MASTER THESIS

Exploring the potential of AI to support team effectiveness in interdisciplinary product development.

Pajam Kordian

Strategic Product Design

thoughtworks

TU Delft

Author

Pajam Kordian
5619629

Graduation Committee

Chair
Dr. Peter Lloyd
TU Delft Faculty of Industrial Design Engineering

Mentor
Dr. Senthil Chandrasegaran
TU Delft Faculty of Industrial Design Engineering

Company Mentor
Nemanja Cvijanovic
Lead Data Science Consultant
Thoughtworks

Company Mentor
Lisa van de Merwe
Senior Experience Design Consultant
Thoughtworks

Larger parts of this thesis were either written by or supported by ChatGPT. For more Information, see page 92.

Executive Summary

This following thesis in Strategic Product Design explores the potential of Artificial Intelligence (AI) in enhancing team effectiveness within interdisciplinary product development teams, using Thoughtworks Amsterdam as an implementation context. The research uncovers present challenges of Human Collaboration in interdisciplinary product development teams and investigates how AI can address these issues to support team effectiveness. By addressing these challenges through AI-driven solutions, the study highlights not only the transformative potential of technology, but also the symbiotic relationship between humans and machines in the field of teamwork.

The sequence of activities carried out is presented below, with the outcomes for each step indicated. This is complemented with a visualised knowledge flow on the right side of this double page. Here, activities (grey), research questions (purple) and outcomes (orange) are presented visually. Orange tiles with initials, indicate particular relevance for the final design outcome.

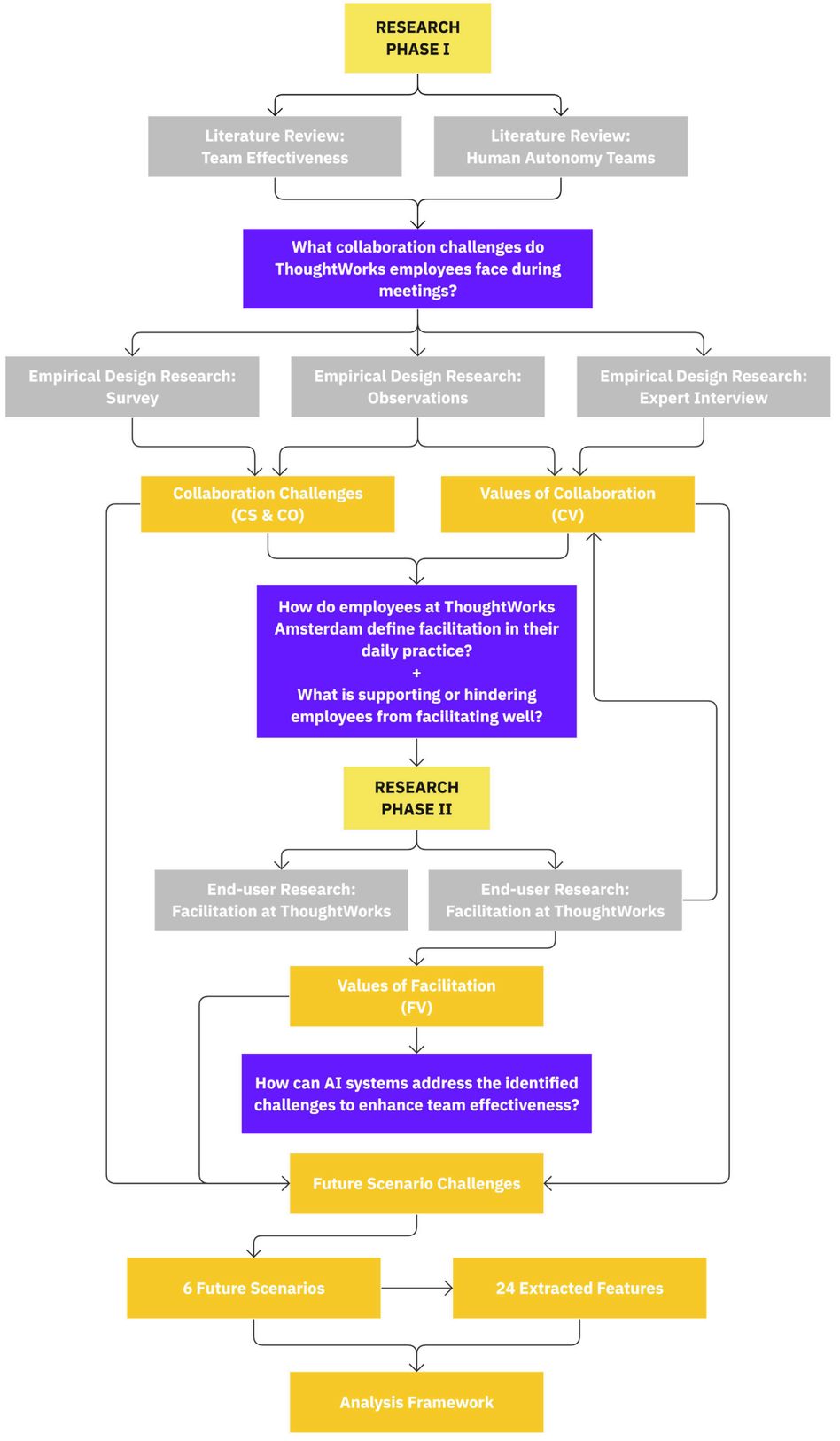
The initial phase of the research was dedicated to establishing a clear definition of team collaboration and uncovering the challenges that employees at Thoughtworks encounter in their daily practice when collaborating in meetings. An extensive literature review was conducted to explore the multifaceted nature of collaboration and its underlying factors, before contextualising it within interdisciplinary product development. Further, it introduced the development of Human Autonomy Teams (HATs) and provided an understanding of their dynamics, complexity and challenges when trying to deploy them as equal team members in organisational contexts.

Following the literature review, a series of observations and an online survey were executed to reveal specific collaboration challenges faced by Thoughtworks employees. Arising challenges were mostly related to facilitation, characterised by a Lack of Clarity and Lack of Alignment. To deepen the understanding of facilitation processes in organisations and outline the potential of AI in supporting team facilitation, a subsequent literature review was conducted.

Using the revealed collaboration challenges, a conducted co-creation workshop resulted in six future scenarios, illustrating AI's role in resolving identified collaboration challenges to support team effectiveness in meetings. To exemplify how these design outcomes lead to additional value creation, a specific feature was extracted and chosen for detailed analysis. A series of steps including User Interviews, Analysis of Autonomy Types and the creation of an Interaction Flow outline the features particular potential and limitations in a concrete context.

This research provides valuable insights into the potential roles and implementations of AI in supporting team effectiveness in team collaboration contexts. It offers a structured approach to envisioning and analysing futuristic AI features and provides a detailed example of how such features can be refined, analysed, and visualised to generate value and enhance collaboration within teams. The findings and methodologies from this study can serve as a foundation for further exploration and development of AI tools aimed at improving team collaboration and effectiveness in professional settings.

The value created through this detailed examination is multifaceted, offering both theoretical insights and practical solutions to advance the field of Human-Autonomy Teams.



Introduction

Motivation

The motivation for this thesis is rooted in the advent of sophisticated AI tools, exemplified by models such as ChatGPT, which have demonstrated the capability to emulate forms of intelligence. These advancements promise to develop new specialised tools and improve existing ones, reshaping the organisational landscape and potentially various aspects of our daily life.

Exploring and envisioning the future is crucial, especially when disruptive technologies like AI are deemed to bring transformative changes to organisations and our daily lives. Yet, while bravely pushing and exploring this new technology, we have not even fully understood its capabilities and potential. Consequently, there are many beliefs and opinions about the extend of integration of AI technology desired. Thus, this thesis builds on one important premise: The extend of technology integration is always a matter of societal negotiation. It is a complex interplay involving the negotiation of values, power dynamics, and societal norms and preferences.

Research Context

While robots and automation in general have been replacing humans in repetitive and routine labour for many years (Vagia et al., 2016), the role of AI is considered to develop from mere tools to integral teammates (Bradshaw et al., 2007; Rebensky et al., 2022; Rix, 2022). Within the fields of Human-Computer Interaction and Human-AI Teams, a transition from rudimentary human-machine task execution to advanced human-autonomy teamwork can be detected, underlined by the emergence of Human-Autonomy Teams (HATs). This transition has been further fueled by recent advancements in the field of Artificial Intelligence. The emergence of advanced large language models (LLMs) for example, have pushed the boundaries of AI capabilities, marking a new era in which machines are able to mimic cognitive human functions (Rai et al., 2019). These capabilities have revealed new opportunities to design machine autonomy and represent a new form of work (Mollick, 2022) in which AI agents might no longer remain subordinate but take on key responsibilities and fundamentally change how humans and AI work together (Baird & Maruping, 2021). This has been already acknowledged by a variety of industries including medicine, manufacturing, spaceflight, and construction, which are already investigating the development and integration of such teams (Begerowski et al., 2023). In an era where human-AI collaboration is on the rise, it is essential to probe deeper into how these teams will function.

Research in this area of HATs is rapidly growing (Seeber et al., 2020), exploring aspects like coordination, trust, shared cognition, and communication, among others. However, most studies are confined to lab settings, emphasising a need for more field research to assess the real-world effectiveness of HATs, especially in the workplace context (Larson & DeChurch, 2020; O'Neill et al., 2022). Thus, this research seeks to address the current limited understanding of the dynamics, complexities, and challenges posed by Human-Autonomy Teams within organisational contexts, using Thoughtworks as an implementation context.

Thoughtworks

Thoughtworks is a global technology consultancy renowned for its innovative approach to software development and delivery. Founded in 1993 by Roy Singham in Chicago, the company has since expanded its footprint to over 40 offices in 17 countries, serving a variety of clients that span multiple industries. At its core, Thoughtworks is driven by a mission to better humanity by combining strategy, design and software engineering.

One of the distinguishing features of Thoughtworks is its commitment to pioneering industry best practices. The company has been at the forefront of numerous movements in the software industry, including Agile development, Continuous Integration, and DevOps. By championing these methodologies, Thoughtworks has not only enhanced the efficiency and quality of software development but has also played a pivotal role in reshaping the way organisations think about and approach software projects. Their emphasis on collaboration, adaptability, and customer-centricity has set new standards in the realm of software consultancy.

Beyond its technical expertise, Thoughtworks is also recognised for its dedication to creating positive social change. The company is deeply invested in promoting diversity and inclusion within the tech industry. This commitment is evident in its hiring practices, internal policies, and the various initiatives it supports. Thoughtworks has consistently advocated for gender equality, LGBTQ+ rights, and the empowerment of underrepresented communities in tech. By leveraging its influence and resources, the company aims to create a more equitable and inclusive tech landscape.

Furthermore, Thoughtworks' dedication to social and ethical responsibility extends to its project choices. The company often engages in projects that align with its mission of bettering humanity. This includes collaborations with non-profits, governmental organisations, and social enterprises to develop solutions that address pressing societal challenges. From healthcare and education to environmental sustainability, Thoughtworks has been instrumental in driving digital transformations that have a meaningful impact on communities worldwide.

In terms of its internal culture, Thoughtworks places a strong emphasis on continuous learning and professional growth. The company fosters an environment where employees, often referred to as „ThoughtWorkers", are encouraged to pursue their passions, innovate, and challenge the status quo. This culture of empowerment and innovation is further bolstered by the company's flat organisational structure, which minimises hierarchies and promotes open communication. ThoughtWorkers are not just employees; they are visionaries, change-makers, and trailblazers who are given the autonomy and resources to bring their ideas to fruition.

A significant facet of Thoughtworks is its vision on AI development. The company perceives AI as a transformative force, primed to revolutionise industries and redefine the boundaries of what software can achieve. Thoughtworks is deeply invested in harnessing the potential of AI to create solutions that are not only technologically advanced but also ethically sound. Recognising the profound implications of AI on society, the company is committed to developing AI systems that are transparent, accountable, and free from biases. Their ambition extends beyond just implementing AI - it is about shaping its future. By actively participating in AI research, Thoughtworks aims to be at the forefront of innovations that drive both business value and societal progress. Their dedication to AI reflects their broader mission: to better humanity through software, ensuring that the AI-driven future is inclusive, equitable, and beneficial for all.

Company Mentors

Specifically dedicated to projects related to AI & Data is the Thoughtworks office in Amsterdam. This latest addition to their global community offers software design and delivery as well as consulting services.
The two most shining stars within this office are mentoring this thesis with their expertise and resources.

Lisa van de Merwe
Senior Experience Design Consultant

Nemanja Cvijanovic
Lead Data Science Consultant

3

LITERATURE REVIEW

Introduction

The following section reviews literature to elicit the concept of team collaboration in organisational contexts, explaining its definition, key features and underlying theories to provide a foundation for the subsequent exploration of Human-Autonomy Teams.

3.1. Team Collaboration

Effective team collaboration brings a variety of benefits, including higher profits, lower costs and improved decision-making processes (Hansen and Nohria, 2004). It has become a fundamental part of strategic decision-making in many organisations (Carneiro et al., 2021). The integration of different experiences, backgrounds and skills in teams improves problem identification, speeds up problem solving and optimises the quality of decisions made (Bose, 2015; Kaner & Lind, 1996).

Further, it is considered as a crucial factor for businesses to sustain in industries that are vulnerable to disruption from emerging technologies and changing markets. In such volatile environments, organisations must develop Innovation Capabilities to adapt and maintain competitiveness (Hernandez et al., 2018; Smulders & Dorst, 2007). These capabilities, cultivated through effective collaboration environments, are essential for navigating the complexities and uncertainties of the modern business landscape. They enable organisations to quickly adapt to changing circumstances and maintain competitive advantage (Smulders & Dorst, 2007)

Thus, fostering and maintaining effective team collaboration is important from a variety of perspectives. Yet, to comprehend the concept of *team collaboration* thoroughly, it is essential examine the components of both terms separately.

Definition of Collaboration

According to research, there is no definite consensus on what exactly constitutes collaboration as seen in Figure 1 (Stulgiene & Ciutiene, 2014). The table reveals how differently collaboration is defined in literature. It is portrayed, among others, as a social process, a mutual benefit or an activity. Having reviewed relevant literature in this in this field, the proposed definition of Bedwell et al. (2012) serves as the most suitable definition in the context of this thesis: *Collaboration is an evolving process whereby two or more social entities actively and reciprocally engage in joint activities aimed at achieving at least one shared goal*. This serves as a suitable definition as it describes collaboration as an evolving process, retaining the *dynamic and **evolving** nature pervasive in definitions across disciplines*.

Expanding on this definition, Bedwell et al. (2012) describe the objective of collaboration being centered around achieving a shared goal. While collaborating entities might have their individual objectives, there must be at least one mutual goal that binds them. This shared goal is what differentiates collaboration from other forms of interaction. As a result, collaboration is a reciprocal activity, affording mutual engagement and interdependency (Graham & Barter, 1999; Henneman et al., 1995). Even if there are conflicting objectives, the presence of a shared goal is paramount for collaboration, as emphasised by Gallant et al. (2002) and Henneman et al. (1995).

However, collaborative endeavors, particularly in organisational settings, are dynamic and multi-dimensional. While the concept of teams and their significance in organisational contexts is well-established (Paulus et al., 2012; O'Neill et al., 2023), factors that influence collaboration are not clearly defined, but certainly go beyond the factors mentioned above. Patel et al. (2012) emphasise that team collaboration is shaped by a myriad of elements, each with its unique dynamics and implications. Their research revealed seven main factors and their according sub-factors of collaboration (Figure 2).

Definition of Teams

In organisational contexts, individuals collaborating towards a shared goal are often termed as ***teams*** (Paulus et al., 2012). These teams, especially when they are interdisciplinary, play a pivotal role in many large companies, bringing together members from various departments with different experiences (Hansen & Nohria, 2004). Literature reveals several criteria to distinguish teams from groups.

The shared objective is the anchor for teams, providing a clear direction for their collective efforts (Hackman, 2002). This aim is enhanced by different forms of task interdependence, such as activity-based interdependence, where members depend on each other for specific tasks (Crawford & Lepine, 2013). Furthermore, clear role definitions ensure that every member contributes essential functions tailored to their specific role, covering both collaborative and individual tasks (Driskell, Salas, & Driskell, 2018). The size of the team is also vital,

Author	Concept of Collaboration
Kukulska-Hulme, 2004	Collaboration is a „philosophy of interaction", which has the main assumption in formation of consensus. Collaboration creates a shared meaning about processes, products or even events. There is nothing routine about it. Something is there that was not there before.
Mattessich & Monsey, 1992	Collaboration is a mutual benefit and well defined interrelationship entered into by two or more organizations to achieve common goals
John-Steiner, Weber & Minnis, 1998	Collaboration is a commitment to shared resources, power and talent: no individual's point of view dominates, but in decision making the influence depends on all group and work product reflects combination of contribution of all members and that base of collaboration constitutes of complementary areas of competencies.
D'Amor & *et. al.*, 2003	Collaboration in structuring of collective action is based on sharing of information and common decision making.
Gray, 1989	Collaboration is a process during which parties envisage different aspects of the problem, can constructively examine their differences and search for decisions by trespassing own limited vision.
Schrage, 1990	Collaboration is a process of shared creation: two or more persons with complementary skills and abilities interacting to create a shared understanding that none had previously possessed working individually.
Bruce & Riketts, 2008	Collaboration is a social process the success of which depends on effectiveness, efficiency and satisfaction in final result of process participants, and lack of communication knowledge and absence of motivation may become an interference.
Dettmer *et. al.*, 1999	The base of collaboration constitutes of communication (contact), cooperation, coordination.
Tereseviciene & Gedviliene, 1999	Collaboration is cooperation in striving for common goal, a social link of people, which appears while working together.
Heide, 1994; Lawrence *et al.*, 1999; Phillips, *et al.*, 2000	Collaboration is like cooperation, inter-organizational relationship, when there is a constant negotiation in communication process and this is related neither to market nor to mechanism of hierarchical control.

Figure 1: Definitions of Collaboration in Literatur

as too many members might dilute responsibility, while too few could lead to overburdening and skill shortages (Wageman, Hackman, & Lehman, 2005). In contrast, a ***group*** may lack one or more of these aspects (Paulus et al., 2012).

Collaboration in Product Development

In the context of product development, interdisciplinary team collaboration is not merely a convergence of varied disciplines but a synthesis aimed at addressing multifaceted problems inherent in product creation (Rosenfield, 1992). It describes a fusion of different knowledge bases and skills, enabling a comprehensive approach to developing products and services that meet the multifaceted needs of users and the market demands.

However, the process of interdisciplinary collaboration is characterised by inherent challenges, primarily revolving around the management of diverse knowledge bases and the alignment of different stakeholder objectives (Rosenfield, 1992). Collaboration encompasses various dimensions, including interactions between individuals, within the organisation, and among teams and firms (Dodgson & Rothwell, 1994). These firms may be partners, suppliers, or even competitors. This collaboration aids in problem-solving, seeking solutions, and suppor-

Main factors	Sub-factors								
Context	Culture	Environment	Business climate	Organisational structure					
Support	Tools	Networks	Resources	Training	Team building	Knowledge management	Error management		
Tasks	Type	Structure	Demands						
Interaction Processes	Learning	Coordination	Communication	Decision making					
Teams	Roles	Relationships	Shared awareness/ knowledge	Common ground	Group processes	Composition			
Individuals	Skills	Psychological factors	Wellbeing						
Overarching factors	Trust	Conflict	Experience	Goals	Incentives	Constraints	Management	Performance	Time

Figure 2: Factors of Collaboration

ting one another. Every member must recognize that the project's success depends on collective efforts, merging intellectual sources with effective interaction methods (Stulgiene & Ciutiene, 2014).

However, the effectiveness of teams in product development is further contingent upon many intrinsic factors that underpin the specific interactions within team collaboration, which will be explored in the following.

Framework for Team Effectiveness

The input-process-output (IPO) model is a concept introduced by McGrath (1964) intended to serve as a theoretical framework to guide research on team effectiveness and team interaction (Kozlowski & Ilgen, 2006; Mathieu et al., 2000).

In this framework, ***inputs*** refer to the characteristics, resources, and conditions that team members bring to the collaborative process. Inputs can include individual attributes such as skills, knowledge, and attitudes, as well as contextual factors like team composition, organisational support, and task characteristics. They are understood as the foundation upon which the team's functioning and performance are built. Further, ***processes*** encompass the interactions, behaviors, and activities when working towards shared goals. They involve communication, coordination, decision-making, conflict resolution, and problem-solving, as well as the development of shared understanding, mutual trust, and cohesion among team members. Team processes are characterized as dynamic though emerging, evolving as the team develops. Lastly, ***outputs*** describe results, products or outcomes that the team achieves. In addition, it also includes the satisfaction of team members' needs or the willingness of team members to continue working together (Hackman, 1987).

However, as the understanding of team dynamics evolved, scholars like Ilgen et al. (2005) and Marks et al. (2001) identified limitations in the IPO model. They argued that the term ***process*** was narrowly defined, focusing mainly on behavioral processes and overlooking individual cognitive constructs. To address this, Ilgen et al. (2005) proposed the Input-Mediator-Output (IMO) model, which encompasses both processes and cognitive frameworks as mediators between team inputs and outputs.

Shared Mental Models

This refined model has brought attention to the concept of Shared Mental Models (SMM), which are now widely considered to have a substantial impact on team collaboration (Kozlowski & Ilgen, 2006). Mental Models serve as the cognitive structures that help individuals describe, explain, and predict the world around them (Johnson-Laird, 1983; Converse et al., 1993; Van den Bossche et al., 2011). The overlap of these individual models with other teammates implies a collective (shared) understanding and mental representation of knowledge. This shared understanding enables team members to anticipate each other's needs and actions, facilitating implicit coordination and thereby improving overall team effectiveness (Cannon-Bowers, Salas, & Converse, 1993). Shared Mental Models are distinguished in shared understanding about equipment and tools (equipment model), understanding of the task and its requirements (task mental model), awareness of team member composition and resources (team-member model), and insights into effective team processes (team-interaction model), each contributing to a harmonious and productive team environment.

Past research has underscored the benefits of shared mental models, noting its positive impact on the quality of team interactions and overall satisfaction with the task execution process (Barczak & Wilemon, 2001; Harris & Woolley, 2009; Miles & Kivlighan, 2010). As Bonito (2004) found out, team members whose individual mental models were more similar dominated discussions during task execution, while those with more dissimilar mental models struggled to communicate and showed lower levels of task participation. Andres (2012) emphasised that *Key elements needed for the development of shared mental models are efficient and effective communication as well as a team climate where participation is encouraged and solution ideas are openly discussed and negotiated* (Blaskovich, 2008; Chidambaram & Tung, 2005; Fiore et al., 2001; Miranda & Saunders, 2003).

