnaires, and introspection, revealing challenges of perceiving, articulating, and acting in social environments, such as organizations (Poole et al., 2017).

Additionally, artistic methods in organizational research, such as visual studies, studies of work processes as rhythms, embodied knowledge through movement and dance studies, and inclusion of noise have been recognized as important addition to more traditional methods (e.g., Bell et al., 2014; Burrell et al., 2014). The study of organizational aesthetics, embodied knowledge within work processes has been developed for over 20 years (Strati, 1999, 2010; Gagliardi, 1992, 1996). Artistic practices, artistic exploration and artworks have been investigated as powerful tools for creating meaningful interactions, sensegiving, and supporting sensemaking practices (Barry et al., 2010; Schnugg, 2019). Combining ideas of artistic methods

in organizational research and the knowledge from studies into art and sensemaking in organizations, including artistic methods is promising.

Dance and performance studies as methodology, theoretical lens of analysis, and metaphor have gained growing attention in organizational studies (Biehl, 2017): Especially, to access embodied knowledge on work processes, leadership skills, kinaesthetic empathy, kinaesthetic politics, collaboration in space, and as metaphor. Drawing on dance studies (Ruprecht, 2015) and using dance as an ‘analogy’ and a ‘heuristic device’ (Chandler, 2012, p. 876) enables analysis of movement in processes and embodied interaction by providing “attentiveness to the rhythms of work – and to disruptions and breaks in rhythm” (Chandler, 2012, p. 876). Dance can be understood as a combination of gestures and movement in space and time (Biehl-Missal, 2016). Furthermore, it can be conceptualized both as flow and arrest, as ongoing movement, and stillness, linking it to different conceptions of embodied agency. Thus, the perspective of dance studies allows one to access the role of embodiment and the integrated sensemaking in embodied processes. Dance is both discipline and overflow, closing and opening of the body; it makes it possible to explore the silenced areas of the body as a spontaneous, experimental, and creative force that challenges organizational life (Slutskaya et al., 2008).

For example, dance theorist von Laban collaborated with a management consultant to reach balanced use of energy in movement to increase enjoyment of work through the awareness and practice of its rhythmic character (Reynolds, 2007). Dance theory and methodologies in analyzing dance, movement, and choreographed performances help to draw knowledge from movements, use of space, expressiveness of gestures, stillness as well as movement, also within organizational settings and in work processes (Reinhold et al., 2018; Bazin, 2013). Especially in organizational development and learning settings, dance helps to make sense through movement, enhance communication, and embody creative revelation (Zeitner et al., 2016), and help to access embodied organizational knowledge (Wetzel et al., 2016). Dance and performance theories help to conceptualize and analyze interruption and stillness of the body contrasted to ongoing motion in dance or during work processes. Thus, engaging with dance practices and including a perspective from dance studies is an insightful tool to analyze occupation of space, collective practices between bodies in spaces, and to focus on embodied agency (Reinhold et al., 2018). In academic research, dance and performance have been linked to researching embodiment in knowledge and practice (Spatz, 2015).

Most recently, dance and performance studies also received growing attention in technology studies and development. For example, the use of metaphors, theories from dance studies, and dance practices have been integrated into the research for robotic development and HCI (LaViers, 2019). LaViers et al. (2018) argue that studies in dance, performance and robotics support technology development to create technology that can sense their human counterpart better, to create movements and interactions based on natural human movements, and to improve expressiveness of the technology in development. They argue, “The methods utilized by choreographers help create meaningful movement and organize the execution of large-scale performances, which may not take on citations in academic journals, but are nonetheless important ways in which society organizes knowledge and makes sense of experience.” Cuan et

al. (2019) take this approach further by engaging in embodied, interactive art installations to explore human perceptions of robot and human capabilities.

Penny (2017) argues that embodied approaches are necessary to elevate and access the range of possibilities the interaction with technology bears. In diverse analysis of human-computer interaction and media art based on cutting-edge technology he points to the important aspect that “every digital interactive event is analogical” (Penny, 2016, p. 64) and thus the focus of the developer, practitioner, or artist working with media art, must be on the qualities of analogizing and the embodied human understanding. Experimental studies using dance and choreography in cognitive science suggest that adding the embodied dimension of dance to more traditional research methods like qualitative interviews help to index and access more detailed content (Barnard et al., 2017).

Setting Triggers for (Co)-Evolution

In the following we provide a roadmap to introduce sensemaking as an instrument to guide technological advancement in cyber-physical environments when propagating to transhuman settings. The focus is on better understanding the aesthetic and embodied aspects of sensemaking as they are assumed to form the ground to a more holistic design (process) in settings digital humanism is referring to. Both, aesthetic, and bodily experience, are part of embodied articulation that is assumed to increase the degrees of freedom in exploring cyber-physical artefacts - as shown on the right side in Fig. 2. Therefore, we suggest to realise art-science collaborations in the form of working with performance artists, dancers and choreographers in order to study the role of the body, the bodily relationship to the physical and cyber-physical environment, and aesthetics.