Moreover, when team members possess a shared mental model, it becomes easier to set cooperative goals. This is achieved by having a mutual grasp of task requirements and agreeing on the best solutions (Tjosvold et al., 2004). As teams align their thoughts and ideas, they can more effectively achieve cooperative goals, leading to enhanced productivity due to the combined and synergistic efforts of the members (Blaskovich, 2008; Ying & Wang, 2010).

In design research, the seminal work of Valkenburg & Dorst (1998) discussed the importance of shared understanding, indicating that without it, decision-making processes will not be supported by all members and later activities in the design process can be hampered by different views of team members on fundamental topics. Hence, the lack of shared understanding causes unnecessary iterative loops (Valkenburg & Dorst, 1998)

3.2. The New Teammate

HCI & HAI

For many years, experts have engaged in understanding the dynamics between humans and technology. To understand the role of technology and AI in collaborative settings, the concepts of Human-Computer Interaction (HCI) and Human-Autonomy Integration (HAI) should be mentioned. Historically, HCI has been about understanding how people engage with computers. This discipline emphasises creating intuitive and efficient interfaces, ensuring that technology is accessible and usable for individuals (Stefanidi et al., 2023).

In contrast, HAI delves into the deeper collaboration between humans and autonomous systems. Research in this field perceives technology as a supportive entity, secondary to humans (O'Neill et al., 2020). This perspective has led to the development of frameworks that evaluate a technology's proficiency and are instrumental in predicting how human-tech collaboration might evolve, especially as technology continues to advance in its capabilities (Endsley, 2017). Together, HCI and HAI provide a comprehensive understanding of the symbiotic relationship between humans and technology, ensuring that as technology evolves, it remains in harmony with human needs and capabilities (Wang & Moutinho, 2015).

Human-Autonomy Teams (HATs)

The integration of artificial intelligence into team dynamics has led to the emergence of Human-Autonomy Teams (HATs), where humans and autonomous agents collaborate to achieve shared objectives. These advancements in AI capabilities have piqued interest in the potential of autonomous agents not just as tools or assistants, but as genuine team members (O'Neill et al., 2022). Within HATs, these agents, ranging from partial to full autonomy, play distinct roles in coordination, task redistribution, and interactions with both humans and other autonomous entities. This evolution stems from research on human-human teams using advanced AI and autonomous systems. While HATs share certain characteristics with traditional human-human teams, they also exhibit unique patterns of formation, interaction, and outcome achievement, making them distinct from conventional human-human teams (O'Neill et al., 2023).

Autonomy in Team Collaboration

The way people work with machines can be understood better when considering the difference between automation and autonomy. Automation, as explained by Lee and See (2004), represents technology that operates within a narrow and predefined task, essentially performing functions that humans no longer need to. On the other hand, autonomy represents a more advanced form of technology, capable of independent decision-making and adapting to situations it was not specifically designed for. McNeese et al. (2018) defines autonomy as a technology that can work alongside humans as teammates, encompassing both task work and teamwork functions alongside a human counterpart. Lyons et al. (2021) highlight the shift from studying human-automation interactions to studying human-autonomy collaboration. They suggest that the human experience of interacting with autonomous systems may be significantly different from interacting with purely automated systems, primarily because autonomous systems can learn and adapt, whereas automated systems strictly adhere to set rules.

O'Neill et al. (2022) characterises autonomy in this context by identifying two main factors for classifying systems as HATs: Agency and Interdependence. Interdependence is crucial for the agent's ability to collaborate with other team members and across different tasks (Walliser et al., 2017). On the other hand, an agent should also possess a sense of agency that demonstrates the ability to act independently (Wynne & Lyons, 2018). An agent's level of automation (LoA) provides further insight into these factors (Figure 3).These levels span from fully manual to fully automated, often also encapsulating both the physical and cognitive capabilities of an agent (Fasth et al., 2011). For instance, an agent with low autonomy would be heavily reliant on human direction for decision-making and actions, representing no more than a mere tool. In contrast, an agent with high autonomy can independently make and act on decisions, aligning more with the requirements of an actual teammate. This high level

Automation Level	Agent Autonomy Level	Automation or Autonomous Agent Role and Capability
High	High agent autonomy	10. The computer decides everything and acts autonomously, ignoring the human. 9. The computer informs the human only if it, the computer, decides to. 8. The computer informs the human only if asked, or 7. The computer executes automatically, then necessarily informs the human, and
	Partial agent autonomy	6. The computer allows the human a restricted time to veto before automatic execution, or 5. The computer executes that suggestion if the human approves, or
	No autonomy / Manual control	4. The computer suggests one alternative, or 3. The computer narrows the selection down to a few, or 2. The computer offers a complete set of decision/action alternatives, or 1. The computer offers no assistance; the human must take all decisions and actions
Low		

Figure 3: Levels of Autonomy

of autonomy enables the agent to manage team interdependencies in an agentic manner. Literature further allows to distinguish these interdependencies into different types of autonomy:

Operational Autonomy: This is basic form of autonomy where the AI system can perform specific, pre-defined tasks without human intervention. It acts based on predetermined algorithms and does nott deviate from its programming (based on O'Neill et al., 2020).

Decisional Autonomy: This refers to the ability of an AI system to make choices or decisions based on the data it processes. These decisions are typically made within a set framework or based on certain rules, but the system has the freedom to choose from multiple options (based on O'Neill et al., 2020).

Adaptive Autonomy: AI systems with adaptive autonomy not only make decisions but can also modify their behavior based on new information or changing environments. These systems can learn from experience and adapt accordingly (based on Hauptman et al., 2023)

Collaborative Autonomy: This type of autonomy is inherent in systems designed to work in tandem with humans or other systems. While these AI systems can function independently, they are optimized to collaborate, taking inputs from human operators or other systems and adjusting their behavior to complement the collaborative effort (based on O'Neill et al., 2020).

Designing effective and efficient Human-AI collaboration with appropriate degrees of autonomy is a complex task that requires careful consideration of various factors. The level of autonomy of an AI system can have a significant impact on the collaboration between humans and AI systems. For instance, an AI system with a high level of autonomy may make decisions without human input, which can lead to a lack of transparency and accountability (Hauptman et al., 2021). On the other hand, an AI system with a low level of autonomy may require constant human input, which can be time-consuming and inefficient (Endsley, 2023). Research has shown that Human-AI collaboration can be successful when the level of autonomy of the AI system is appropriately matched with the task requirements and the human team members' skills and expertise (O'Neill et al., 2020). This in turn also helps to promote feelings of trust, perceived effectiveness, competence, and unity within human team members (O'Neill et al., 2022). Moreover, designing Human-AI collaboration that respects human autonomy is critical to ensure that AI systems do not hinder human autonomy (Laitinen & Sahlgren, 2021). Therefore, considering the levels of autonomy when designing Human-AI collaboration is valuable to ensure effective, efficient, and ethical collaboration between humans and AI systems.

Affordances to HAT Research

However, as already implied above, HAT research is too often viewed as advanced versions of human-human teams. This perspective fails to recognise the unique advantages and limitations of autonomous teammates, which can lead to unrealistic and suboptimal standards for HATs (O'Neill et al., 2023). Thus, McNeese et al. (2023) defined three fundamental propositions to guide research in this field and ensure that HATs develop their own distinct identity:

1. Teammate Concept in HATs:
Autonomous agents in HATs do not need to mimic humans to be effective teammates. Aiming for a human benchmark should not be desirable for HAT researchers to achieve success as the term *teammate* does not necessarily imply or demand human characteristics. McNeese et al. state that it is crucial in HAT research to recognise this, especially when there is a prevailing trend to design autonomous systems with human-like communication and appearance as highlighted by Blut et al. (2021). Here, inspiration can be drawn from Human-animal teams, like search and rescue teams, to highlight the effectiveness of non-human teammates. Thus, HATs should emphasise function over imitation.

2. HATs are Unique from Human-Human Teams:
HATs should not merely replicate human-human teams as they will have their distinct dynamics. For example, the way values such as trust or cognitive factors such as shared mental models are defined and constructed, differs due to the artificial nature of autonomous agents, resulting in the need to develop new means of measuring and assessing these factors for HATs. Thus, only fixating on mirroring human-human interactions and practices could hinder Human-Autonomy Teams from unfolding their potential.

3. Managing Human Expectations in HATs:
Humans not only bring expectations for teaming based on their experiences with human-human teams to HATs (Chen & Klimoski, 2003), but also from interacting with current AI platforms (Aydin & Karaarslan, 2023). These expectations can either hinder or enhance the performance of HATs. Thus, it is essential to manage these expectations and provide training to humans working with autonomous agents.

Social Systems

The need to further explore Human Autonomy Teams (HAT) in general arises from complexity when embedding these systems into social contexts (Lyons et al., 2021).

Embedding sophisticated technologies such as AI in collaborative contexts creates both a socio-technical and socio-cultural construct due to the intricate interplay between humans, technology, and society at large. From a socio-technical perspective, these systems represent the convergence of advanced technological systems with human processes, requiring a deep understanding of how humans and machines can best collaborate (Xu, 2023). This involves designing systems that are not only technically proficient but also mindful of human behaviors, limitations, and strengths (Xu, 2021). On the socio-cultural side, these systems should consider societal norms, values, and beliefs during development and interaction design (Gmeiner, 2022). As autonomous systems become more integrated into everyday life, cultural perceptions of trust, responsibility, and agency are challenged and reshaped (Rezwana, 2022). The acceptance and adoption are contingent on cultural attitudes towards technology, work ethics, and the human role in decision-making (Sarkar, 2023).

Already in the past, the integration of AI systems into the workplace ushered in a new dynamic between emerging technologies and human workers. Studies in Human Factors and Ergonomics have delved into the impact of digital technology on the psychological health of employees, especially concerning workload and stress (Castillo et a., 2019). These human-centric elements, which include job skills, satisfaction, and fatigue, are not mere side considerations but are fundamental to overall job performance (Tsiakas & Murray-Rust, 2022). As AI systems are crafted to work alongside humans, it remains essential to deliberately integrate these human factors into the design of human-AI interactions.

Human Perception & Machine Acceptance

Research is ongoing to determine the technological capabilities that make machines acceptable to humans as teammates (de Visser et al., 2018). The challenge lies in humans accepting machines as partners, with the human side often being the limiting factor in human-agent interactions (Sycara and

Lewis, 2004). Despite advancements in technology, there is still a gap in understanding what makes a machine a good teammate.

Wynne and Lyons (2018) introduced a model detailing when humans perceive technology as a tool versus a teammate. Next to factors such as Agency and Interdependency that were already outlined by O'Neill et al. (2022), they further mention the importance of three other factors as well: Communication, Intent and Synchrony. Communication describes a foundational process where humans and machines exchange and interpret information, going beyond mere data transmission to ensure content is rich, relevant, and timely, crucial for establishing shared awareness, aligning goals, and building trust within teams (Hanumantharao & Grabowski, 2006; Iqbal & Riek, 2017). Intent is pivotal, referring to the machine's ability to project its future actions or decisions, providing clarity and reducing uncertainties in interactions, and is vital for fostering trust and understanding in dynamic environments (Lyons, 2013). Synchrony, or shared mental models, represents the harmonised understanding between team members, enabling them to anticipate needs, coordinate actions, and respond effectively to changing scenarios, pivotal for collective interpretation and action in dynamic contexts (Cannon-Bowers et al., 1993; Salas & Fiore, 2004).

Concluding, while there are unique factors emphasised in human-machine teams, the underlying principles of effective collaboration, such as trust, shared understanding, and interdependence, remain consistent across both human-only and human-autonomy teams.

Thinking in Futures

The field of Human-AI teaming (HAT) research is still in its formative stages and may seem abstract to many. As Guznov et al. (2020) and Jung et al. (2015) pointed out, designing HATs to be effective is not a straightforward endeavor. Past attempts to make autonomous agents and robots better team players have not always succeeded. This underscores the importance of a holistic systems design approach that considers the nature of the HAT system, such as roles, tasks, team objectives, level of autonomy, and teamwork requirements.

In such a context, methods that shed light on the unknown future of sophisticated collaboration systems are essential (Rezwana & Maher, 2022). Muller & Liao (2017) advocate for the use of future thinking methodologies such as design fictions to place future users at the forefront of anticipating, designing, and evaluating intelligent systems. It provides a platform for users to express their visions of future technologies and the values they implicate. Such methods are invaluable in opening spaces for diverse speculations about future technologies (Blythe, 2014) and ensuring that the ethics and values of intelligent systems reflect the interests of their users.

Discussion

The literature review presented, laid the foundation for understanding the multifaceted nature of collaboration, the evolution of Human-Autonomy Teams (HATs), and the importance of autonomy in team collaboration. This discussion section will synthesise key findings and insights from the literature review to conclude on the next steps for the upcoming research phase.

The first part of literature review delves into the intricacies of collaboration, emphasising its complexity and the various factors that influence its effectiveness. Further, it underscores the critical role of effective collaboration for organisations, highlighting that it is not only desirable but often imperative for achieving business objectives.
Now, with recent advancements in AI and the emergence of of promising tools, new opportunities were revealed to boost the efficiency of teamwork through technology (Todoros & Todoros, 2023). Extrapolating this development, literature points toward great potential to integrate autonomous AI agents, indicating a shift from mere tools to essential teammates. Thus, many organisations, including Thoughtworks, aim to explore the potential for integrating AI to improve operations and foster effective team collaboration. Here, a crucial need emerges to navigate the transition by exploring potential interaction of future Human Autonomy Teams.

However, as most studies are confined to lab settings (O'Neill et al., 2022), this study aims to ground the research in a real workplace setting, using Thoughtworks as an implementation context. Therefore, the following empirical research phase of this thesis will use the insights gained to identify the specific challenges Thoughtworks employees face when collaborating on a daily base. The revealed challenges serve as a foundation to explore the potential of AI to support effective team collaboration.
Therefore, the following two research question can be formulated:

RQ1: What collaboration challenges do Thoughtworks employees face during meetings?

RQ2: How can AI systems address the identified challenges to enhance team effectiveness?

Research Guidelines

As research within the field of HATs often draw parallels to traditional human-human teams, research guidelines for this thesis have been set, to ensure meaningful contribution to this field. Referring to McNeese et al. (2023) suggestions for research on Human Autonomy Teams three aids can be defined guiding the outcome of this thesis:

1. Emphasise Function over Imitation:
The research of this thesis shall emphasise the functionality and capabilities of AI in enhancing team effectiveness rather than aiming to imitate human teammates.

2. Respect Uniqueness:
The research of this thesis shall respect and highlight the unique nature of AI driven systems.

3. Implement Human Expectations: The research of this thesis shall understand and address the concerns, thoughts, and values of humans.

Speculative Design

Given the recent emergence and abstract nature of Human Autonomy Team research, the utilisation of methodologies that illustrate the potential future landscapes of sophisticated collaboration systems is integral. Next to empirical methods to reveal present challenges of collaboration, this thesis further aims to employ methodologies inspired by Speculative Design, as it offers a proactive approach to envisioning and understanding the transformative impacts of AI on organisational collaboration. It enables the exploration of future collaboration between humans and AI, acting as a link between the present reality and a variety of possible futures, allowing stakeholders to envision and consider potential solutions in a constructive, imaginative environment (Blythe, 2014).

The speculative futures developed with this method serve as effective communication tools that translate the abstract potentials of AI into tangible, comprehensible stories, enabling shared understanding across different organisational levels. This is particularly relevant to interdisciplinary collaboration as it serves as an inclusive means of inviting end-users with different skills, backgrounds and perspectives, allowing them to explore their values, concerns and expectations.

By proactively envisioning and understanding these changes, Thoughtworks can position itself at the forefront of these developments, harnessing the full potential of AI to drive innovation, efficiency, and competitive advantage. Delving into the potential of

AI to support collaboration now, they can set the standards and best practices for the future working environments, ensuring that they remain leaders of in their field.

Outcome Implications

The research outlined in this thesis carries significant implications for both the field of strategic product design and the broader landscape of interdisciplinary team collaboration, particularly in the context of AI integration. By focusing on the potential of Artificial Intelligence (AI) to enhance team effectiveness within interdisciplinary product development teams and using Thoughtworks as an implementation context, this study addresses a pressing need in today‘s rapidly evolving work environments.

Further, it aims to explore the transformative potential of technology, by creating understanding of how AI can transition from being a mere tool to becoming an integral teammate within interdisciplinary teams. Moreover, it seeks to employ Speculative Design methodologies, helping to translate present insights into possible future scenarios.

4
EMPIRICAL RESEARCH

Introduction

This research phase aims to identify challenges and values of collaboration at Thoughtworks Amsterdam. To achieve this, data was collected through the distribution of an online survey, observations of collaborative activities and one interview with the Head of Capability Development. Collaborative Activities are here defined as meetings that are related to existing projects and exclude internal leadership meetings and similar. Meetings must include some sort of co-creation, requiring the team to collaborate in order to achieve a shared goal (cf. Kocsis et. al, 2015). Such tasks often involve interaction, discussion, evaluation, shared understanding, decision making and/or consensus building (cf. Vreede & Briggs, 2005, Briggs et al., 2006).

4.1. Meeting Observations

Method Description

A total of 7 collaborative activities have been observed over a period of 5 weeks. All meetings were held online, which is the preferred way of working at Thoughtworks Amsterdam. Due to reasons of confidentiality, observations were limited to internal projects, only allowing for spontaneous note-taking without taking video or audio records of the sessions.

While 6 of those observations were used to gather data, the first meeting intended to gain initial impressions of collaborative practice at the office. These impressions indicated a complex collaborative environment, in which employees not only exchange information but are also required to anticipate teammates' behaviors and coordinate closely to complete high-complexity tasks in a collective way. Thus, to cope with this complexity and maximise the value of these observations, a framework was chosen to capture insights in a more systematic way and set focus. The Shared Mental Model framework of Badke-Schaub et al. (2007, p.8) seems to serve as a suitable lens in this context. In their foundational work, Cannon-Bowers et al. (1993) describe these shared models as knowledge or belief structures that are shared by members of a team, enabling them to predict their teammates' actions and needs. This collective understanding facilitates the selection of actions that are consistent and coordinated with those of their teammates, especially in rapidly changing task environments.

According to Badke-Schaub et. al (2007), they further embrace both individual mental models as well as their distribution within a team, making them a suitable theoretical framework for exploring how teams approach complex problem-solving. By applying team mental model research to investigate design problems, insights into the development of solution finding, as well as the communication and implicit coordination processes within a team can be gained. (Badke-Schaub et al., 2007).

For each observed meeting, protocols were created trying to capture the respective project, meeting goals, facilitator, attending participants, their roles, observations and general insights, helping to build contextual understanding of collaboration at Thoughtworks. This was crucial as observational methods might be influenced by subjectivity (Bisantz & Roth 2007), requiring to always consider the broader meeting context. Observations were then translated into a single or multiple challenges in a manner that is indicated in Figure 4.

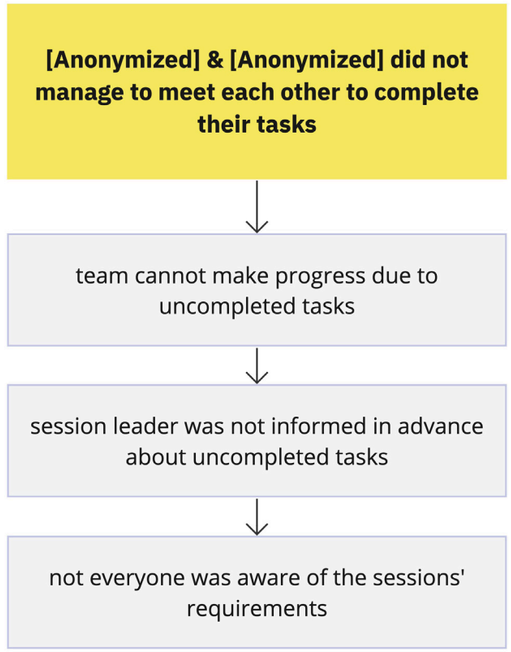


Figure 4: Translation of an observation into challenges

Using Mental Models

However, Team Mental Models originate from Cognitive Sciences and lack common means of measurement (DeChurch et al., 2010; Casakin et al., 2015). Previous efforts made to uncover the cognitive processes and behaviors of designers could not reveal the specific process by which mental models are formed during co-creation activities (Badke-Schaub & Frankenberger, 1999). This is due to the complexity and multidimensional nature of team mental models. Thus, researchers need to carefully consider the research purpose, team context, and participant selection to determine the most suitable technique (Mohammed et al., 2000).

Building on the mental model framework for design of Badke-Schaub et al. (2009) and the foundational work of Cannon-Bowers et al. (1993) a slightly adapted framework was created to fit the goals of this research phase and allow for proper categorisation of the observation notes (Table 1). It intends to help reveal occurrences that disturb the building and maintenance of Shared Mental Models and thus hinder effective collaboration. As shared mental models refer to knowledge representations, an occurrence is here defined as a manifestation that points towards the underrepresentation or ineffective distribution of knowledge that has been implied through observation.

For this initial research phase, it was chosen to employ both observational methods and a survey to measure Shared Mental Models in team collaboration. The rationale for this dual-method approach is grounded in the complexities of mental model elicitation, as outlined by Norman (1987) and Cooke et al. (2000). Observational methods offer the advantage of capturing the nuanced details of how tasks are performed in real-time, thereby providing qualitative insights into team members' reasoning and interactions (Bisantz & Roth 2007).

Shared Mental Model	Description	Source
Task Model	Shared understanding related to the problem/brief at hand. It embraces representations related to the problem statement, requirements, solution ideas, opportunities, definitions, analysis and evaluations.	adapted from Badke-Schaub et al. (2009, p. 2)
Process Model	Shared understanding associated to the appropriate practices for solving the task. It includes the strategies, rules and procedures that need to be considered in order to attain the goals. It includes understanding about planning (in what moment to proceed and what to do), procedures (in what way to proceed, as well as planning strategies, tools and methods to use), and reflection (considerations about what the team has already accomplished, and how it should continue in the coming steps).	adapted from Badke-Schaub et al. (2009, p. 2)
Interaction Model	Shared understanding about skills, abilities, preferences, expertise, motifs and tendencies of other team members. Furthermore it includes understanding about each others roles, responsibilities, team composition, way of communication, collaboration values and the flow of information.	combination of Team Interaction Model and Team Model from Cannon-Bowers et al. (1993) as found in Rasker (2002, p.18-19).

Table 1: Adapted Shared Mental Model framework

While surveys may lack the expressive power of observational methods, they compensate by producing results that are easier to quantify, which is essential for many research applications (Cooke et al. 2000).

By combining observations and surveys, I aim to mitigate the limitations inherent in each method. Observations will provide the qualitative depth needed to understand the intricacies of team dynamics, while surveys will offer the quantitative breadth for a more generalised understanding of Shared Mental Models. This multi-method approach aligns with best practices in the field of cognitive task analysis and is designed to provide a comprehensive understanding of how mental models are shared among team members (Bisantz & Roth 2007; Cooke et al. 2000).

→ *see the appendix for detailed analysis*

4.2. Online Survey

The online survey was designed to collect data about the challenges Thoughtworks employees face when collaborating on projects. A total of 21 responses were collected over a duration of three weeks. To increase the number of submissions a reminder mail was sent out twice a week. Additionally, the two company mentors supporting this study kept reminding employees via internal communication channels.

The first question asks to describe a recent collaborative activity and specify its purpose and/or objective. Participants were then asked to state up to 3 challenges that occurred during this activity and prevented the team from making progress or slowed down. In addition, a five-point Likert scale was displayed, through which employees could indicate the frequency of each mentioned challenge.

The last section requires choosing one of nine ***superpowers*** that employees would have liked to possess for the prior mentioned activity and one they would have allocated to an AI teammate (Figure 5). The shown superpowers describe a variety of skills and were deliberately given an exaggerated description to help submitters reflect on what they value most. This further helps to achieve a clear distinction of skills, which can be difficult when it comes to intangible, social skills. The superpowers have been defined after the observation of the first

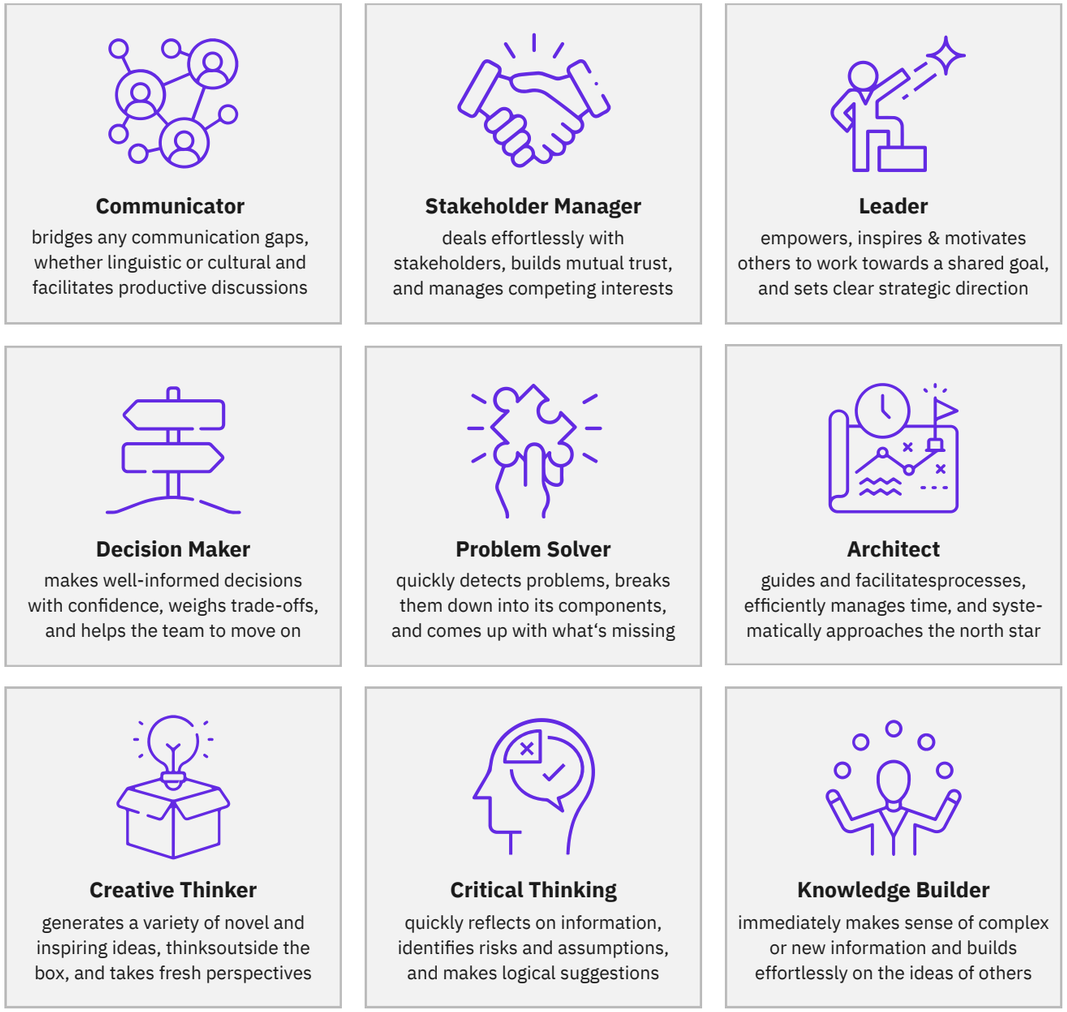


Figure 5: Defined superpowers, encompassing a variety of skills relevant for collaboration

meeting and aim to cover essential skills of collaboration. In addition, the survey was tested with a small sample of employees to refine them and obtain their approval. Displaying these in a graphical overview, along with iconographic representations, supports the perception of choosing a truly special trait for collaboration and prevents the participant from focusing too much on evaluating these skills against the existing collaborative practice. This increases the likelihood that underlying needs and values will be uncovered.

The purpose of this order is to let users first engage with challenges and experiences of their past before thinking about possible futures involving an AI teammate. This section aims to reveal insights about when and why particular skills are chosen or allocated to an AI. The selection might generate interesting patterns pointing towards particular sets of skills or functional roles. Finally, the survey asks to justify both choices.

The survey design leads to the addition of two Sub-Question to the main research question of this section:

RQ: What collaboration challenges do Thoughtworks employees face during meetings?

SQ1: Based on the challenges identified, what skills would they have liked to possess to resolve them?

SQ2: Based on the challenges identified, what skills would they have liked to allocate to an AI teammate in order to resolve them?

4.3. Analysis of Collaboration Challenges

Collaborative Activities

The collaborative activities mentioned by Thoughtworks employees present a variety of activities that span across different areas of the business. The descriptions also vary in their level of detail as some employees tried to thoroughly describe the activity with its purpose and objectives (*E7: The purpose of the meeting was to select a list of Tech Trends from the TW Global Tech Strategy, according to the intersection between: Global recommendations, Market needs in NL and TWer willingness. Each person selected 5 Tech Trends individually, per each „lens“ (6 in total), at the end we have discussed which ones we should filter based on most selected Tech Trends.)* while others kept it brief *(E5: I worked on spike recently.*)

Besides anticipated activities such as ideation sessions, building proposals or defining success metrics it was particularly interesting to reveal the company's efforts to improve efficiency and productivity of employees and internal processes. These were expressed in meetings engaged in aligning team norms, redesigning business critical functions and adjusting/defining new roles and responsibilities. Moreover, it is noteworthy that some activities are focused on knowledge sharing and training, such as *coming up with a knowledge-sharing/training plan for responsible tech topics* and *co-creation of a slide deck to make material accessible to non-AI tech-savvy clients*. This indicates that the company values continuous learning and development of its employees and clients.

Challenges

The 23 submissions of the survey resulted in 52 challenges. On closer inspection, some challenges encompassed multiple distinct challenges, resulting in a refined count of 55 challenges. Additionally, observation notes contributed to another 34 challenges. Both sets of challenges were coded into 14 themes in two iterations (Figure 6). Throughout the coding process, emphasis was placed on a data-driven approach, ensuring that themes emerged organically from the raw data itself.

The themes were then assigned to one of the three shared mental models, based on the model they disturb the most, with the exception of the theme „External factors", which could not be assigned to any of the mental models. As the submitters elaborated the challenges with varying levels of detail and partially used ambiguous formulations, the assignment of codes and creation of themes have always taken the particular context of the challenge into consideration and were furthermore supported by the impressions gathered throughout my own observations.

Task Model	Process Model	Interaction Model
Unclear session objective/outcome	Lack of Facilitation	Unclear Ways of Working/Communication
Unclear Problem Definition	Unclear Process	Diverging team knowledge/experience
Explanation/ Description Issues	Sparsity of Time	Unclear Roles & Responsibilities
	Inappropriate method	Lack of Participation
	Unclear use of method	Inadequate Documentation
		Methods

External Factors

Figure 6: 52 Challenges were coded into 14 themes

Results

Figure 7 shows the distribution of all challenges among the three models indicating the different sources of challenges (bottom part: survey, top part: observations). The majority of challenges (37) affect the ***Process Model***, followed by the ***Interaction Model*** (29) and ***Task Model*** (20).

Figure 8 shows that the four themes containing ten or more challenges are ***Lack of Facilitation*** (13, Process Model), ***Unclear Process*** (11, Process Model), ***Unclear objective/outcome*** (11, Task Model) and ***Unclear Roles and Responsibilities*** (10, Interaction Model), indicated through the left Y-axis.

The right Y-axis, together with the transparent bars, show the average occurrence of the challenges within each topic. However, it needs to be considered that these occurrences were indicated by employees only through the survey and therefore do not refer to the challenges from the observations. The higher the value, the more frequently the challenges inside the theme occurred (on cumulated average). Leaving out themes with less than 5 challenges, the top 3 most occurring topics are Unclear Problem Definition, Lack of Facilitation and Unclear Process. Comparing this to the previous graph, we can see a correlation between the most occurring challenges and the subjective prevalence of certain challenges.

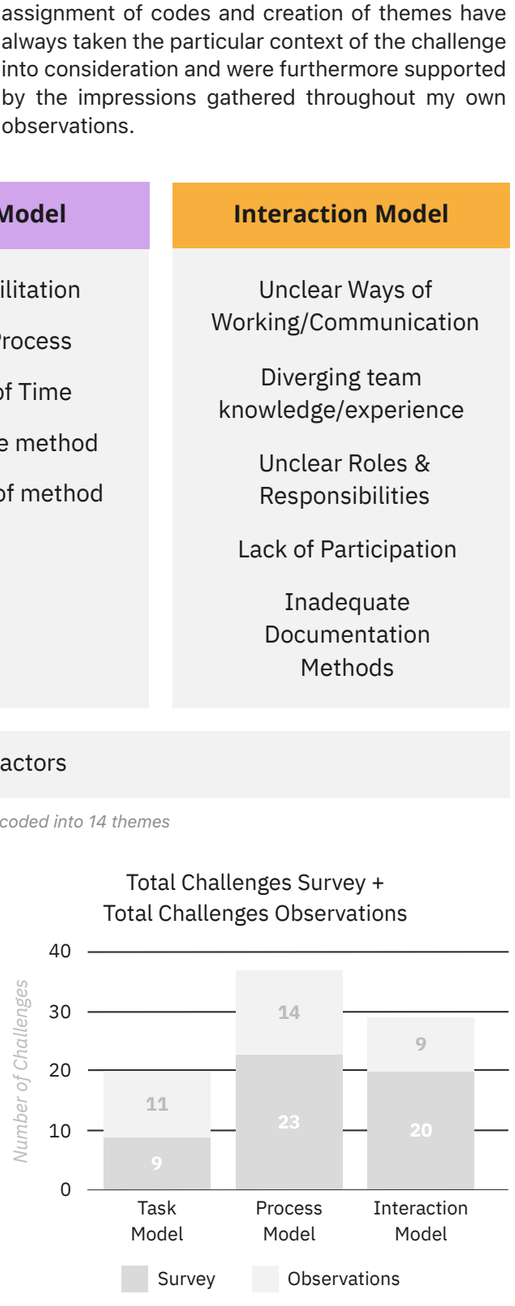


Figure 7: Split of all challenges according to SMM framework and originating source

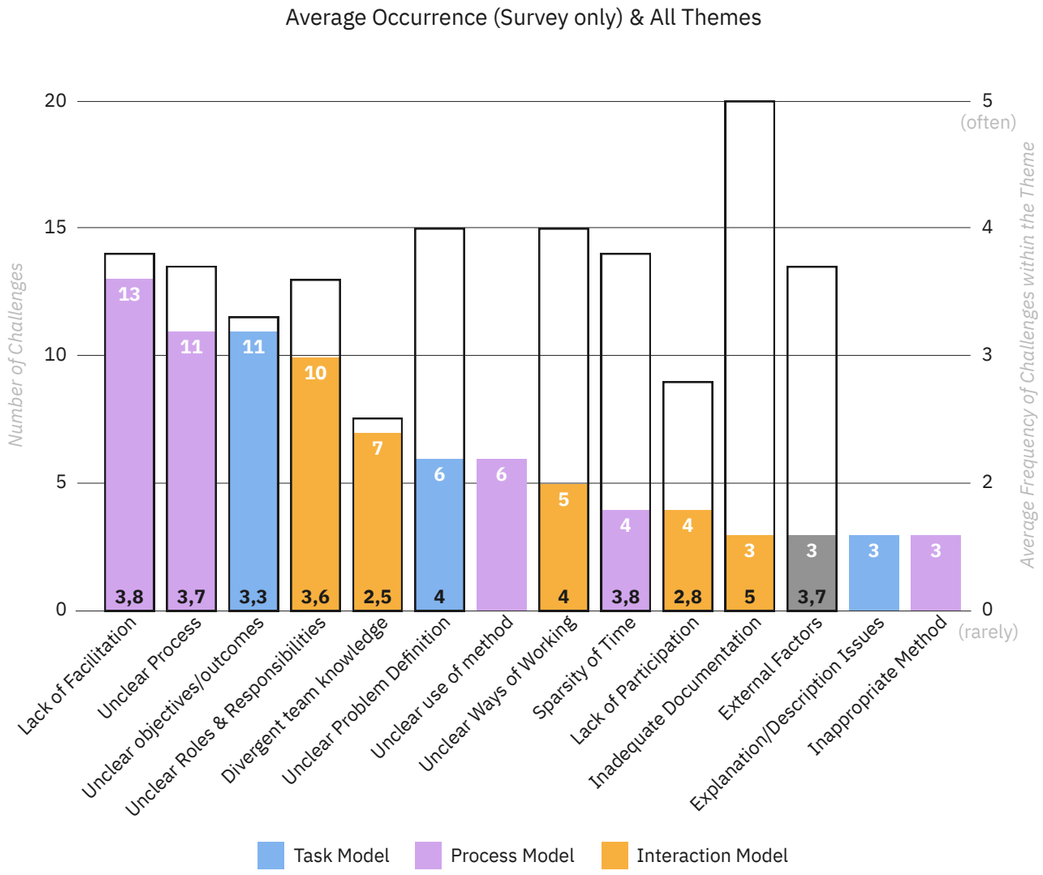


Figure 8: Total Number of Challenges per theme & Average occurrence of challenges within each theme

→ *see the appendix for detailed analysis*

Superpowers

Results

Decision Maker (5), ***Leader*** (4) and ***Architect*** (4) belong to the most self-assigned superpowers, whereas ***Knowledge Builder*** (10), ***Problem Solver*** (4) and ***Communicator*** (4) would have been allocated to an AI teammate (Figure 9).

Superpower choice reasonings

The total of 42 reasonings why employees chose a certain superpower for themselves and an AI teammate were coded into 11 themes in one iteration (Figure 10)

Results

When considering skills for themselves, the primary theme was ***to facilitate better***, as indicated by 7 respondents. This was followed by a ***needed in general*** (4), the desire ***to communicate effectively*** (3), and the aim ***to increase the effectivity of meetings*** (2). Additionally, 2 respondents felt that certain skills were inherently ***part of my role/skillset***.

In terms of skills allocated to an AI teammate, the AI's ability to ***summarize & extract information*** served as the most dominant justification as highlighted by 6 respondents. This was closely followed by the desire to ***standardise/automate tasks*** (5) and ***increase the efficiency of meetings*** (4). Other reasons included the AI's potential to ***reduce cognitive load*** (3) and to ***gain new perspectives*** (2). Notably, 4 respondents expressed ***concerns about AI.***

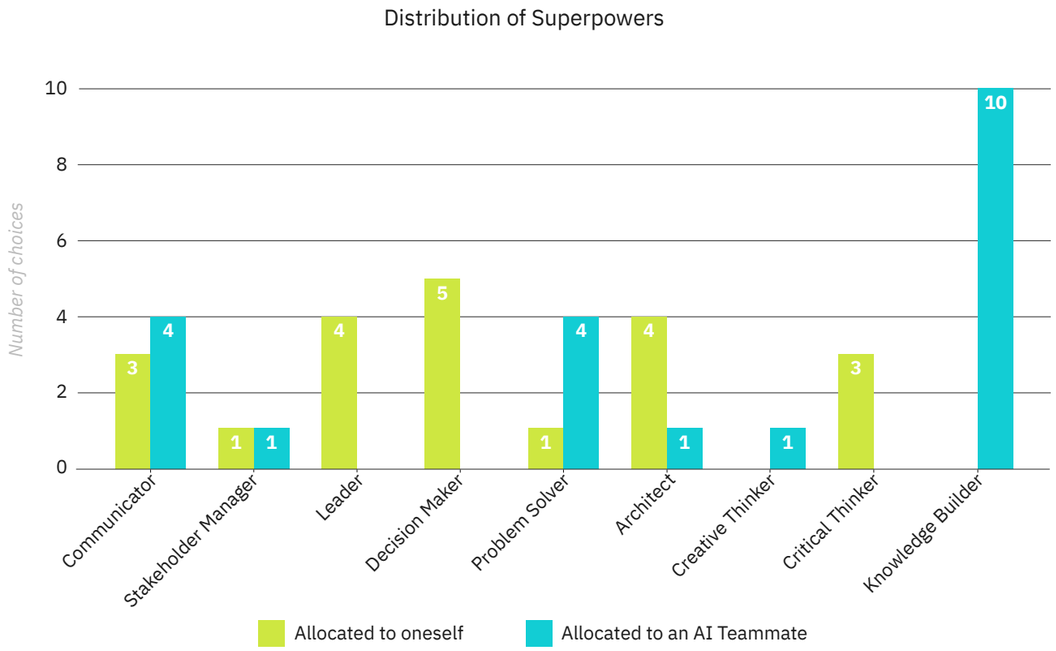


Figure 9: Distribution and allocation of superpower choices

Employee	AI Teammate
to facilitate better (7)	to summarise & extract informations (6)
Needed in general (4)	to standardise/ automate tasks (5)
to communicate effectively (3)	to increase efficiency of meeting (4)
Part of my role/skillset (2)	to reduce cognitive load (3)
to increase effectivity of meeting (2)	to gain new perspectives (2)
	Concerns about AI

Figure 10: superpower reasoning themes

Analysis

Need for Facilitation

The results indicate a great need for proper facilitation from a variety of perspectives. First, this is supported by the high amount of submissions (10) choosing either the ***Communicator*** or ***Architect*** superpower, both of which greatly overlap with typical functions of a facilitator. Having chosen 6 of those for themselves, the corresponding reasonings reveal that submitters sought for effective guidance through structure and clear communication to build shared understanding or reach alignment. The 4 choices allocated to an AI teammate were justified to either standardise processes or receive assistance by capturing and processing meeting information.

Second, most reasonings of other superpowers point towards similar needs as well despite referring to superpowers that do not necessarily overlap with the facilitator's role (i.e. ***Communicator*** or ***Architect***). For example, one employee chose the ***Leader*** superpower for themselves while arguing *E4: This superpower should help me to facilitate better.* However, this superpower is described as an enabler to empower, inspire & motivate others to work towards a shared goal, and set clear strategic direction. This indicates how differently facilitation is perceived by office employees and asks for further research to reveal definitional nuances.

Third, not only the most prominent reasoning theme ***facilitate better*** but other themes such as ***Needed in general***, ***to increase effectivity of meeting*** or ***part of my role/skillset*** indicate a need or personal desire for the according collaborative activity to be appropriately facilitated. The theme ***communicate effectively*** mainly concerns achieving shared understanding and the need for better communication to improve the effectiveness of meetings. Given the description of this superpower, it can be assumed that proper facilitation would help to (partially) solve the mentioned challenges here as well.

The reasonings reveal some other insights about facilitation as well. One submitter argued in their reasoning that due to *E14: the lack of clarity on the purpose and alignment of the process, people started to lose focus and trust in the facilitation of the session.* This indicates that good facilitation is more than achieving shared understanding. It seems to be connected to intangible values of collaboration as well (i.e. trust or focus).

General Insights

Perception of AI
Looking at the reasonings for superpower choices allocated to an AI teammate it becomes clear that submitters understand the AI here not necessarily as an equal teammate but rather as an assisting technology to which only certain tasks are delegated.

The separation of team subjects is indicated by formulations such as *(...) it seems an AI could do this better and allow us to focus more on the interesting part of decision making.*, *Converting random texts, ideas, scribbles in something meaningful to process later (knowledge) is tedious work and might be made simpler and faster with an AI assistant* or *might help with giving a base for us to move forward with (E9)*, as well as the choice of words to divide the team subjects into AI (”AI”, “it”, “AI team member”, “AI assistant”) and humans (”humans”, “us”, “we”).

Choice of Expression
Submitters justified their choices of superpowers using varying articulations. Looking at the superpowers reasonings, submitters often used a different set of words to reason the superpower of an AI teammate even if they roughly aim to address the same issue. Although the AI was intentionally described as a teammate *that could do everything*, some often used words to indicate the allocation of narrow tasks like *highlighting agreements*, *converting text* or *grouping ideas* along side with rather mechanical descriptions such as *to standardise processes* or *automate and delegate*. However, some also indicated the allocation of more intangible, abstract tasks such as *to look at a problem & think about it from multiple perspectives* or *keeping everyone on the same page with good communication* that are more difficult to address with current technologies.

Leveraging Strengths
Looking at the reasonings for the overall most chosen superpower ***Knowledge Builder*** (10), which was always exclusively chosen for an AI teammate, a need for this team member to mainly focus on processing information during meetings can be revealed. However, this focus is again also supported by reasonings that are not related to this superpower. The submitters express a need to be supported during processes such as facilitation, decision-making or achieving shared understanding in order to move forward. Information and knowledge should be treated in a way to reduce cognitive load or create a base on which human team members can build on. These are often seen as a means to focus on other tasks. Further, the AI teammate is imagined to help providing and considering multiple perspectives. All of this implies a potential intention to distribute work in a way that maximises efficiency and balances the unique capabilities of both humans and AI.
Surprisingly, AI is not only seen as a means to leverage its known capabilities but also for assessing whether or not meeting contents serve the overall goal: *E17: In brainstorming sessions, colalting, grouping & building the big picture & validating if it serves our North start would be a great assist & we can save time in such analysis & spend more in generating creative solutions.*

Low relevance of creativity
Furthermore, no employee would like to have used the ***creative thinker*** skill, although it would have objectively matched their mentioned challenges. This skill was also only selected once in total which might be related to the fact that the majority of employees in this office engage in rather technical/analytical work and consider creative work as a contrasting craft that has not yet been needed extensively.