Embodied articulation targets to convey the intertwined body-cognition experience when acting in a digitally transforming environment. Setting triggers for (co-)evolution involve the means and instruments as part of the environment helping to perceive and articulate embodied feelings and needs. Informed by sensemaking theory we expect retrospective and proactive elements for meaning construction on the basis of individual expressions. They can be considered as input for stimulating, designing, or simulating change in a community context. The aesthetic dance performances are behavior probes that are intended to help understanding the process meaning creation, i.e. sensegiving. Resulting changes may lead to sensebreaking, and include changing behavior sequencing and the localization of acting.

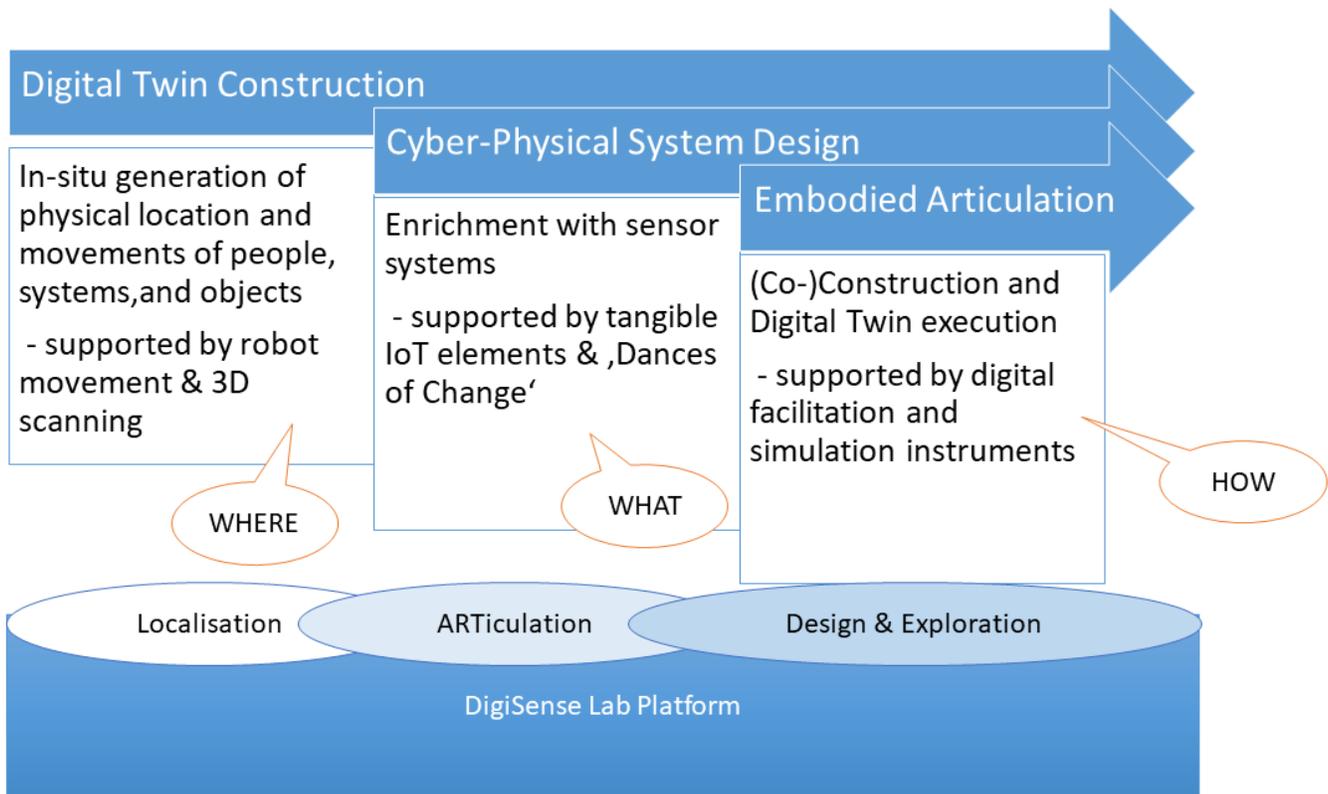


Fig. 2 Digital Sensemaking Roadmap

We consider a digital twin (DT) representation of the artefact that is generated in the first phase described as 'localisation' (see top and left side of Fig. 2) as baseline for context-based materialized articulation. A DT model is understood as a matter of socio-materiality (cf. Boyd, 2021), as it is (co-)constructed in the social context of activities. It captures objects, the environment of a person and its social community. It is the first context that is reconstructed and can concern private or public space. All future articulation can be put into that location representation, including the movement of people in the course of task accomplishment or information delivery and decision making.