Safeguarding human capabilities
The theme ***Resistance towards technology*** should be highlighted. This theme was deliberately not included in the table as its corresponding reasonings show some form of resistance to include AI as a team member. Here, the submitters express a desire to safeguard the unique contributions such as ***critical thinking***, ***decision making*** or interpersonal skills such as empathy that humans are equipped with. Further, also other inherently empathetic roles seem to be safeguarded as no submitters allocated ***Leader***, ***Decision Maker*** or ***Critical Thinker*** to the AI.

AI Facilitator
Two respondents specifically pointed out the value of an AI teammate for facilitation. One described facilitation as something that is in some cases *not the most interesting part but can still be crucial. Therefore, delegation would be helpful (E9).* This is surprising, considering that the majority of the justifications given by employees presenting the priority of facilitation as a necessity for themselves or their profession. Another submitter describes the struggle of time pressure when trying to think about a problem from multiple perspectives: *For humans this generally requires a dedicated focus time which is separate from the collaboration exercise. If an AI can parallelise this during the activity & surface the info, it’ll greatly help the facilitator (E16).*

Conclusion

Meeting Observations
According to Badke-Schaub et al. (2007) there is some evidence that both low and high levels of sharedness can negatively impact team performance. While low levels of sharedness correlate with a lack of knowledge, high levels of sharedness are correlated with a phenomenon called groupthink (Janis, 1975), which describes a strong group cohesion leading to a lack of creativity due to team members’ tendency to avoid the evaluation of alternative considerations. However, the optimal level of sharedness depends on the specific task and team composition:
Operational tasks with clear procedures need a highly shared task model whereas tasks that require individual decisions like creative activities might be more reliant on highly shared team models. (Badke-Schaub et al., 2007)

This implies a sweet spot of sharedness, depending on the project and meeting objective, which also became apparent during the observations. If team members happen to have a poor understanding of each other’s knowledge, it might not always have significant impact on team performance, when comparing open-ended ideation to decision-making activities for example. My experience in design practice has definitely helped here to sense this sweet spot and intuitively determine which occurrences have most likely impacted the creation and maintenance of Shared Mental Models.

Dynamic Mental Models
Another insight gathered through the observations is that disturbances are easier to detect in some models than in others. While occurrences related to the task model can be identified with more ease as they typically manifest through verbal expressions, occurrences related to the interaction model are more difficult to reveal when not expressed verbally. This insight is supported by Badke-Schaub (2007, p. 11) describing that team interaction models *entail probably more unconscious elements and there is no specified reference to relate to.*

Figure 11 presents the assignment of particular attributes to the three mental models, based on how I perceived them during the first Research Phase. The shared mental model framework applied in the context of my thesis revealed different characteristic behaviours and attributes. Contrary to Andrews et al. (2022) claims that shared mental models are by definition dynamic and slowly evolving, each model behaved differently in this particular context of team collaboration at Thoughtworks. The Task Model being the most vulnerable Model that can be disturbed the easiest and is often built and adjusted during meetings and activities. The Interaction Model on the other hand is a model that will be built over a longer period of time-building knowledge about how the team works and interacts with each other. Teams can deliberately plan to build and maintain it through good onboarding or team building activities for example.

Figure 11: SMM framework characterised as perceived during research

4.4. Outcome of Qualitative Analysis

The following presents an overview of barriers and drivers of collaboration at Thoughtworks Amsterdam, which were extracted from the empirical research.

Drivers of Collaboration

My research also revealed insights into the values that underpin collaboration at Thoughtworks. Two specific research activities from which values were extracted are presented below.

Observing a Project Kick-Off

One of the sessions I attended was an internal team-building activity, also called Engagement Kick-Off Workshop. This meeting not only intended to formally introduce everyone to the new client and its brief but also aimed to define ways of working and sustaining team cohesion. Thus, this meeting was particularly interesting to observe as it gives insights into how a shared Interaction Model is built in practice.

Right at the beginning, a team-building directive is being used that emphasises the importance of individuals coming together, leveraging their unique strengths, and working collaboratively to achieve shared goals. The directive highlights the belief that collective efforts and collaboration yield greater success than individual achievements alone. It encourages fostering an environment where cooperation and teamwork are valued and nurtured, leading to increased productivity and overall success. Subsequently, the team worked through several smaller activities in which everyone shared some personal information such as fun facts and indicated strengths and weaknesses. This helps to foster an environment of trust, openness and appreciation, that serves as a base to transition towards exercises related to the project: defining client and team objectives. All this is done collaboratively and provides space to share initial expectations and objectives, whether measurable (Success Metrics) or not (Vision). Following that, the team tries to define roles & responsibilities within and outside of the team. Stakeholders are identified and categorised according to their (competing) interests and involvement. Furthermore, besides each member's functional role, additional roles are assigned to make sure that certain practices are followed. In this case, this regards "constantly reminding the team" about feedback or security practices.

Finally, the last few minutes were deliberately designated to explore how team members feel, once more giving space to strengthen alignment, regulate expectations and making sure everybody feels safe and supported to tackle the project.

Interview with the Head of Capability Development

In addition to the survey and observations, one interview with the Head of Capability Development was conducted to generate deeper insights into values of collaboration at Thoughtworks Amsterdam.

The capability development role is vital for what Thoughtworks defines as meaningful collaboration. This role's responsibility is centered around the ambition to create environments in which individuals can build on their capabilities, unlocking their potential and equipping them with the skills and confidence to solve future challenges. It emphasises building a working environment that promotes ***Support*** & ***Safety***. Support describes the ambition to drive individual growth and match the market needs in terms of technologies and tools with the skills of the employees: *So the way that I see it is that we need to be able to keep growing people such that we're able to meet the challenges of new technologies, and w* This in turn is also important to make the team members feel valued and increase their level of fulfilment. Furthermore, identifying *the motivations of people and the things that ignite their passion* makes it *easy to create an environment in which people can bring their whole self to a problem*.

Safety places mental wellbeing at its core. It follows the ethos that failure is a result of a flawed process rather than individual mistakes: *We succeed as individuals. We fail as a team.* This is particularly emphasised during retrospectives, where *the team always starts by saying that we truly understand and believe, that everybody did the best job they could*. By assuming positive intent and creating trust, the team can build a safe environment where individuals feel comfortable sharing their experiences and taking interpersonal risks. This is further expressed by paying attention to avoid post hoc blaming of security incidents as *people haven't failed, the process failed them.* So by taking collective responsibility for outcomes, the team can learn from mistakes and continuously improve. *You should not have been in a situation where it was possible for this mistake to happen. And now, as a team, we are going to fix those processes, so that it never happens again.*

Barriers to Collaboration:

The findings highlighted a general lack of proper facilitation that can be further defined through a Lack of Clarity and Lack of Alignment. In addition, the choice of superpowers and their according reasonings imply that the employees are aware of the value of proper facilitation for effective collaboration, indicating the (personal) need either explicitly or implicitly.

Need for Facilitation

In the context of my thesis the Need for facilitation can be defined as the general insufficiency of guidance during collaborative activities. Proper facilitation is characterised by the deliberate choice of strategies and their appropriate way of planning, communicating and using them in order to achieve the desired outcomes. It is essential for steering discussions, ensuring active participation, and building shared understanding.
When facilitation is lacking or ineffective, several challenges can arise:

- Meetings may lack structure and direction, leading to extended durations without conclusions or

actionable outcomes. (CS6, C4S3)
- Some participants might dominate discussions, while others remain passive or disengaged, resulting in an imbalance of contributions and potential loss of valuable insights. (CS38, CS40, CS46, CS49)
- The team may struggle with prioritising topics, grouping similar thoughts, or converting discussions into tangible outputs. (CS29, CS42, CS45)
- There can be a lack of tools or methods to support the conversation, such as visual aids or digital platforms like Mural, which can help bring structure and clarity. (CS24, CO8, CO23)
- Team members might feel their input is not adequately captured or valued, leading to reduced motivation and engagement in future collaborative endeavors. (CS49)

Improper facilitation can significantly hinder the team's productivity, cohesion, and overall morale. It emphasises the importance of having skilled facilitators who can guide the team, manage dynamics, and ensure that collaborative sessions are both efficient and inclusive.

Lack of Clarity

Describes the insufficient or unachieved clarity. Clarity issues are related to unclear or ambiguous information. When clarity is lacking, team members often find themselves in a state of uncertainty, unsure of their roles, responsibilities, or the particular steps in a process.
This has manifested in various ways:

- Ambiguity in understanding specific terminologies, as seen when team members had to search for definitions of Tech Trends. (CS9)
- Uncertainty about ownership and responsibility, as evidenced by confusion over who should make decisions or take the lead in certain situations. (CS7, CS26, CS47, CO35)
- Challenges in translating verbal discussions into written summaries or digital assets, which can lead to loss of vital information. (CS50, CO34)
- Broad scopes of exploration, causing team members to lose track of updates and findings. (CS5, CO10)
- Uncertainty about session requirements. (CO3, CO15)

Such issues can result in inefficiencies, delays, and potential missteps in the project, as team members grapple with the uncertainty and seek clarity on various fronts.

Lack of Alignment

Describes the insufficient or unachieved alignment. Alignment issues are more focused on agreement and understanding among team members regarding project goals, vision, roles, or processes.
It has manifested as follows:

- Differences in opinions, especially when team members feel strongly about certain topics, leading to prolonged discussions and debates. (CS30, CS32)
- Misalignment in expectations, as seen when the outcome of a meeting does not match the anticipated results. (CS48)
- Challenges in establishing a shared vision, especially when team members come from diverse areas of expertise. (CS28)
- The need for negotiation and consensus-building, particularly when there are conflicting objectives or visions. (CS52)
- Passive participation or disengagement of certain team members, which can stem from a lack of understanding or feeling out of place due to differences in technical knowledge. (CS46, CS38)

Alignment issues can lead to friction, reduced efficiency, and potential conflicts within the team. It underscores the importance of open communication, negotiation, and consensus-building to ensure that all team members are aligned in their objectives and approaches. This theme is more relational and often involves multiple team members compared to Lack of Clarity which rather affects members individually.

Model Linkage

As these affected all of the three Shared Mental Models, they indicate linkage between each other. The following two examples describe these linkages:

Meetings that used facilitation methods, often suffered from similar issues. Team members were often not entirely aware of the activity objective and how the session facilitator intended to connect them to the anticipated solution. Consequently, often in the middle of the meeting, spontaneous discussions about objectives and outcomes arose, which only then made the facilitator aware of the lack of alignment. This was also often the case when it comes to task specific knowledge. This example shows how the Shared Mental Model layers are linked together: When it becomes apparent that some team members lack a shared understanding of the purpose of certain activities, not only the process model but subsequently also the interaction model is being disturbed, leaving the facilitator in doubt about his knowledge of what other team members know.

This interconnectedness becomes especially apparent when there is a lack of clarity. Often evoked by improper facilitation, unclarity about crucial meeting subjects is likely to impact other mental models causing moments of silence or people being left speechless. This in turn might cause affected team members to step back and question purpose and outcome of meetings, activities or projects.

One of the sessions observed particularly suffered from a lack of clarity: The meeting was about assigning tasks, which were defined in a previous meeting, to a new role within the Thoughtworks office. The session leader had the most knowledge about how this new role should look like but struggled to recap the previous session, which apparently did not fully result in the anticipated outcomes. Ambiguous post-its, unclear definitions and uncertainty whether or not the last session resulted in the meaningful outcomes lead to a general confusion with many moments of silence. Subsequently, the team struggled to make sense why this project was called into being in the first place. One team member even expressed his doubts about whether he can even add any value to this project, being not sure if his expertise can add any value. This furthermore resulted in a discussion revealing misalignment of expectancies and objectives. The session leader ultimately admitted that they could not recall the initial objective and suggested to adjust the target, which was received positively.
Although the team spent much time on recapping and clarifying steps, which lead to confusion and a stressed climate, all members showed great willingness to work collaboratively and *negotiate* their understanding of the task and process in a respectful and empathetic way.

Conclusion

Despite revealing several shortcomings of collaboration, further research needs to be done in order to reveal additional facets and nuances. These would enrich the data, that often lacks contextual information about the specific meetings due to submitter's varying levels of elaboration. For example, indications pointing towards a Lack of Facilitation do not always reveal whether this is due to insufficient skills or the general absence of a facilitating role. Further, the collected challenges rely on the subjective perception of either the survey submitters or the researcher, not including interpretations or reflections of others when noticing a challenge or occurrence. This is especially relevant since noticing a challenge not only includes individual perceptions but also the complex context it occurred in. Thus, not being able to reach alignment or resolve conflicts, for example, might be due to mundane reasons such as a high number of participants or connection issues in online environments that remained unnoticed.

All of these, not only point towards the complexity of collaboration but also the intricacy of the challenges revealed, often being results of longer, interconnected cause-and-effect chains.

Next Steps

Although (lack of) facilitation skills has been shown to be the root cause of many occurrences that hinder effective collaboration, it is also, according to employees, the most important factor in resolving these hindrances. This seems logical at first, but also reveals the general need and importance of this skill for the teams. However, the data also reveals that facilitation seems to be perceived and defined differently as already mentioned under 4.3. in the analysis of superpowers. Following this insight, a second literature was conducted to deepen the understanding of facilitation processes in organisations. Next to this, the role of technology to support facilitation was reviewed as well, building on the interesting allocation of skills between humans and AI revealed with the analysis of superpowers. This allows to adjust and align the research objectives of this project with current literature, according to the revealed insights.

5
LITERATURE REVIEW II

Introduction

The following section provides a foundation for un derstanding the importance of facilitation as a role and activity for the product development process. Furthermore, it presents how collaborative decision support tools have been used for team collaboration, revealing challenges and outlining the role of AI technology in these contexts.

5.1 Facilitation in Meetings

Team meetings are essential for companies, serving as key platforms for coordination and communication, as highlighted by Pollard & Hayne (1996). However, there is a common perception that these meetings can often be lengthy and unproductive (Hackman & Kaplan, 1974; Mosvick & Nelson, 1992). With the rise of globalisation and the increasing complexity in business operations, there is a growing need for collaboration across different departments and even organisations, requiring interdisciplinary collaboration. To ensure these meetings are both efficient and effective, it is pivotal to have trained facilitators (Hayne, 1999). This is supported by Clawson et al. (1993), describing facilitation as an essential act for effective collaboration in team meetings: "A dynamic process that involves managing relationships between people, tasks and technology, as well as structuring tasks and contributing to the effective accomplishment of the meeting's outcome". Research indicates that facilitators with proper training tend to lead groups to higher quality decisions (Bostrom et al., 1993; Phillips & Phillips, 1990). These facilitators rather guide than dictate, remaining aware to the diverse characteristics of the group (Hayne, 1999).

Functions of a Facilitator

Several authors describe tasks or functions a facilitator should carry out during a meeting. Hirokawa & Gouran (1989) classify facilitation into (1) substantive, which deals with the quality and availability of information and knowledge or its utilisation, (2) procedural, concerning the optimal order of activities, and (3) relational, focusing on the dynamics between group members. These classes align well with the shared mental model framework presented in the first literature review. Building on the work of De Vreede et al. (2002) and Hengst & Adkins (2007) the following framework captures an extensive list of relevant facilitation functions:

Atmosphere management
- Creates and reinforces an open, positive and participative environment
- Actively builds rapport and relationships
- Encourages/supports multiple perspectives
- Manages conflict and negative emotions constructively

Content focus
- Promotes ownership and encourages group responsibility
- Presents information to group
- Tests agreements among participants

Meeting procedures – execution
- Sets the stage
- Keeps group outcome focused
- Directs and manages the meeting
- Manages time
- Evaluates and redesigns the meeting process
- Is available

Technology
- Select and prepares appropriate technology
- Understands technology and its capabilities
- Creates comfort with and promotes understanding of the technology and technology outputs

Personality
- Demonstrates self-awareness and self-expression
- Demonstrates flexibility

Ground rules
- Test assumptions
- Share all relevant information
- Use specific examples and agree on what important words mean
- Explain your reasoning and intent
- Focus on interests, not position
- Combine advocacy with inquiry
- Jointly design next steps and ways to test disagreements
- Discuss undiscussable issues
- Use a decision-making rule that generates the level of commitment needed

Type of Meetings

In addition to the person facilitating the session, the type of meeting also influences the success of facilitation. Meetings come in various forms and can be classified based on aspects like size, frequency, participants, purpose, and the decision-making approach (Jay, 1976). Processes and tools are strategically chosen to align with and achieve the meetings' objectives (Hayne, 1999). A balance needs to be maintained between maintaining consistency and coordination through restrictiveness, and fostering creativity and exploration through flexibility (Nunamaker et al., 1991). The nature of the meeting and the group dictates the kind of facilitation it needs (Hayne, 1999; Elwart-Keys et al., 1990). For instance, project retrospectives in which the team aims to define learnings and reveal opportunities to improve, are already familiar to the team and might not need much direction or structure, compared to a co-creation session with a client where a more structured and clearly defined facilitation style is more suitable. Further, facilitation needs to be adjusted to the environment the meeting is held, distinguishing between face-to-face and online (Hayne, 1999).

Meetings need a structured approach to ensure focus and achieve the desired outcomes while minimising interpersonal conflicts (Hayne, 1999). Research indicates that meetings with clear, structured facilitation can not only enhance the quality of group decisions (Bouchard, 1972; Maier & Hoffman, 1960; Maier & Maier, 1957; Wheeler & Valacich, 1996) but also foster effective and efficient communication (Chilberg, 1989). Part of this should also be the importance of providing a summary detailing discussions, decisions, and possible action steps to the participants once a meeting reaches its end (Mosvick & Nelson, 1992).

Typically, a single meeting is just one of many throughout the duration of a project (Oppenheim, 1987), necessitating frequent interactions among group members (Mandiwalla, Gray, & Olfman, 1997). Bostrom et al. (1993) explain this continuous activity in their Cycle Model, which portrays a meeting's progression from pre-meeting to the actual meeting, and then post-meeting (Figure 12). It captures typical activities of each phase, trying to serve as a rather generic meeting model. The cycle then restarts with preparations for the subsequent meeting, continuing until overarching objectives are achieved or persisting indefinitely for ongoing committees.

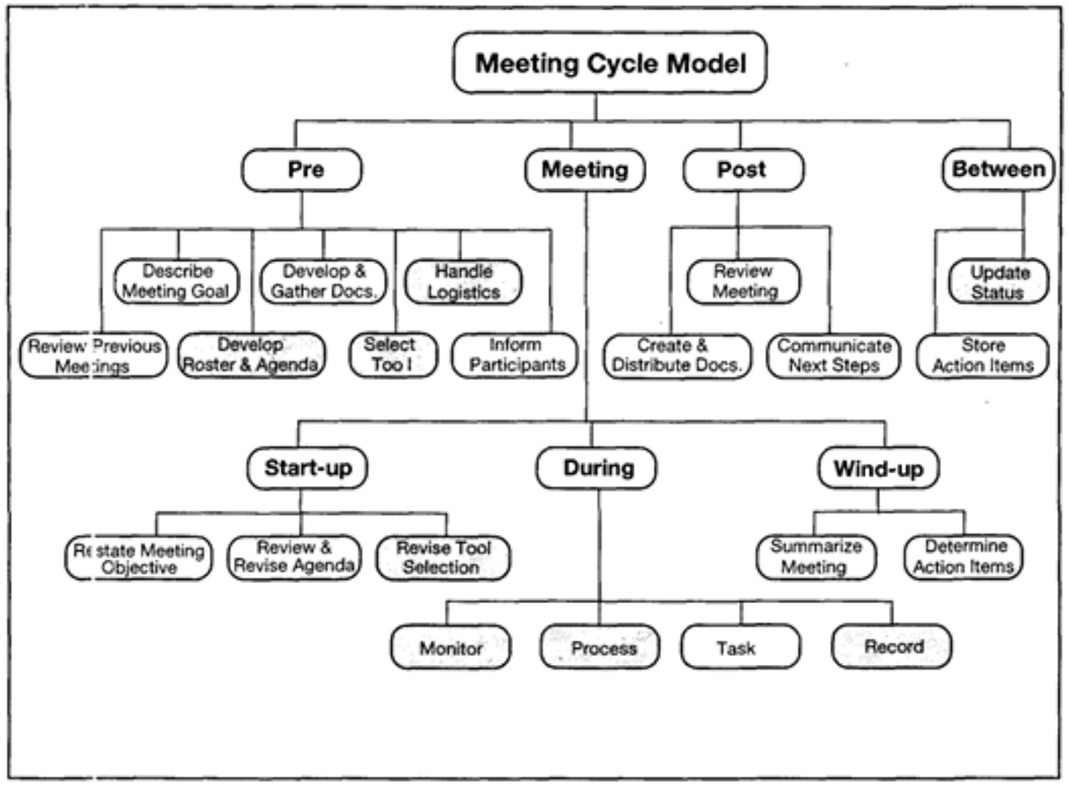


Figure 12: Meeting Cycle Model covering essential activities of different meeting phases

5.2. Group Support Systems

Since the early 70s, the advent of Decision Support Systems (DSS) has highlighted the potential of computer technology in enhancing organisational processes by leveraging communication technology, data, and knowledge to optimise decision-making (Rayed, 2013; Pearson & Shim, 1995). This technological leverage was pivotal for achieving sustained economic growth in the increasingly global business environment of the 70s (Porter et al., 2006). However, the increasing realisation that many decisions within organisations are taken collectively, led to the evolution of DSS into Group Support Systems (GSS) or Group Decision Support System (GDSS), designed to support collaborative decision-making by facilitating group decision-making and consensus (Al-Mafrji et al., 2023; Rayed, 2013). These systems, predominantly implemented in larger organisations and government entities (Rayed, 2013), typically comprise hardware, software tools, and a trained human facilitator operating it (Beranek et al., 1993). Hayne (1999) outlined four critical functions for GSS to successfully support facilitation: recording group activity, monitoring the group, controlling process structure, and updating the status of action items.

Despite the proven benefits of Group Support Systems (GSS) on team performance (Seeber et al., 2020), their practical integration has been slow and fraught with challenges (Hengst et al., 2007). Individuals often struggle to leverage GSS effectively without specific training in group processes, leading to stagnation and miscommunications within teams (Briggs et al., 2010; Briggs et al., 2005). The scarcity and mobility of expert facilitators amplify these challenges, as their unique skills are costly and hard to retain, making consistent internal facilitation a rarity in organisations (Briggs et al., 2010; Munkvold et al., 2001; Agres et al., 2005). Furthermore, when such individuals depart, the valuable knowledge goes with them, leaving no one equipped to harness the technology to its full potential (Post, 1993; Munkvold et al., 2001). This makes the effective use and integration of GSS even more challenging.

To address challenges in developing Group Support Systems (GSS), Briggs et al. (2010) proposed three strategies: First, the simplification of collaboration tools, as current technologies like Instant Messaging and Google Docs often do not address the holistic needs of a collaborating group (Mittleman et al., 2008). Catering tools more towards what users value and need while easing interaction will help. Second, they emphasised the need to enhance the transferability of facilitation skills by using defined procedures to invoke particular collaboration patterns such as creative thinking or consensus reaching (Vreede et al., 2006; Kolfschoten et al., 2006). Lastly, they suggested building facilitation support into technology itself, serving as a means to educate practitioners on designing collaborative work practices.

Intelligent Agents

The combination of DSS with Artificial Intelligence technology yields in another subclass called Intelligent Support System (ISS) (He & Li, 2017). The capabilities of conventional decision support systems have been expanded by AI, helping users make decisions in highly uncertain decision environments, manage multiple information flows, treat dynamic data, handle information overload, make time-constrained decisions and deal with inaccurate and difficult-to-access data (Phillips-Wren, 2011).

Among the different AI methodologies, Intelligent Agents (IA) have had received the greatest attention in decision-making challenges (Jain et al., 2008). An agent is defined as a component within a system that exists in a certain environment and can independently act within that environment to achieve its intended purpose (Wooldridge 2002, p. 23). This inherent ability to act autonomously mirrors human-like decision-making, which is based on the surrounding context rather than just predefined logic found in typical if-then computer language (Phillips-Wren, 2012). This kind of intelligent behaviour was defined by Phillips-Wren (2012) as a key concept of agent technology.

However, the evolution of these systems was hindered, remaining largely in their infancy due to the limitations in computational abilities of the time.

Discussion

Contextualising Facilitation

The second literature review underscores the pivotal role of facilitation in meetings, serving as the backbone for effective coordination and communication within teams. The essence of facilitation is not just to manage but to guide, focusing on managing relationships between people, tasks, and technology, and contributing to the effective accomplishment of the meeting's outcome. Doing so, they might have to take different roles based on the objective and type of meeting or affordances of the group. While they must be procedural gatekeepers, ensuring that meetings follow the set agenda and achieve their goals, they also have to foster an open environment that encourages participation and manages interpersonal relationships. Balancing these responsibilities might be challenging, especially in the face of evolving group dynamics.

Yet, having acquired a broader understanding of the facilitators role and functions, the thesis requires a more contextual view on what constitutes facilitation at Thoughtworks. For this purpose a workshop has been conducted aiming to answer the following research question:

How do employees at Thoughtworks Amsterdam define facilitation in their daily practice?

Evolution of GSS

Further, the historical context of technology to support decision-making and team collaboration has been highlighted. Herein, Group Support Systems emerged as a technological solution, aiming to enhance team collaboration. But while they offer several advantages, they could not reach their full potential. However, GSS may appear in a new light given the recent emergence of sophisticated AI. The use of Intelligent Agents in decision-making challenges has received great attention over the past decades. The key concepts and ideals of agent technology, especially those of communication, coordination, and learning, align with the essential facets of facilitation. Nevertheless, with the recent advent of AI-powered tools such as ChatGPT, a pinnacle has been reached, helping us to imagine AI agents with much more granularity. The potential to incorporate these sophisticated AI into Support Systems could provide a new dimension to the facilitation process. This opens up new possibilities and gives hope to overcome the long-standing challenges associated with such systems. The three strategies suggested by Briggs et al. (2010) reflect possible pathways that might be addressed through AI: First, AI-driven GSS could become easier to use through Natural Language Input for example, reflecting possible needs for collaborative technology more appropriately. Second, technology might make use of proven Design Methodology to intelligently suggest the most appropriate activities. Finally, technology itself could act as an educator to build facilitation skills.

Nevertheless, the realisation of this potential will depend on our ability to balance innovation with adaptability, technology with humanity, and progression with practicality. This aligns well with the research directives of this thesis defined in the discussion section of the first literature review.

6
EMPIRICAL RESEARCH II

Introduction

The first research phase revealed that many collaborative activities suffer from a lack of clarity and alignment as a consequence of improper facilitation. To gain a deeper understanding and reveal nuances of revealed facilitation challenges at the Thoughtworks Amsterdam office, a physical workshop with 6 employees was conducted, trying to answer the following research questions:

RQ1: How do employees at Thoughtworks Amsterdam define facilitation in their daily practice? (Part 1)
RQ2: What is supporting or hindering employees from facilitating well? (Part 2)

To reflect the perspectives of the office, a diverse and balanced mix of participants was sought:

Participant	Expertise
P1	Senior Software Developer
P2	Senior Data Scientist
P3	Software Developer
P4	Business Analyst
P5	Senior UX Designer
P6	Head of Delivery

6.1. Facilitation at Thoughtworks

Approach

In the first exercise, participants were asked to silently write down their first associations when they hear the term „facilitation“. This ensures that they quickly get into the topic and let go of the obvious. Then, using a similar method called Brainwriting, participants were asked to answer the question „What does facilitation mean to you?“, making the question more specific to their experience and area of expertise. In addition, participants were now encouraged to speak up and build on each other‘s ideas while putting sticky notes a whiteboard. Subsequently, one participant was chosen to lead the process of clustering all notes into themes.
Throughout the session, discussion, reflection and thinking aloud were encouraged.

→ *see the appendix for detailed analysis*

Results

7 themes were generated of which 5 contained 5 or more sticky notes. 10 sticky notes were not assigned to any theme due to exclusive occurrence, thematic distance or time constraints (Image 1). The three most prominent themes were ***Safe Space***, ***Process Guidance*** and ***Mediation***.

Overall, participants portray facilitation as a set of abilities of one person guiding a group of people through a structured decision-making process in an inclusive, empathetic and effective way.

Interestingly, the effectivity here is not only characterised as a result of efforts to make process by having a good structure or achieving outcomes. Instead, it is also seen as a collective effort to ensure that the process allows participants to contribute in the best way possible. This is mainly supported by themes ***Safe Space*** and ***Meditation*** as well as quotes such as *(...) cause we believe if you don’t create that [safe space] we wouldn’t notice that people are centering inside themselves. They might hesitate to contribute... fear to appear stupid or get laughed at (P4)*.

The themes ***Safe Space***, ***Enable Conversation*** and ***Mediation*** strongly relate to what was already elicited in the interview with the Head of Capability Development under *4.4*. The value of psychological safety becomes prevalent here as well, considering the sticky notes that indicate principles of meaningful collaboration (see Interview under *4.4.*). The facilitator is given a role in which they have to be constantly aware to create a psychologically safe environment, free of inappropriate judgements of others or their contributions. Pointing towards the sticky note *give visibility to everyone*, P1 reveals another nuance by stating that some people are more outspoken than others, affording particular attention from the facilitator to “*make sure everyone has the chance and feels okay to speak up*.” Expanding on this, they should actively care for team members and also act protecting.

Discussing the theme Mediation participants emphasised the importance to appropriately anticipate and manage the emotions of the group. This is particularly important for sessions with many conflicting interests or involvement of external stakeholders: *I like mediation as its more general and focusses on conflict, disagreement, expectation management, insecurities (P5).*

At some point P3 summarises that facilitation *only works as a group*. Here, not only the facilitator has its duties and principles to strive for but also the group in general shall adhere to *guidelines and ground rules*. The latter mostly includes appropriate social behaviour of teamwork such as being respectful or not interrupting others. However, they also include settled measures commonly known to avoid endless discussions, contextual deviations or leaving the session scope. Some of which were also mentioned on the board and include the ***Parking Lot***, which describes a measure to capture and postpone unrelated or deviating concerns to a later point, or ***Rabbit Hole***, which is used to describe discussions centered around topics that often only open up other discussions and thus feel endless. The participants pointed out that facilitators have to sense these moments and be decisive on how to proceed.

Speaking of senses, one cluster theme was titled ***Spidey Sense***. Despite this cluster being relatively small containing no more than 2 sticky notes, it was related often to during the session. Here, it was mentioned to be comfortable to pivot when the situation requires it and go *off script*. It describes the ability to sense when situations need to be steered by conveying a feeling of control towards the group. Adding to that, a stand-alone sticky note stating ***Energy Regulator*** was also often mentioned in this context, referring to the ability to adequately assess the energy levels of participants and undertake spontaneous measures such as breaks or energisers. These all again point towards the fine sensation and keen intuition participants deem important for facilitators.
The themes ***Alignment***, ***Process Guidance*** and ***Outcome Focused*** mainly refer to factors affecting the actual content itself. These themes describe facilitation as a means to reach alignment, provide clarity enable creative problem solving. Along side with stand-alone sticky notes such as ***Time Keeping*** and ***Responsibility Allocations*** do these reflect a definition of facilitation that overlaps with contemporary literature.

To conclude, the group was encourage to reflect on What can be facilitated? Here communication (mediation, conflict resolution), problem-solving, processes (growth, change process), workshops, alignment and environment were mentioned.

Conclusion

Many sticky notes refer to an implicit set of duties or principles fundamental to what facilitation is defined by the employees at Thoughtworks Amsterdam. This might be surprising at first sight, but must also be seen as a result of successful efforts to build an inclusive and empathetic working culture. Inclusion, empathy and psychological safety are not seen as a “nice to have” but rather fully acknowledged as supporting factors of productive work and building blocks of meaningful collaboration. Measures to build such a working culture are proactively fostered by constantly promoting these values.

Combining these workshop insights with the interview insights mentioned under *4.4.* we can derive the following two value frameworks, encompassing values of facilitation and collaboration specific to Thoughtworks Amsterdam. The frameworks consist of core values (yellow) and sub-values (grey).

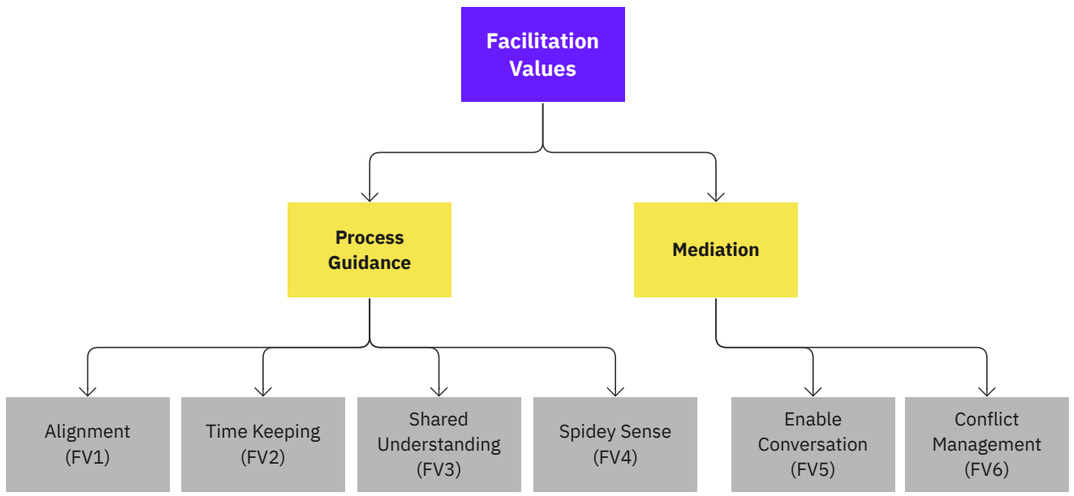


Figure 13: Revealed Facilitation Values

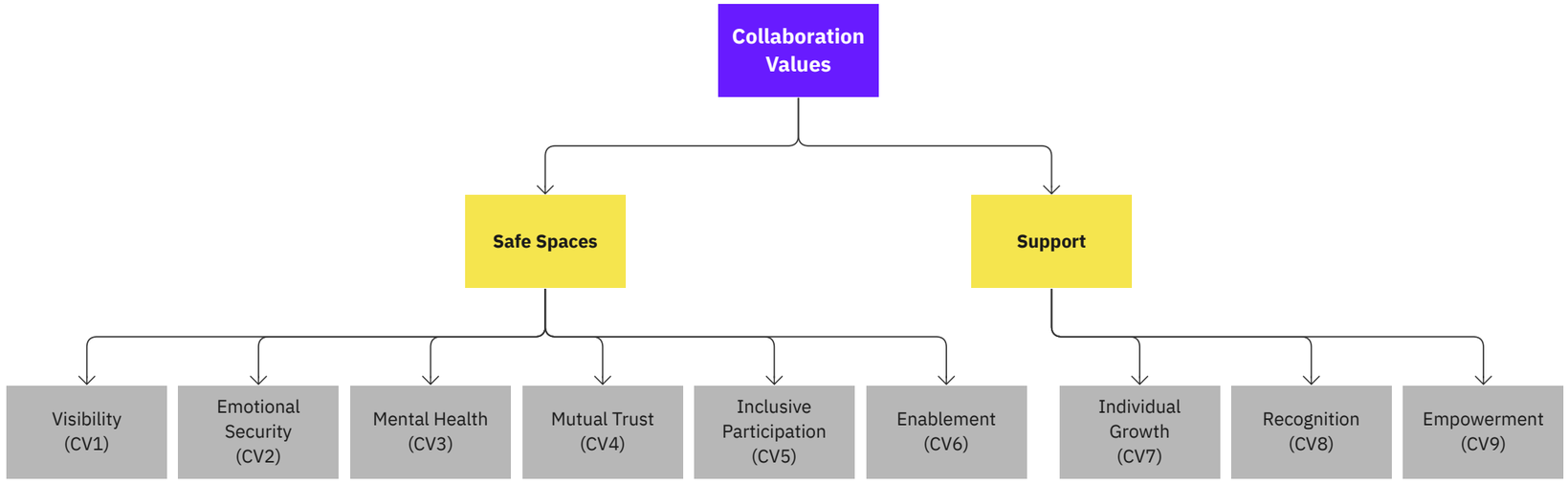


Figure 14: Revealed Collaboration Values

6.2. Values of Thoughtworks

Approach

In the second part of the workshop participants were asked to map factors that either support or hinder them from facilitating well. These were placed along a timeline with sections corresponding to moments before, during and after collaborative activities. Participants were encouraged to think out loud, be specific and ask for clarifications. At the end, each participant was given two points to mark one supporting and one hindering factor they deemed impactful. Subsequently, the selection was used to have an open discussion.

Results

The whiteboard revealed a mix of concrete and abstract factors (Image 1). The distribution of both supporting and obstructing factors before and after a collaborative activity were similar (4-6 notes). For both supporting and obstructing factors, most sticky notes (11-12) related to moments during a collaborative activity.

In the ***pre-meeting phase***, the importance of a structured approach became evident. An ***agenda*** stood out as a pivotal element, emphasising its role in ensuring clear outcomes and aligning expectations. The workshop participants noted that a default or proven agenda could serve as a useful scaffold, especially for recurring facilitative activities like brainstorming. On the other side, the ***lack of context*** appeared as a major obstructive factor, indicating that participants who are unaware of the meeting's objectives or prior progress can significantly hamper the flow.

For factors ***during the meeting***, the role of other present meeting participants and their interaction dynamics was highlighted. Facilitators, while steering the process, rely on participants to drive the outcomes. Thus, the essence of ***cooperation*** and ***shared ownership*** of the outcome came into focus. A ***facilitation buddy*** was also mentioned, serving as an assistance who takes on light tasks such as time keeping such as having. Obstructing factors described the potential for underlying tensions, whether interpersonal or related to broader organisational politics, that can derail sessions (i.e. ***personal agenda*** or ***power dynamics***). Lastly, ***people talking over each other*** was also considered as a hindrance.

Post meeting, ***ensuring continuity*** and ***effective follow-through*** were declared as supporting factors. While ***follow-ups*** and clear ***ownership of action items*** were seen as supportive, ***ambiguity in outcomes*** or a ***lack of alignment*** emerged as primary hindrances. In addition, ***meeting summary*** and ***assigned action items***, proposed as a means to reinforce group understanding, underscores the need to continually ensure alignment, even after the formal meeting has concluded.

Conclusion

The second part of the workshop at Thoughtworks Amsterdam focused on capturing factors that either promote or hinder effective facilitation and provided valuable insights in several ways. First, it provided additional depth to the insights gained from the first research phase by validating and further enriching the qualitative outcomes. This exercise allowed participants to voice their nuanced experiences and offered first-hand insight into the practicalities of facilitation in their own daily practice. At each stage, particular factors emerged that either helped or hindered the mediation process.

The outcomes of the workshop suggest that the role of a facilitator is pivotal, as they need to appropriately handle the complexity and unpredictability of human behaviour. However, they also point out that the success of facilitative processes is intrinsically linked to a variety of factors. Overall, the insights accentuate the challenges revealed in the first research phase and form a comprehensive landscape of facilitation within Thoughtworks Amsterdam, providing a base for potential interventions and areas where AI could support these processes to increase team effectiveness.

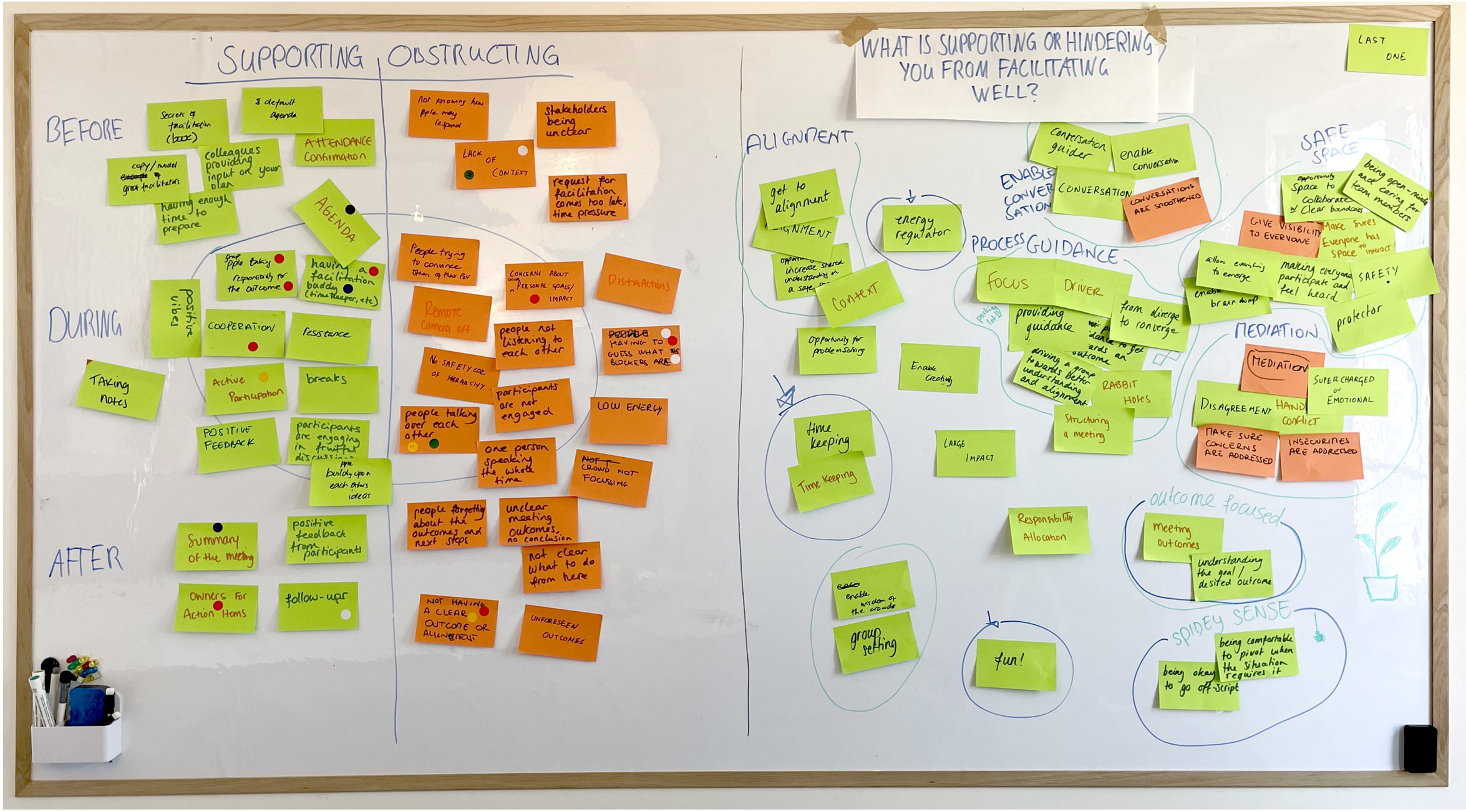


Image 1: Revealed Collaboration Values

→ *see the appendix for detailed outcomes*

7
DESIGN PHASE

7.1. Future Scenario Workshop

Based on the revealed challenges and insights of the two research phases, a co-creation workshop inspired of speculative design methodology was designed to ideate possible future scenarios with a diverse mix of employees at Thoughtworks Amsterdam (Figure 15). Here, it was made use of future signals to support the creation of future scenarios, exploring what could be, rather than what is. This approach is inspired by speculative design as it does not confine itself to existing technologies or current realities but extends into the projection of future developments, societal changes, and technological advancements.

Participant	Expertise
P1	Senior Software Developer
P2	Tech Principal
P3	Software Developer
P4	Principal Consultant
P5	Senior UX Designer
P6	Head of Delivery

Figure 15: Future Scenario workshop participants

In teams of two the employees worked on three different tracks resembling the main themes revealed through the research phases: Improper Facilitation, Lack of Clarity and Lack of Alignment. Each of those three tracks contained two different challenges for which they had to come up with a future scenarios placed in the year 2100 indicating how the particular challenge could be resolved.

This approach allowed participants to transcend the constraints of present technologies, enabling them to explore a possibilities and opportunities that the future might hold. By projecting into a distant future, the employees were encouraged to think beyond incremental changes and immediate solutions, fostering a space for radical imagination and innovative thinking. This temporal setting facilitated the exploration of transformative scenarios, where societal shifts, technological breakthroughs, and novel paradigms could be envisioned without the limitations of current frameworks and existing paradigms. The three main themes—Improper Facilitation, Lack of Clarity, and Lack of Alignment—served as focal points for the participants to ideate on how the challenges associated with these themes could be resolved in a world vastly different from our own.

The challenges were defined based on several criteria. First, each challenge needs to be sufficiently grounded in the conducted research. Second, each challenge needs to relate to its respective track, trying to capture its essence. Further, the two challenges within each track need to be distinct from each other. Lastly, they need to provide a context that is specific enough to offer ideate on particular challenges, yet leave enough space for individual interpretation. This was essential as collaboration challenges are bear complexities that relate to the particular context they were situated in. Further, participants have different experiences and perceptions, affording to allow for interpretation to achieve challenge ownership.