The location DT is generated by using respective support systems. It is based on a combination of the agile mobile robot system Spot[®] (<http://www.bostondynamics.com>) with the Trimble[®] x7 3D-scan system (see also <https://de.geospatial.trimble.com/x7-scanner>). Thereby, physical sites and highly relevant environment data for operating cyber-physical systems (CPS) are scanned and represented in various formats for further processing. In a second step, movement can be represented. Scenarios will be created and investigated with dancers, performers, and choreographers (artists) for exploration of embodied processes, influences on practices of the human in the analog realm and sensemaking processes.

When studying the nature and components of cyber-physical systems (CPS) the initial question to be answered in cooperation with the artistic performers is: What is and can be articulated in a CPS, in order to operate them successfully and to experience their capabilities in an explorative form? The knowledge gained in the interaction and exploration with the artists and

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by researching the artists' practice and embodiment of the interaction through the interdisciplinary team of researchers from distributed systems development, knowledge engineering, organizational studies, and artistic research will elucidate central aspects of embodiment in sensemaking processes in interaction and operating components in cyber-physical systems.

We will work with the artists in two ways: a) in prepared scenarios, and b) along an artistic exploration phase. The scenarios that have been prepared refer to tangible and digital conceptualizations. The tangible elements of the prepared scenarios comprise IoT components from M5Stack (<http://m5stack.com>) that the performers can compose to cyber-physical applications, either bottom-up or based on use cases (cf. Stary et al., 2022). Both allow for individual exploration and construction, either on the component level or using a physical site for construction, i.e. a smart home installation. The digital part contains a Python-based, visual programming environment, in order to adjust the behavior of the cyber-physical system and implement the business logic required for operating one of the prepared use cases. The digital conceptualizations comprise patterns encoded in digital twins that could be derived from underlying technological enablers, such as agent-based systems (cf. Stary, 2021). These patterns comprise structure and behavior elements, including encapsulations of actions and the flow of messages between acting entities, creating patterns of communication and interaction.

The initial step of getting used to technologically-based capabilities of cyber-physical systems triggers a learning phase addressing the artistic performers together with digital media specialists. Direct contact with tangible elements and working with the prepared scenarios should help to develop basic principles of tangible and digital articulation and development means. It is considered as facilitator of artistic explorations and embodied perception to finally develop embodied practices and gain deeper insights into specific bodily, gestural, and embodied aspects for the design of transhuman creations.

The further phases of research pictured in Fig. 2 give artists space in an experimental setup for artistic exploration of sensemaking, sensebreaking, and sensegiving. The settings will be enriched with further IoT elements and embodiment-relevant connectors, such as coupling body movement with light and robot movements. For analysis, dual movements will be recorded in diverse approaches, as proposed in studies in dance in technology development projects (such as, LaViers et al., 2018; Cuan et al., 2019). These recordings allow us structuring the experiments and interpreting the results with respect to identify meaning in terms of sensemaking, sensegiving and sensebreaking. The digital twin model will serve as point of reference, as it provides an integrated component and behavior view on cyber-physical settings. This intermediate step will create ideas and facets of embodied perception and articulation when experiencing digital immersion, i.e. being and acting in increasingly intelligent digital worlds. Thereby, embodied experiences will be expressed through dancing performances.

In the final stage of performances – termed embodied articulation in Fig. 2 - experimental use cases and scenarios are to be generated, informed by the knowledge gained in the previous steps. The DT model – representing the design memory for the entire project – will be enriched with IoT elements and CPS parts enabling the explored embodied forms of behavior. Platforms, such as the Metasonic Touch® (<https://www.metasonic.de/en/products/metasonic->

[process-touch/overview](#)) or compunity[®] (<http://www.compunity.eu>) are part of these experimental use cases. They allow to generate digital behavior representations through executable DT specifications. Of major importance is their capability (i) to focus on modeling personal perceptions of use cases without losing the individual interaction context, i.e. the behavior of other actors or system elements, either physical ones or digital ones; (ii) to integrate variants of intelligent behavior, such as socio-emotional behavior sequences under certain conditions (cf. Barachini et al., 2022).