Approach

All participants worked their way through four activities, resulting in a future scenario concept for their particular challenge. These activities were identical for each track/challenge and consisted of the following:

1. Brainstorm Activity
Here, participants were asked to come up with as many ideas as possible to tackle the challenge. As the workshop aims to create far-future concepts, participants were provided a set of future signals they could use as inspiration. Each signal contained a provocative question, aiming to spark creativity. and unusual ideas. The signals were inspired through a variety of literature (Table 2).

2. Concept Generation Activity
Participants were now asked to choose promising ideas and turn them into one coherent concept. Also, they had to choose an embodiment for the AI that they deemed exciting based on their chosen idea.

3. Concept Framework Activity
Having crafted a concept, participants were now asked to clarify and enrich their concept by indicating how it might resolve the particular challenge in a step-by-step manner.

4. Value Tension Activity

TRACK: POOR FACILITATION

CHALLENGE 1

CONTEXT
You notice that some participants struggle to contribute. They might have something valuable to say.

CHALLENGE
How might AI give and maintain visibility to everyone?

CHALLENGE 2

CONTEXT
In an hour, you have to facilitate a session for a project unfamiliar to you.

CHALLENGE
How might AI support the facilitator to manage the situation?

TRACK: LACK OF CLARITY

CHALLENGE 1

CONTEXT
A meeting about particular product attributes ended without any conclusion or next steps.

CHALLENGE
How might AI help to manage the situation?

CHALLENGE 2

CONTEXT
A project manager struggles to articulate the project requirements clearly, leading to misunderstandings and unsatisfied information needs of the disciplines attending.

CHALLENGE
How might AI help the PM to express and communicate themselves better?

TRACK: LACK OF ALIGNMENT

CHALLENGE 1

CONTEXT
One participant (client side) fiercely defends their agenda leading to ongoing conflict.

CHALLENGE
How might AI help to manage the situation?

CHALLENGE 2

CONTEXT
At some point of the ongoing project you notice that the clients' way of collaborating and communicating is toxic and not aligned with TW ambitions to build safe spaces.

CHALLENGE
How might AI help to improve communication and maintain a safe space?

Figure 16: The challenges used to generate future scenarios

As a last step, participants were now asked to think of 3-4 critical values that are likely to be threatened by their concept. They could either choose from a set of values extracted from in literature about Human-AI collaboration (such as Trust, Explainability, or Control) or define their own. For each value, they were asked to note down concerns about why the particular value might not be adequately addressed in their concept. Having done that, they were then asked to ideate potential solutions that could be built into the concept to address the particular value.

Recognising the inherent value in their contributions, it is important to note all initial scenarios required refinement. To add depth, reduce ambiguity and ensure that each scenario adequately addresses its respective challenge, I further refined and enriched each scenario after the workshop. ChatGPT supported this process with its capabilities to work out necessary details and ideate possible features, allowing me to build coherent scenarios. It is through this combined lens of all inputs that I analyse the potential of AI. This collaborative approach, underpins the objective insights presented in the following.

Results

The workshop resulted in 6 future scenarios that illustrate the role of AI in helping to resolve the defined challenges. The future scenarios consist of a concept name and a narrative, describing how a set of futuristic AI-driven features address the main challenge as seen on the following pages (3 of 6 were presented, see the appendix for all scenarios). These pages further indicate the relevancy of each challenge by presenting specific research insights that relate to it.

Additionally, a total of 24 features have been extracted across all scenarios, each aiming to address a particular sub-challenge within its respective context. Figure 17 exemplifies how an extracted feature was analysed. Each feature tile contains a description of its functionality in its context, the addressed sub-challenge, ethical considerations and an explanation of a possible Near-Future Value. The ethical implications aim to enrich each feature by providing initial consideration of ethical aspects. The Near-Future Values attempt to translate the futuristic feature into a more tangible context and show how a similar value could be generated with the means available today.

SUB-CHALLENGE
Preparing Meeting Environment

FEATURE
Spatial Adaptation

FEATURE DESCRIPTION
The room is dynamically modify its environment – from lighting to spatial layout – based on the nature and progress of the session, relieving the facilitator from the burden to prepare the meeting adequately.

NEAR FUTURE VALUE
Implementing AI into current collaboration tools such as Mural or Miro would allow to dynamically adjusting the virtual workspace based on the needs and interactions of the meeting participants, making real-time changes according to the conversation's flow.

ETHICAL IMPLICATIONS
It might be misinterpreting the meeting progress creating environments that are uncomfortable or distracting for some participants. Finding a balance between aiding the session in sync with the facilitator while ensuring effectivity and focus will be crucial.

Figure 17: The initial analysis of an extracted feature

→ *see the appendix for other scenarios*

Future Signal	Inspiration	Provocative Question
Dream Mode	Bulkeley (2023) - AI and Dream Interpretation.	What if we could intentionally and consciously dream?
Brain Interfaces	Tang et al. (2023) - *Flexible brain–computer interfaces.*	What if brains could be accessed?
Artificial Teammates	Bubeck (2023) - *Sparks of Artificial General Intelligence: Early experiments with GPT-4.*	What if we would have AI teams?
Alternative Realities	De Oliveira et al. (2023) - *Virtual Reality Solutions Employing Artificial Intelligence Methods: A Systematic Literature review.*	What if we were able to create and switch into other realities?
Spatial Unification	Bruin (2018) - *Design media arts professor creates neuroscience-based installation*	What if our mind is connected to the environment?
Digital Twin	Miller & Spatz (2022) - *A unified view of a human digital twin.*	What if you could create a copy of yourself? Or the client?
Cognitive Vault	Agarwal et al. (2019) - *Protecting privacy of users in Brain-Computer interface applications.*	What if we were able to encrypt information and memories in our brains?
Intelligent Environment	Alazab et al. (2023) - *AIoT technologies and applications for smart environments.*	What if all things are smart and connected with each other?

Table 2: Future signals inspired by literature

IMPROPER FACILITATION - SCENARIO I

Inclusive Facilitator

CHALLENGE

You notice that some participants struggle to contribute. They might have something valuable to say. How might AI give and maintain visibility to everyone?

INSIGHTS SUPPORTING CHALLENGE CONTEXT

- **CS20** - Provide space for everyone to share their ideas [...].
- **CS38** - Passive participation
- **CS40** - some people were more quiet and we had to be intentional to get their opinion
- **CS46** - From the 4 people involved in the activity, 1 of them was less engaged than the others. We tried to ask some specific questions to the person, to try and make them participate more. [...].
- **CV1 -** Visibility
- **CV5 -** Inclusive Participation
- **CV6 -** Enablement
- **CV9 -** Empowerment

DESCRIPTION

This Inclusive Facilitator plays a crucial role in ensuring that every participant's voice, expertise, and opinion are acknowledged and integrated into the meeting, even when not verbally expressed.

Through ***Digital Twins***, each participant in the team has a digital representation, acting as an ever-present voice championing their knowledge, even when they choose to remain silent or not be present at all. Additionally, participants are free to opt out for a moment and enter an ***alternative reality***. In this, they can interact with a digital copy of themselves aiming to overcome insecurities or expression issues in a safe space.

To further break down barriers of verbal communication and enable richer and more diverse input in meetings, participants can trigger a ***Telekinesis Mode***, in which they can see their thoughts transcribed & visualised in real-time.
All of these feature remove the conventional limitations faced by those who may find it challenging to voice their opinions in group settings or are unable to do so, ensuring a more inclusive environment.

Throughout the meeting, the AI system stays vigilant by using its ***Awareness Engine*** to monitor all inputs and ensure no input or consideration is left ignored. It further subtly prompts the Digital Twins to offer input or nudges the facilitator to seek opinions from quieter members.

In this envisioned collaborative landscape, the AI transforms traditional team interactions, emphasizing inclusivity and diversity of thought. This concept illustrates a future where AI is not just a tool, but an ally in championing the voice and expertise of every individual in a team, ensuring no valuable insight is ever missed.

Extracted Features

SUB-CHALLENGE	FEATURE
Creating Visibility	Digital Twins

FEATURE DESCRIPTION
Crafting a digital representation of each participant, the AI ensures that the insights and expertise of all individuals, including those who are reticent or not present at all, can be represented and heard whenever needed.

NEAR FUTURE VALUE
Existing virtual meeting platforms like Zoom or Microsoft Teams could offer a "proxy participant" feature that allows users to pre-load talking points or ideas. This proxy would then automatically present these points in text form during relevant moments in the meeting, acting as a stand-in voice for the participant.

ETHICAL IMPLICATIONS
Ethical concerns may arise related to informed consent and data handling, as it is crucial that each participant agrees to the creation and use of their digital twin. Ensuring the digital twin accurately reflects the person's authentic thoughts also poses ethical concerns regarding representation.

SUB-CHALLENGE	FEATURE
Resolving Self-Expression Barriers	Alternative Realities

FEATURE DESCRIPTION
This feature gives agency to participants, allowing them to enter an alternative virtual space where they can engage with their digital twin to work through issues related to insecurity or self-expression in a safe environment.

NEAR FUTURE VALUE
Companies could offer a virtual "breakout room" where participants can engage in AI-driven coaching sessions, providing communication tips based on simulated scenarios.

ETHICAL IMPLICATIONS
The feature raises ethical questions about psychological well-being. For some individuals, the experience of confronting their insecurities or fears could be distressing or potentially harmful. The digital twin must ensure to not misrepresent or oversimplify the individual's beliefs, emotions, or character traits, as this could lead to feelings of alienation or misrepresentation.

SUB-CHALLENGE	FEATURE
Ease Communication	Telekinesis Mode

FEATURE DESCRIPTION
By transcribing participants' thoughts without them verbally expressing them, the AI tackles the challenge of inclusion for those who might be hesitant to voice out in group settings. This envisions a future where AI bridges the communication gap, making interactions richer and more diverse.

NEAR FUTURE VALUE
While we might not have telekinesis-driven systems yet, voice recognition software and transcription services can play a role. Typed input could be analyzed and handled by AI systems, highlighting information worth mentioning to the facilitator. This would help create safe spaces and provide an alternative medium for those uncomfortable speaking up in real-time.

ETHICAL IMPLICATIONS
The direct transcription and visualization of thoughts could inadvertently expose sensitive personal information or inner emotional states. Further, next to inaccurate representation, participants could also become overly self-conscious, knowing that their thoughts are being processed and displayed in real time.

LACK OF CLARITY - SCENARIO I

MindMesh

CHALLENGE

A meeting about particular product attributes ended without any conclusion or next steps. How might AI help to manage the situation?

INSIGHTS SUPPORTING CHALLENGE CONTEXT

- **CS33 -** unsure about what was the next step
- **CS41 -** At the end of the workshop, we weren't completely clear on next steps yet
- **CS43 -** Long meeting - no outcomes
- **CS12 -** time constraints to capture the ideas, process them and convey in a common set of prioritized list
- **FV5 -** Enable Conversation
- **CV6 -** Enablement

DESCRIPTION

MindMesh is an advanced AI system tailor-made for multidimensional reasoning and informed decision-making. This system erases the boundaries of individuality and integrates the cognitive abilities of all team members to harness unparalleled collective intelligence.

Prior to discussing relevant features, team members engage in a synchronized activity via a ***Brain Connection Interface***, essentially forming a collective consciousness. Participants can individually decide what is being shared, protecting sensitive information in a ***Cognitive Vault***. This process enables the group to share thoughts, perspectives, or insights safely and utilize their combined cognitive power to collaboratively assess a myriad of possibilities, pinpointing the most promising features. By taking advantage of this shared brain compute power, MindMesh ensures a comprehensive analysis that might have been otherwise overlooked by individuals.

Building upon this, the ***Hypothesis Hopper*** function propels the team into alternative realities crafted uniquely for each feature hypothesis. Here, members can navigate and experience the practicalities and potential of each feature. These immersive simulations provide firsthand knowledge of what could work best in real-world scenarios.

Having documented the all proceedings via its ***ClearPath Engine***, MindMesh draws from the participants' inputs, and outputs clear meeting conclusions. Further, leveraging its omnipresence and the data on the participants' backgrounds, the AI autonomously assigns tasks and action item to the team members best suited for them, ensuring efficiency and clarity.

Extracted Features

SUB-CHALLENGE	FEATURE
Ensuring Clarity	Brain Power

FEATURE DESCRIPTION
An interface that synchronises and interlinks the cognitive abilities of all participants, creating a combined consciousness. It allows users to choose and control the information they wish to share through a Cognitive Vault.

NEAR FUTURE VALUE
Platforms can offer an intelligent feature allowing participants to create a real-time shared mind-maps based on shared information where AI helps to visualise collective understanding and areas of alignment or difference. Information flagged as sensitive must be approved by the individual upon use.

ETHICAL IMPLICATIONS
Harvesting brain data poses risks of unauthorised access and misuse. Clear guidelines around consent, storage, and data security are essential. Moreover, ethical quandaries around personal autonomy and the potential for unintended psychological impact should be considered.

SUB-CHALLENGE	FEATURE
Simulating Ideas	Hypothesis Hopper

FEATURE DESCRIPTION
Using a Brain Connection Interface this features enables teams to dive into simulated realities tailored for each hypothesis or idea, offering a tangible experience of potential outcomes, allowing to identify challenges or obstacles that might arise during the implementation or usage of a feature.

NEAR FUTURE VALUE
Combining Natural Language Processing & Virtual Reality teams can visualise abstract concepts or ideas in a more tangible way. This fusion can help simplify complex decisions and provide clarity in ambiguous situations.

ETHICAL IMPLICATIONS
Ensuring the alternative realities are unbiased and do not push participants towards a specific direction, and being clear about the simulated nature of these environments.

SUB-CHALLENGE	FEATURE
Providing Effective Conclusion	ClearPath Engine

FEATURE DESCRIPTION
Documents meeting proceedings but also derives actionable next steps based on the discussions. By understanding the depth and nuances of the conversation, coupled with knowledge about team members, it autonomously assigns tasks.

NEAR FUTURE VALUE
Meeting platforms can integrate an AI-driven feature that analyses discussions to produce actionable summaries. Combined with an understanding of participants' profiles, this feature can suggest optimal task delegation, streamlining post-meeting activities.

ETHICAL IMPLICATIONS
It is important to ensure the system's suggestions respect individual workloads, preferences, and are transparent. Users should be able to understand how conclusions are derived and tasks assigned, ensuring there is no undue influence or bias in the process.

LACK OF ALIGNMENT - SCENARIO I

Alignment Sphere

CHALLENGE

One participant (client side) fiercely defends their agenda leading to ongoing conflict. How might AI help to manage the situation?

INSIGHTS SUPPORTING CHALLENGE CONTEXT

- **CS10 -** Communication. The client team and our team did not seem aligned
- **CS30 -** For Tech Trends where we could not agree immediately, the discussion sometimes went too far, because people felt passionate about defending one particular Tech Trend. So we took extra time to find agreements for some of the trends.
- **CS48 -** misalignment on outcome and expectations of the meeting understanding, either takes time to align at the beginning or impacts in discussion topics unrelated or that could been potentially moved to a parking lot
- **CO8 -** Co-Creation method is inappropriate for session objective
- **FV6** - Conflict Management
- **CV2** - Emotional Security

DESCRIPTION

The Alignment Mediator is designed to recognize and resolve instances of discord before they escalate, ensuring smoother meeting interactions.

Central to this transformative approach is the AI-powered ***Stakeholder Profile Builder***. Prior to the meeting, the AI diligently constructs a comprehensive profile of each participant, especially those on the client side. By analyzing their past interactions, projects, feedback, preferences, and even emotional triggers, the system not only allows the facilitator to gain insights about all participants, but also provides tactics to deal with certain profiles. This deep understanding allows the facilitator to anticipate potential points of contention, paving the way for fruitful collaboration.

To ensure conversations do not reach a boiling point, the AI adopts the role of a ***Tension Diffuser.*** Should the atmosphere become heated, the AI intervenes with a light-hearted joke, an energising activity, or even a simple suggestion for a break.

For prolonged disagreements, the facilitator can additionally initiate the ***Alignment Sphere*** which is triggered by an audible alert reminiscent of a boxing match bell, creating a space for focused resolution. Techniques inspired by improv theatre (scene plays) or lateral thinking (intermediate questions) are initiated, urging participants to view the problem from a fresh perspective and find a middle ground. As participants voice concerns or defenses, the sphere captures these to generating visual aids like mind maps or flowcharts, showcasing the impact of their viewpoints in different scenarios. This serves as an immediate, visual reminder that every participant's perspective is valid and deserves consideration.

Extracted Features

SUB-CHALLENGE	FEATURE
Handling Personal Agenda	Stakeholder Profile Builder

FEATURE DESCRIPTION

The AI constructs a comprehensive profile of each meeting participant, analysing their past interactions, projects, feedback, preferences, and emotional triggers. This system aids the facilitator by providing insights about all participants and tactics to deal with certain profiles.

NEAR FUTURE VALUE

CRMs and team management platforms can be evolved to capture and analyse the histories, preferences, and feedback of stakeholders. Through data mining and NLP, insights into potential triggers and preferences can be formed into profiles, preparing facilitators with tailored strategies for each stakeholder.

ETHICAL IMPLICATIONS

Care must be taken to respect privacy and ensure data used to construct these profiles is obtained ethically and consensually. There is also a risk of over-reliance on data-driven insights, potentially neglecting the importance of individual agency and the dynamic nature of human behavior.

SUB-CHALLENGE	FEATURE
Resolving Tension	Tension Diffuser

FEATURE DESCRIPTION

When the AI perceives heightened emotions or potential conflict, it takes proactive measures to diffuse the situation, be it through humor, suggesting a break, or recommending an energising activity.

NEAR FUTURE VALUE

Real-time emotion and sentiment analysis could be integrated into virtual meeting platforms and suggest the facilitator to implement interventions to prevent tension or conflict.

ETHICAL IMPLICATIONS

Over-reliance on automated interventions might oversimplify complex human emotions or be perceived as artificial and insincere. Proper calibration and cultural considerations are essential.

SUB-CHALLENGE	FEATURE
Overcoming Disagreements	Alignment Sphere

FEATURE DESCRIPTION

Triggered by an audible alert, this sphere initiates techniques inspired by improv theatre or lateral thinking. As participants speak, the sphere visualizes their viewpoints in the form of mind maps or flowcharts.

NEAR FUTURE VALUE

A digital whiteboard could be used to intelligently map out participant views, updated in real-time. Templates or pre-set frameworks in the sphere based on the type of discussion (e.g., SWOT analysis, risk assessment, brainstorming) could further help to guide participants in structured thinking and ensures productive discussions.

ETHICAL IMPLICATIONS

Misrepresentation of views remains a concern. Facilitators should be trained to ensure accurate representation, and participants should be encouraged to review and adjust as needed.

7.2. Analysis Framework

The following presents a design outcome that aims to allow a guided interpretation of the scenarios and their extracted features.

The following framework serves as a comprehensive guide for exploring the potential of AI in enhancing team effectiveness. It combines a general analysis with in-depth investigation, ensuring a holistic understanding of the roles, capabilities, and interactions of AI within teams.

It is characterized by a systematic analysis including multiple steps, starting with a general overview of the envisioned features, followed by a detailed exploration of a particular selected feature.

First, to create a general understanding about how AI is envisioned to support team collaboration according to different stages of a meeting, a general overview of its capabilities is provided. This analysis serves as a foundation to comprehend how the extracted features are generally envisioned to effectively address Improper Facilitation, Lack of Clarity and Lack of Alignment. This is achieved by clustering features into capabilities and placing them on different stages of a meeting to gain a holistic overview. Subsequently, an analysis of the roles of AI within these features provides insights into the diverse abilities autonomous agents employ across all scenarios.
However, to fully exploit the value of each scenario, a deeper exploration of the features to discern their practical implications, potential benefits, and challenges in real-world settings is required. A detailed analysis will allow for a nuanced understanding of how these features can be integrated into team dynamics to address collaboration challenges effectively, considering the values and needs of end-users.

Thus, a thorough examination of each feature will facilitate the translation of abstract concepts into tangible solutions, providing clearer insights into user behaviors and interactions, and allowing for the refinement and optimization of these features to meet the specific requirements of the teams and the tasks at hand.
This application of this framework is presented in the following pages.

1: Capability Overview

PURPOSE

To develop a comprehensive understanding of how various features or components support different phases or aspects of a process or system.

OBJECTIVE

To construct a structured overview of how envisioned features could potentially support various stages of team meetings, offering a structured view of the capabilities and their applications.

2: Roles & Abilities

PURPOSE

To characterise and understand the diverse roles and abilities that components or agents within a system are envisioned to have.

OBJECTIVE

To identify and quantify the roles and abilities of the components or agents, highlighting which are deemed most crucial, and providing insights into the variety and frequency of abilities across all features or components.

3: User Interviews

PURPOSE

To delve deeper into specific features or components, exploring user perceptions, concerns, and requirements, focusing on essential values of Human-AI Collaboration.

OBJECTIVE

To refine and enrich the description or design of specific features by deriving user-centric requirements and considerations, ensuring the development remains ethically grounded and value-sensitive.

4: Autonomy Types

PURPOSE

To structure the understanding of how components or agents within a system function and interact, focusing on varying levels of autonomy.

OBJECTIVE

To facilitate better integration and interaction between human and non-human agents by determining the appropriate level of autonomy that aligns with task requirements and human capabilities.

5: Interaction Flow

PURPOSE

To detail the interactions of specific features or components with users in a given context, offering tangible insights into potential user behaviors and interactions.

OBJECTIVE

To decompose complex functionalities into actionable steps, exploring feasibility and desirability, and translating insights and requirements into tangible prototypes or designs, contextualised with specific use-cases.

General Analysis

Concrete Analysis

Figure 18: Overview of Analysis Framework

1: Capability Overview

This page provides an overview to create a general understanding about how AI is envisioned to support team collaboration according to different stages of a meeting. Each block presents a selection of extracted features that constitute a particular capability.

PRE-MEETING

1. Meeting Preparations & Collaboration Directive

Setting the scene before any collaborative activity, and ensuring all participants are aligned.

Safe Collaboration Module: Participants receive a virtual package with the meeting's rules, Thoughtworks' collaboration ethos.
Dynamic activity Builder: Co-create activity agenda and align with intended outcomes.
Spatial Adaptation: Prepare & adapt the meeting environment.
Swarm Holograms: Gather relevant knowledge and brief human facilitator.

MEETING

2. Inclusivity & Communication

Ensure that all participants are heard, and communication gaps are bridged.

Alternative Realities: Engage with digital twins in a safe environment for self-expression.
Awareness Engine: Nudges the facilitator to include opinions from quieter members.
Digital Twins: Captures and represents insights from all participants, even the reticent ones.
Telekinesis Mode: Transcribes silent participants' thoughts for richer interactions.
Brain Flow: Direct exchange system that promotes clearer expression and communication.

3. Conflict & Emotion Management

Manage heightened emotions, potential conflict, and ensure a harmonious environment.

Tension Diffuser: Diffuses heightened emotions or potential conflicts.
Toxicity Detector: Flags harmful communication and suggests safer phrasing.
Ethos Educator: Educate on harmful communication.
Immersive Reflection Space: Handle persistently harmful behavior.

4. Facilitation & Meeting Effectiveness:

Support facilitators in running efficient meetings and make real-time adjustments.

Shadow Tutor: Assists the facilitator in navigating unfamiliar territories.
Alignment Sphere: Visualizes viewpoints in mind maps or flowcharts, aiding the decision-making process.
Brain Connect: Picks up cues directly from participants to adapt and update the meeting context.
Stakeholder Twin: Provides foundational knowledge using a digital replica of stakeholders.
Hypothesis Hopper: Enables immersion into simulated realities for tangible experiences of potential outcomes.
Spatial Adaptation: Prepare & adapt the meeting environment

5. Information & Knowledge Sharing:

Facilitate efficient sharing of information and knowledge.

Intelligent Mind Mapper: Structures information into discipline-specific mind maps.
Information Gap Detector: Pinpoints missing information within discussions.
Brain Connect: Picks up cues directly from participants to adapt and update the meeting context.
Brain Power: Synchronizes cognitive abilities for a collective consciousness.

POST-MEETING

7. Effective closure & Responsibility allocation

Provide effective conclusion of outcomes and define action items.

ClearPath Engine: Documents meeting and assigns actionable tasks based on the discussions.
Information Gap Detector: Pinpoints missing information within discussions.

8. Continuous Learning & Conclusion

Ensure that the system and participants continue to grow and adapt.

Shadow Tutor: Helps facilitator to improve skills by simulating facilitation sessions.
ClearPath Engine: Documents meeting and assigns actionable tasks based on the discussions.

2: Roles & Abilities

This section analyses particular roles that the agent takes to achieve its objective and resolve the respective sub-challenge.

Defining AI roles in this section does not aim to create distinction but rather serve as a means to capture and characterise the overall employed abilities. Therefore, analysing these roles that AI takes within all extracted features provides valuable insights into the variety of abilities autonomous agents are envisioned to have when it comes to resolving collaboration challenges. However, most features illustrate the use of multiple abilities in order to address their according sub-challenge. The Shadow Tutor feature for example not only learns the facilitation style of a person over time through analyzing past sessions, but also coaches the person in a conversational manner and provides training simulations. Thus, it seemed fruitful to analyse these abilities across all 24 features. Hereby, we can deduce six roles that the autonomous agents take (Figure 19), each comprising a set of abilities, covering all 55 occurrences of abilities. Quantifying these abilities helps to illustrate which abilities were indirectly considered most relevant for autonomous agents in teams. The frequency of used abilities across all features is presented in the below.

Role	Occurrence	Percentage (%)
Coach	7	29.17
Communicator	16	66.67
Visualizer	11	45.83
Monitor	11	45.83
Synthesizer	12	50
Guide	8	33.33

Figure 19: AI roles across all features

Analysis

The most dominant role is ***Communicator*** with a frequency of 66.67%, highlighting the importance of effective communication by promoting clearer understanding, and ensuring that all participants have a voice in the collaborative process. This ability not only describes features that require the autonomous agent to communicate itself but also to enable communication for human agents. This is mirrored in features such as ***Telekinesis Mode***, which transcribes unvoiced thoughts, and ***Brain Flow***, designed to eliminate articulation barriers. These tools collectively underline the emphasis placed on enabling clear, empowered communication, especially in collaborative environments.

Following closely is the ***Synthesizer***, marked at 50%. This role gathers, processes, and compiles various inputs to generate organized and actionable outputs, helping teams make sense of dispersed information. A prime example of this is the ***ClearPath Engine*** feature. Designed to not only document meeting proceedings, it goes a step further by autonomously deriving actionable next steps based on discussions. By understanding the depth and nuances of the conversation, coupled with knowledge about team members, it assigns tasks efficiently. The scenarios highlight a demand for tools that can seamlessly integrate different inputs into actionable directives, aiding in streamlined decision-making processes in collaborative settings.

The roles of ***Visualiser*** and ***Monitor*** each reaching a frequency of 45.83%, represent two other important roles of AI-supported collaborative experiences. On the one hand, the ***Visualiser*** shows a strong desire to distil complex ideas into more tangible forms. The ***Alignment Sphere*** feature, for example, reinforces this function by transforming auditory feedback into visual mindmaps or flowcharts, making complicated viewpoints easy to digest and facilitating more nuanced discussions. On the other hand, the ***Monitor*** emphasises the value through AI meeting observations. A function such as the ***Awareness Engine*** exemplifies this, as it actively scans inputs and encourages facilitators to include insights from quieter members to ensure participation.

The ***Guide*** role, represented at 33.33%, emphasizes the value of clear direction within collaborative efforts. An illustrative example is the ***Shadow Tutor*** feature, which adapts to and assists the facilitator across multiple sessions. This tool offers structured guidance, particularly beneficial when navigating new or complex situations. Concurrently, the ***Coach*** role, at 29.17%, speaks to the importance of skill development within teams. The ***PM Coach*** feature is a case in point, aiming to systematically enhance a project manager's articulation and thought sequencing through scenario simulations. Although the prevalence of the coach role is less than some others, its existence indicates a consistent focus on equipping team members with the skills necessary to address evolving challenges in a dynamic environment.

→ *see the appendix for detailed analysis*

Discussion

Drawing a sharp distinction between the abilities employed by the AI features is challenging due to the limited granularity and depth of the provided features. Moreover, as these features apply forms of artificial intelligence to adapt their behaviour, it can be expected that roles will be taken dynamically and vary in their sophistication based on the context they are embedded in. However, the quantitative analysis provides valuable preliminary insights into the distribution and emphasis of different AI roles in supporting effective collaboration. Glancing over the distributions, there is a clear trend towards a multi-functional design of AI features.

The main insight is that autonomous agents are not only envisioned to deploy a variety of abilities in general, but also within each feature. This indicates multi-modal and multi-sensory requirements, suggesting that the future of AI in collaborative environments will likely hinge on systems that are able to perform multiple roles seamlessly. Such systems will be more adaptable and versatile, meeting the diverse needs of various collaboration scenarios and enhancing overall team efficiency.

3: User Interviews

This section explores the relationship between social aspects of collaboration and technical requirements of autonomous agents by investigating an extracted feature through the lens of a collaboration value.

The scenarios present an range of socio-technical constructs. As these constructs acknowledge the intertwined relationship between social and technical aspects of a system, a deeper look into these relationships is required. In this case, the AI does not simply appear as in isolation, but as a collaborative partner that seamlessly integrates with human processes, both complementing and helping to shape them. While they differ in their autonomy and dependency to human agents, both human and AI seek to contribute to effective team collaboration.
To explore these relationships deeper and exemplify how the consideration of social aspects influences technical aspects and vice-versa, the following section examines a particular feature against the value of trust.

Drawing from Value-Sensitive Design (VSD) a framework was used to indicate how the interview insights can translate into design requirements of developing autonomous agents for team collaboration, prioritizing the particular human value of trust in design decisions. Advantages of such an approach include its capacity for critical reflection on value translations, fostering constructive discussions among stakeholders, as describes by Van De Poel (2013). While the framework provides clarity and direction, it also recognizes and highlights potential conflicts, emphasizing the need for ongoing evaluation and dialogue. Thus, VSD serves as an appropriate means to ensure that the development of autonomous agents remains rooted in ethical considerations, catering to the social dynamics team collaboration.

As a means to guide the conversation and allow immersion, the interviewees were presented a fictive scenario: *Shawn, a developer at Thoughtworks, was invited to attend a meeting to discuss the next project phase. However, instead of Shawn being actually present, his Digital Twin is there, representing him. Throughout the meeting, the Digital Twin offers Shawn's insights, draws from Shawn's previous experiences, and even suggests potential concerns based on Shawn's perspectives. At one point, a team member, Alex, challenges the Digital Twin's input, wondering if it truly represents Shawn's current perspective.*

→ *see the appendix for transcriptions*

Analysis

Concerns weakening Trust

Inaccurate Replications: The first concern that was mentioned regards the challenge to create adequate representations in general. The interviewee 1 state that we lack still lack sufficient understanding of us human beings in order to replicate it. While we may be able to replicate parts of ourselves as a digital twin - the human heart for example - to simulate the intake and effects of drugs, we do not fully understand out brain faculties yet: *To give you an example, humanity hasn't really come together to define the word intelligence yet*.

Reliability: The interviewees state that trust in this context is essential and can only built when the digital twin consistently matches the real-life experiences team members made with Shawn. Thus, building trust is described as a matter of evidence. Ensuring that the digital twin's responses align closely with the actual employee's views and experiences will be a design challenge here.

Capturing Ego & Identity: Expanding on this notion and referring back to the Example Scenario, Interviewee 1 states that capturing perspectives of Shawn in his digital twin is already doable using knowledge graphs. Virtualizing Shawns dynamic ego on the other hand, is the actual challenge here: *How does shawn identify himself? What kind of layers he will project on top on that particular scenario as shawn would react different based on a different room, different people, you know, different things. How would you keep that into consideration?*

Long-term perspective: Interviewee 1 also expresses concerns about the potential long-term risks associated with over-reliance on algorithms. While recognizing short-term benefits in decision-making and augmenting our knowledge, they caution that this could compromise the deep-rooted capabilities that we humans have developed over our existence. The satisfaction derived from traditional research methods, like reading and connecting ideas from various sources, is fundamental to human fulfillment. Relying too heavily on algorithms could erode this fulfillment, resulting in a potential negative impact on human confidence and psyche in the long run: *You might get a little dopamine from that [using ChatGPT]. But the long term loss of you know, losing that that are impacting your confidence is going to be. Have detrimental effects on on human mind.*

Misrepresentation: Interviewee 2: *It's dangerous. The team member who knows Shawn can say like "Hey, well, I think Shawn wouldn't say this or like, or react like this way or propose this, right?". Then we are relying on Alex, knowing Shawn.* This illustrated scenario emphasises the importance of accurate representation and dedicated routines to deal with such situations whenever incidents occur.

Stability: Interviewee 2 also describes that such incidents with digital twins might make the team doubting the feature in general. This in turn causes that the team's process is reliant on the common perception that the twin behaves authentically, in case the human counterpart is chooses not to be present at all. *It's gonna craft something as an opinion that Shawn might will have, but it can escalate into something else.*

Machine Ethics: The complexities of having a digital twin acting for oneself, raising questions about emotional responses and rights, also became apparent: *Who might be offended if someone happens to offend the digital twin: the human or the twin?* Interviewee 1 wonders if reactions would differ between the human and the digital counterpart and whether the same rights that apply to humans should also be extended to digital twins.

Internal & External Trust: *Do you trust yourself before you know you go to a digital twin? And then, do you trust the environment in which the digital twin is, you know, performing right now?* The particular role of trust here was discerned into internal and external, implying nuances of this particular value that need to be explored further. Here, it refers to building confidence about your own capabilities as well as in those of your teammates.

Data Privacy: The fear of data leaks was exposed as well, implying the potential to develop mistrust over your own twin. *If my digital twin is in a meeting without me, maybe they are revealing private thoughts that are meant to be for me and my digital twin only and not anyone else."*

Free Will Safeguards: Lastly, the Interviewee 2 mentioned the HBO series Westworld to illustrate that safeguards need to be implemented in order to avoid the development of artificial free will.

Ideas to strengthen Trust

Establish Boundaries: Interviewee 1 suggests to draw a line by leveraging the unique strengths of both autonomous and human agents: *Let the machines do the connecting work, and then you go do the ego work. So, you know, if we can combine both these entities and then draw boundaries, then I think, there is a very good possibility that, we might get more out of the technology in this particular case. (...) I wouldn't give any decision making kind of activities to my digital replica. But I would kinda like anything I need to analyze. Like, going deep it can help me see maybe things that I'm blind to at that moment, right? Because it can go deeper than me can help me connect those thoughts.*

Leveraging unique capabilities: Adding to that Interviewee 2 states a more concrete example, in which a tech lead might wants to allocate research tasks to its digital twin expanding the utility of this feature to a broader collaboration context in the twin works in a tandem with its human counterpart to achieve tasks: *Hey, can you research those? Can you bring me like, you know, all the pros and cons. Can you tell me why I should use one or the other, and then I can kinda get that summary*

Participation Support: Referring to the outlined value the Digital Twin feature might provide in terms of inclusivity and participation, Interviewee 2 mentioned that helping participants to find the right moment to interrupt during meetings would already greatly impact participation. In meetings, many team members seem to struggle to interrupt and speak up due to various reasons. The AI could support here by making sure that it interrupts in the right moments without negatively impacting the meeting flow: *You can have your digital twin there, just to kind of raise the hand or say "Hey, I have an opinion. I have something to say" and just give you this space right, so it doesn't have to be a complete*

3: User Interviews

This section explores the relationship between social aspects of collaboration and technical requirements of autonomous agents by investigating an extracted feature through the lens of a collaboration value.

replacement [of its human counterpart]. So having the option to customise would help.

Data Control: Having control over what is going to be shared with the twin: *I would say definitely than having a boundaries right like, there are limitations on to like the maybe the knowledge or the things that they are gonna have access to, that they can share with anyone else.*

Define Performance Metrics: Metrics should be defined to allow observers of the digital twin to assess the digital twins performance on particular parameters to ensure gaps are mitigated and trust is maintained: *Defining performance parameters and then trying to match that real world performance with the actual performance on Sean and for the system to be able to learn on these performance parameters would help build trust systemic trust*.

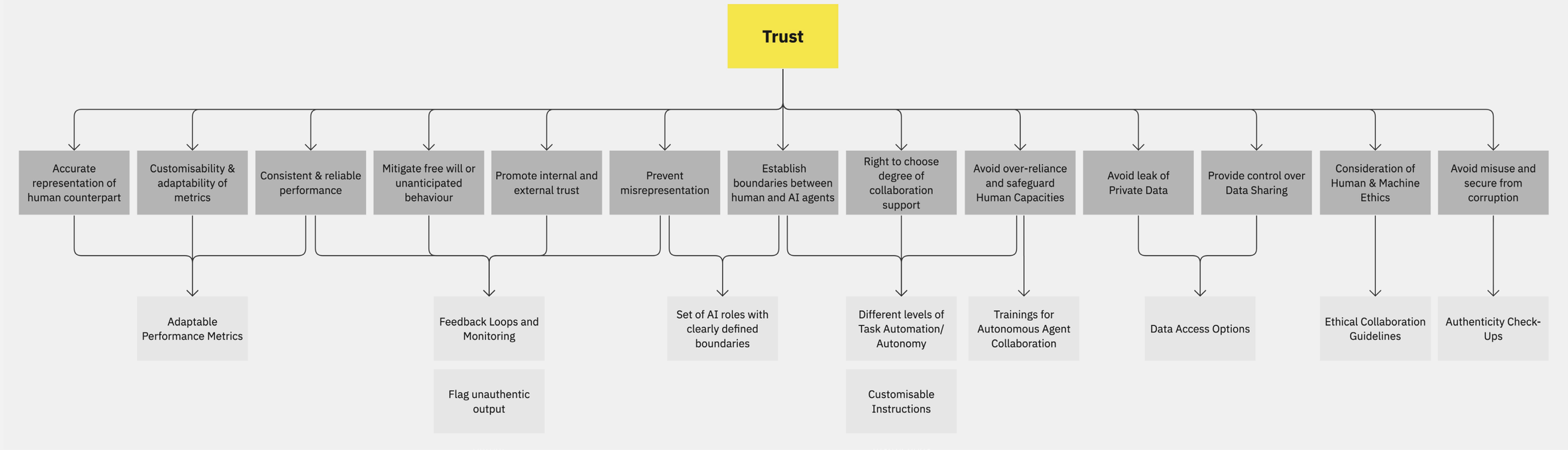
Discussion

In the exploration of the ***Digital Twin*** feature through the value of ***Trust***, Interviewee 1 delved into the intricate components that constitute an adequate virtual replica, distinguishing between uniquely personal aspects such as emotions, thoughts, or beliefs, and externally verifiable aspects like knowledge, domain expertise, or professional experience. This distinction is crucial in designing autonomous agents for teams, as it emphasises the need for a comprehensive and balanced representation of both internal and external facets of an individual. Participant 1 not only seperated the building blocks of an adequate virtual replica into uniquely personal aspects and verifiable aspects, but further also implied a monitoring system that ensure the regulation and balance of all aspects, by emphasising the term “ego“ (similar to Freudian Psychoanalysis). This nuanced approach to constructing digital replicas opens up broader debates surrounding human rights versus machine rights, particularly exploring whether a machine has the right to feel offended.

In conclusion, the design and implementation of the Digital Twin feature require thorough consideration of both personal and externally verifiable aspects, balanced monitoring systems, and a dynamic approach to decision logic to navigate the blurred boundaries between human and machine rights and maintain trust and efficiency in human-AI collaboration.
The interview inisghts allow to draw conclusions about desirable norms when designing digital twins. These either directly or indirectly revealed a set of design requirements that are presented below.

Limitations

While being extracted from a particular scenario context, it should be consider that the users expanded the purpose and functionality of this particular feature beyond its initially intended subchallenge of creating visibility. Thus, when working with user interviews, changes in the purpose of particular feature must be taken into account. Further, insights might introduce considerations that lack sufficient understanding or research to address them appropriately (e.g. machine ethics).



3: User Interviews

This section explores the relationship between social aspects of collaboration and technical requirements of autonomous agents by investigating an extracted feature through the lens of a collaboration value.

The interviews resulted in the following, refined description of the examined feature:

The „Digital Twins“ feature is an advanced AI-driven system designed to champion the knowledge and insights of every team participant. To construct these digital representations, the system not only builds a profile of its human counterpart, which includes general information about their domain expertise and experience but also specific information about their role and contribution to the present project. It goes a step further by ensuring an authentic and holistic representation of their viewpoints. This is achieved by reviewing past meetings to capture aspects such as behavior, tendencies, body language, communication type, and personality.

To ensure the system's adaptability and relevance, ***Adaptable Performance Metrics*** *are integrated, allowing the digital twin's performance criteria to be tailored to the specific needs of a project or team. Continuous* ***Feedback Loops*** *and* ***Monitoring*** *mechanisms are embedded, enabling team members to provide real-time feedback on the digital twin's performance, refining its accuracy and responsiveness over time.*

The digital twin comes with a predefined ***Set of AI Roles with Clearly Defined Boundaries****, such as a „Researcher“ for gathering information or a „Participant“ for aiding in discussions. This clarity in function ensures the AI doesn't overstep its boundaries. Users can also select from* ***Different Levels of Task Autonomy****, granting them the flexibility to decide how autonomous their digital twin should be based on the task at hand.*

Recognizing the importance of human-AI synergy, ***Trainings for Autonomous Agent Collaboration*** *are provided. These modules educate team members on maximizing the benefits of their partnership with their digital twins. To safeguard user privacy and ensure the depth of knowledge the digital twin possesses, granular* ***Data Access Options*** *are available, allowing users to control the data their twin can access.*

Ethical Collaboration Guidelines *have been established to ensure that the collaboration between humans and their digital twins remains respectful and ethical. Periodic* ***Authenticity Check-Ups*** *are scheduled, assessing the digital twin's alignment with its human counterpart, ensuring its continued authenticity and trustworthiness.*

During meetings, participants can activate their digital twin whenever they feel reticent to participate. This ensures participants remain visible, knowing their digital twin is an ever-present advocate. By addressing the sub-challenge of providing visibility to participants, Digital Twins ensures that no valuable insight is overlooked, fostering an environment where every voice, whether voiced or not, is acknowledged. This not only increases the inclusivity of meetings but also significantly enhances team effectiveness by ensuring decisions consider the full range of available knowledge and expertise.

4: Autonomy Types

By analysing the Digital Twin on different types of autonomy, this section offers a structured understanding of how an AI system functions and interacts with human teammates, providing understanding to facilitate better integration of AI tools into teams.

Designing effective and efficient Human-AI collaboration is a complex task that requires careful consideration of various factors, including the levels of autonomy of the AI system. The level of autonomy of an AI system can have significant impact on the collaboration between humans and AI systems. Therefore, it is essential to consider the appropriate level of autonomy for an AI system that matches with the task requirements and the human team members' skills and expertise (O'Neill et al., 2020). Moreover, designing Human-AI collaboration that respects human autonomy is critical to ensure that AI systems do not hinder human autonomy (Laitinen & Sahlgren, 2021).
The autonomy framework used for the following annalysis is based on the work of O'Neill et al. (2020) and Hackman et al. (2023) and has already been presented in the literature review section. It provides a more nuanced investigation compared to common, rather generic Level of Autonomy frameworks.

Defining and understanding the contextual scope in which a particular feature operates is crucial to ensure an accurate and meaningful analysis, as a different objective might result into different types on autonomy.
The scope of this analysis is primarily centered around the feature's objective to resolve its sub-challenge (Creating Visibility) on a regular basis.

Analysis

1. Operational Autonomy
The degree to which agents perform specific, pre-defined tasks without human intervention and operate solely based on predetermined algorithms when trying to fulfil its objective.
Level: High
Reasoning: In achieving its sub-challenge, the Digital Twins feature autonomously constructs a comprehensive profile of its human counterpart by gathering and processing data from various sources, such as past meetings, behavior or tendencies. Further, it autonomously represents its human counterpart, advocating their viewpoints. While it still needs to be initiated, its operational autonomy remains relatively high.

2. Decisional Autonomy
The degree to which agents make decisions within a set framework or rules, choosing from multiple options based on processed data when trying to fulfil its objective.
Level: Moderate
Reasoning: The system itself decides when the Digital Twin should voice out the participant's knowledge, autonomously deciding timing and exact content of output. However, the human facilitator and human counterpart can challenge decisions when misrepresentation was sensed. Further, the human counterpart can also give specific instructions to act on.

3. Adaptive Autonomy
The degree to which agents modify their behavior in response to new information or changing environments, learning and adapting from experiences when trying to fulfil its objective.
Level: Moderate
Reasoning: The digital twin is highly adaptable to the meeting flow and team dynamics. It continuously refines the profile, ensuring accurate representation. Being able to observe meetings and access internal data management systems it will already be prepared for upcoming projects. However, if the autonomy might change if the human counterpart chooses to restrict the data access prior to the meeting, influencing the system's ability to make use of particular knowledge.