In any case, the idea is to bring abstract representations and exploration to life, i.e. back to concrete action and exploration. In line with Weick's Poets of Change referring to encoding explorations in language in the course of sensemaking processes to include feeling and flow (Weick, 2011), we consider incorporating the perceived images and flow of knowledge generation and expression essential to convey the implementation of experiences and change accurately. Like change poets the dancers as carrier of experiences control "the first abstraction of flux and the first movement toward concreteness of an abstract hunch. In both cases, they are molding reality" (Weick, 2011, p. 17). The digital twin as a model of behavior allows keeping track of changes and abstractions.

According to Weick's concept, traceability seems to crucial for both directions: "The first abstraction from concrete perceptual flux sets the boundaries for subsequent abstracting. Each successive abstraction abstracts a prior abstraction. Experience gets lost when it is treated as too subtle or too insignificant to preserve in categories. Likewise, the first conversion of a condensed abstraction back into the flux of perceptual experience weakens the boundaries of the abstractions." (Weick, 2011, p. 17). Consequently the Dance of Change in DIGI-Sense the embodied experience and aesthetic performance includes re- and decontextualization, shaping and blurring shapes, creation and removing images, and trigger and reverse processes in cyber-physical settings.

We anticipate to lay ground for extending the developed scenarios and to experiment with further technological enhancements, such as smart textiles. Although such experiments will involve artists, they are intended to attract further participants (non-artists) to experience digital sensemaking settings and processes. However, it is still open and needs to be evaluated under which conditions such an endeavor leads to sensemaking, -giving, -or breaking.

The experimental setup and research method juxtaposes more traditional methods such as observation, experimental setup for different groups of individuals, qualitative interviews and quantitative evaluation with artistic methods and aesthetic approaches with a special focus on dance (drawing on methodologies including dance in organizational research and technology development as shown above; e.g. Bell et al. 2014, Barnard et al., 2017; Biehl, 2017, Reinhold et al., 2018, Cuan et al., 2019; LaViers, 2019). Additionally, the research will allow for art-science collaboration and artistic exploration as already used in a diverse range of research and industrial settings in the development of human-centered technologies and human-centered approaches to technology development (Schnugg, 2020). Embedding the experiment's artistic exploration in the research setting framed by this diverse range of methods, they can be analyzed to understand impacts and implications.

For all cases of interaction episodes in the experimental settings, sequences have to be described (Poole et al., 2017) of the process and the location, involving interviews and direct observation. This builds the basis for identifying units of sequences and categories of sensemaking (micro-processes), guided by sensemaking categories as they have been identified in previous research, building on the broad micro phases of sensemaking, describing context, identity, retrospect, cues, ongoing development, interpretations and enactments (Weick, 1995). These categories can then be expanded and detailed through induction. Interviews taking place at several points during the research process guide the subsequent analysis, that needs to follow well established standards of qualitative inquiry, employed previously in sensemaking research (e.g., Stigliani et al., 2012), and especially the analysis of sequences from process data (Poole et al., 2017).

This analysis should especially lead to systematic comparisons of sensemaking processes, to understand the role of DT, or new technologies, and the embodiment of interaction processes in sensemaking of work processes. Including the dimension of embodiment through dance and the lens of dance and performance studies allows a better understanding of the material and immaterial aspects that mediate this process (Strike et al., 2016).

Conclusion

All constitutive factors of sensemaking are tackled when implementing the proposed roadmap for digital sensemaking: identity of role understanding, retrospect on experiences, enactment in terms of design and task activities, social contact, ongoing events to reveal behavior, cues on design support and change, and plausibility of process steps and results. Although “sensemaking never starts” (Weick, 1995: 43), the classification of variables and conditions (also following Weick’s (1995) lead through distinguishing micro phases), the proposed roadmap shall function as a basis for novel empirical enquiry, enabling others utilizing interdisciplinary approaches, simulation, artistic and qualitative methodologies (Maitlis et al., 2014, p.107).

The implementation will contribute to the sensemaking literature by adding an embodied approach which is currently not at the focus of research. With reference to most recent meta studies on sensemaking literature (Sandberg et al., 2020), what Maitlis and Christiansen (2014, p. 102) summarize on important future research in sensemaking theory is still valid: “We are only just starting to understand sensemaking as an embodied process, and one in which sociomateriality plays a much greater role than we have to date recognized. We strongly encourage further scholarship in this area.”

Following the roadmap, highly interdisciplinary research is triggered by intertwining aspects of a diverse range of subjects with an experimental setting applying cutting edge technology and artistic approaches. Recent literature and studies from this diverse range of fields promise essential and completely new insights. In the light of the rapidly developing digitalization and the advent of technologies featuring transhuman developments, the need of understanding the implications for human workforce and being, i.e. the impact on digital humanism, has become a timely endeavor. Accordingly, we already triggered further methodological developments for digital sensemaking through bodily experience (Brill et al., 2022), integrating aesthetics and performance into sensemaking and mental model building processes.

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