4. Collaborative Autonomy
The degree to which agents are capable of functioning independently but also take inputs from humans or other systems to enhance collaborative efforts when trying to fulfil its objective.
Level: High
Reasoning: As the feature inherently aims to mimic its human counterpart, it employs all necessary abilities to seamlessly and independently collaborate with human agents. The means of communication and interaction match those of human agents, requiring no special means or support to ensure effective collaboration. In order to reach its objective it autonomously collaborates with other team members. Additionally, the system also potentially collaborates with other systems or tools to gather data and insights.

Discussion

The analysis of autonomy types provides valuable insights into the nuanced roles autonomous agents can play in Human-Autonomy Teams. The high operational autonomy envisions that once set up, such agents can efficiently handle complex tasks without constant human oversight, streamlining processes and ensuring that the human counterpart's viewpoints are consistently represented.

The moderate decisional autonomy suggests a balanced approach, where the autonomous agent has the capability to make decisions, but there's a safeguard in place allowing human intervention when necessary or desired. This balance is crucial in complex social environments, ensuring that while AI can act independently, it does not override human judgment. This is especially relevant in Human-AI collaboration as supported by Bao et al. (2023).

The high adaptive autonomy of the Digital Twins feature underscores the importance of continuous learning and adaptability in autonomous agents (supported by Sigaud et al., 2021). In dynamic team settings, where the context and objectives can shift rapidly, the ability of an agent to adapt in real-time is invaluable. Such adaptability ensures that the agent remains relevant and effective, even as team dynamics evolve.
However, the system's adaptability also depends on its access to data. If a human counterpart chooses to restrict data access prior to a meeting, it could limit the system's ability to adapt and make use of particular knowledge. This emphasises the balance between autonomy and human data control, highlighting the need for transparent data management practices and the empowerment of individuals to manage their own data.

Lastly, the moderate collaborative autonomy highlights the agent's capability to work both independently with human team members and other systems. This dual capability ensures that while the agent can function autonomously, it doesn not operate in isolation. Instead, it seamlessly integrates into the team, enhancing collaboration and ensuring that the valuable knowledge is made visible.

Limitations

The analysis has several limitations that should be taken into account.

First, the scope of the context in which the feature operates is paramount. Autonomy is not an absolute measure but is highly dependent on the specific context in which the system is deployed. A feature that exhibits high autonomy in a controlled environment might require significant human intervention in a more dynamic or unpredictable setting. The analysis provided is based on the particular context and focuses on achieving the sub-challenge.
Second, the autonomy scales, as currently defined, can be subjective. Clear criteria needs to be defined to create distinction and allow for confident interpretation.

5: Interaction Flow

This section shows how the refined concept is translated into a User Flow, revealing how the previously revealed design requirements could be manifested. The interactions are illustrated through an example scenario of a project meeting.

The refined feature description has gained enough depth to outline its interactions with humans in a particular context. Illustrating such a feature through interaction flows offers a clearer, more tangible insights into potential user behaviors and interactions before implementation. The Interaction flow will help to break down the complex functionalities into concrete action steps, allowing to explore its feasibility and reflect on its desirability. This flow was further complemented with user interfaces, that help to outline how the previously revealed design requirements could be translated into a prototype. An example scenario with fictional characters was defined to add specific context to the interaction flow.

Participants
Alex (Product Manager & Session Facilitator)
Shawn (Software Developer)
Jessie (User Experience Designer)
Elliot (Business Analyst)

Context
The team is working on Project Nebula, a software solution aimed at streamlining business processes for small to medium-sized enterprises. To finalise the integration strategy for the new analytics module, Alex, the product manager and facilitator, sends out invitations for a virtual meeting.

---

1 PRE-MEETING

ACTIONS

- Shawn gets notified that a meeting about Project Nebula is about to start. Already feeling the weight of his day, he decides to activate his Digital Twin for the upcoming meeting.
- ♦ Shawn initiates his Digital Twin and selects the role *Meeting Participant*. Further, he sets the data access to *only projects with Elliot*, intending to speak up himself when other projects need to be referenced. Lastly, he changes the machine autonomy on *decision-making* to *OFF* as he always feels more comfortable taking decisions on his own.

The User Interface on the right shows how some of the design requirements can be translated into a more tangible concept.

Here, Shawn sets up his digital twin by selecting the role and indicating what kind of personality should be employed when acting upon this role. Each role can be understood as a set of particular abilties. In this case, Shawn want so make sure that his digital twin represents him as a typical participant, aiming to share recent progress, retrieve information relevant for his position as a developer and define action items he can follow up on.

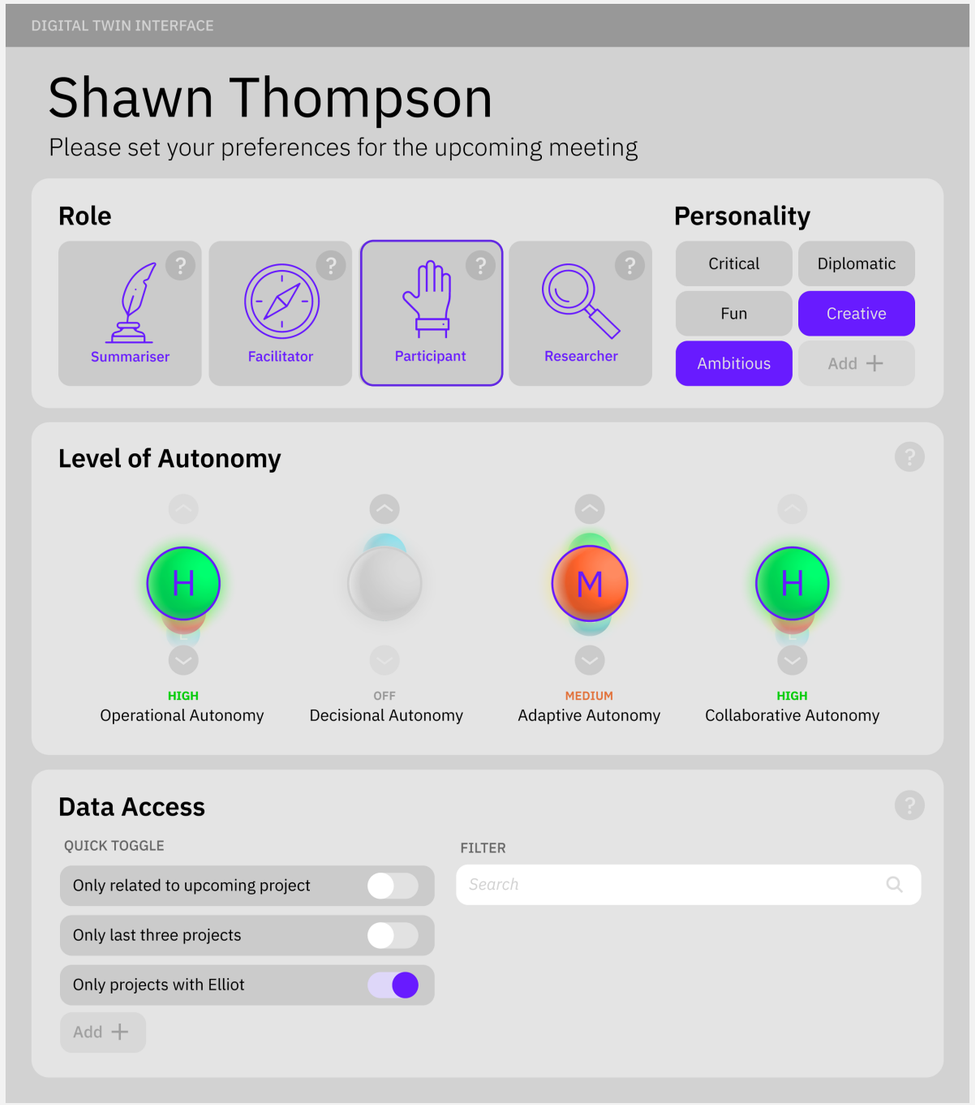
However, he deliberately chooses to turn off decisional-autonomy as he often feels more comfortable taking important decisions on his own and intends to speak up whenever necessary.

Further, as he recently finished a very similar project in which Elliot was also involved he wants to make sure that the digital twin only utilises insights very relevant to the current project.

Set of AI Roles with clearly defined boundaries →

Different levels of Task Automation/ Autonomy →

Data Access Options →



5: Interaction Flow

This section shows how the refined concept is translated into a User Flow, revealing how the previously revealed design requirements could be manifested. The interactions are illustrated through an example scenario of a project meeting.

---

2 KICK-OFF

ACTIONS

- Alex initiates the meeting, setting the tone and agenda. She acknowledges Shawn's Digital Twin and ensures that everyone is comfortable proceeding with it representing Shawn.
- The Digital Twin introduces itself, mentioning that Shawn is present but chooses to remain silent for this meeting.
- Jessie, who joined the company recently, just finished a training course on Autonomous Agent Collaboration and introduces herself to the Digital Twin granting access to her profile.
- Every participant provides a brief summary their recent process.

3 DISCUSSION

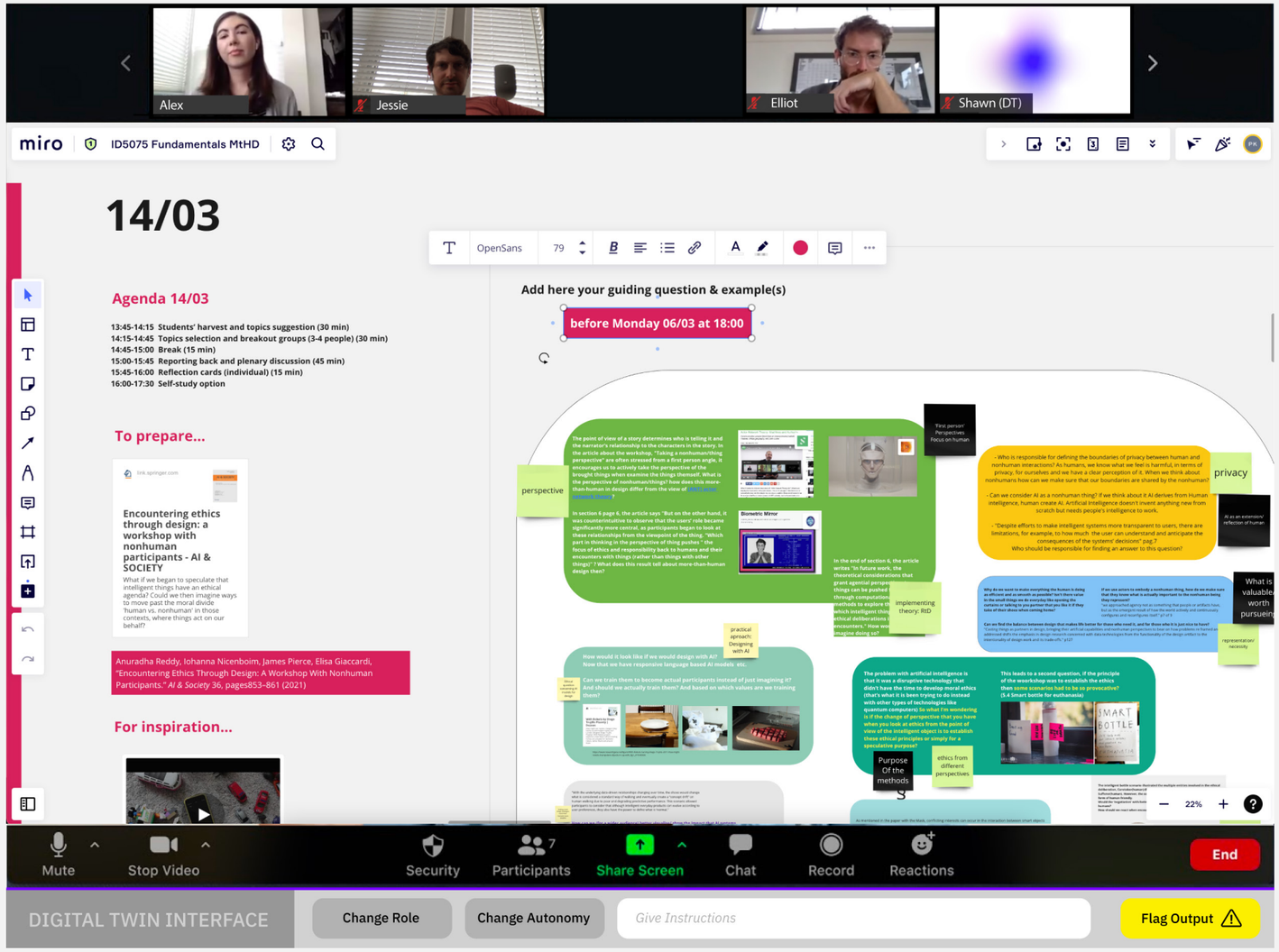
ACTIONS

- As Jessie presents a mock-up of the user interface, Shawn's Digital Twin offers insights on data visualisation based on Shawn's previous research.
- Elliot raises concerns about data processing speeds. The Digital Twin, channeling Shawn's expertise, suggests a hybrid cloud solution that Shawn had been exploring.
- Alex notes the contributions, appreciating the depth the Digital Twin's contributions.
- Shawn instructs the Twin to clarify with other participants whether the Data Stack needs to be adjusted.

This design artefact shows how the virtual meeting between the participants could look like.

During the Discussion stage Shawn can use the embedded interface within the used on-line conferencing tool to make changes to his twin or give specific instrcutions to act on. In this case he wants to clarify a question that came up during the discussion.

Trainings for autonomous agent collaboration



Customisable Instructions

5: Interaction Flow

This section shows how the refined concept is translated into a User Flow, revealing how the previously revealed design requirements could be manifested. The interactions are illustrated through an example scenario of a project meeting.

---

4 INTERRUPTION

ACTIONS

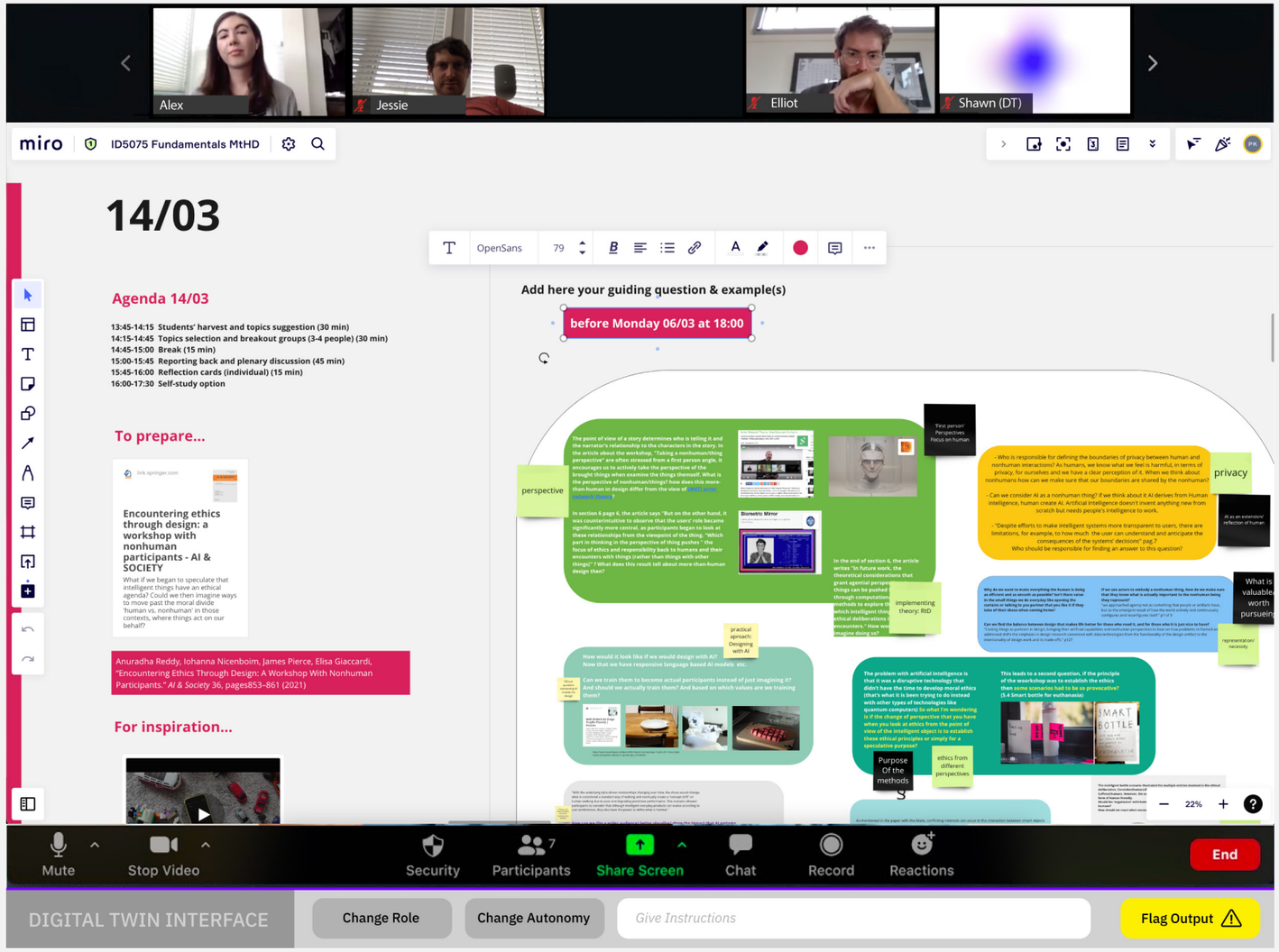
- A brief ping sounds, and Shawn's face appears on the screen. He apologises, mentioning that another project needs his immediate attention. He decides to leave the away entirely and grants the twin full autonomy.
- Alex confirms, while Jessie and Elliot nod in understanding.

5 INCIDENT

ACTIONS

- Having agreed on the specifications of the module, team members now need to agree on an implementation timeline. As everyone voices their estimations, Elliot gets suspicious about the estimation of Shawn's digital twin. During a recent coffee break, Shawn indicated that he is about to use a new tool that significantly boosts his workflow, making the given estimation questionable. Hence, Elliot flags the statement.

Having already gained experience in working with digital twins, Elliot is aware of the system's limitations and weaknesses. Thus, he can confidently flag its recent output as inaccurate or unauthentic, helping to make the system aware of its information gap.



Flag unauthentic output

5: Interaction Flow

This section shows how the refined concept is translated into a User Flow, revealing how the previously revealed design requirements could be manifested. The interactions are illustrated through an example scenario of a project meeting.

---

5 POST-MEETING

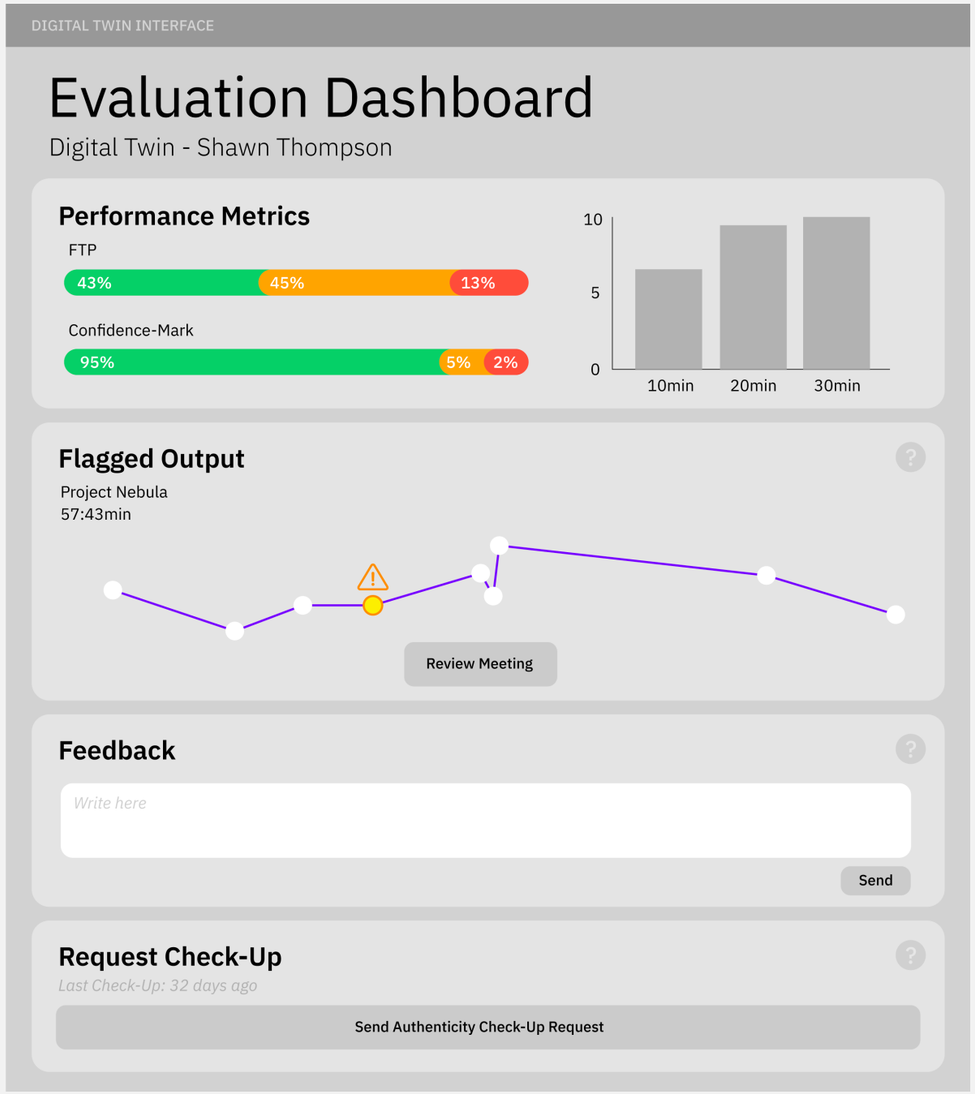
ACTIONS

- After the meeting ended, Alex is automatically presented the digital twin interface. Being responsible for post-meeting evaluation of the digital twin, she checks the performance metrics to assess aspects such as decision confidence or accuracy. She decides to review the incident and write feedback. Finally, she also sends a check-up request to Shawn to fill the information gap and ensure that the knowledge base is up-to-date.

Adaptable Performance Metrics

Feedback Loops & Monitoring

Authenticity Check-Ups



Conclusion

This framework serves as a comprehensive guide for exploring the potential of AI in enhancing team effectiveness. It combines a general analysis with in-depth investigation, ensuring a holistic understanding of the roles, capabilities, and interactions of AI within teams.

The approach is characterized by a systematic and multi-layered analysis, starting with a general overview of the envisioned futuristic features, followed by a detailed exploration of a selected feature, the Digital Twin. The initial capability overview provided a structured understanding of how the features could support different stages of team meetings, offering insights into the potential roles and capabilities of AI in resolving collaboration challenges. This general analysis is crucial in establishing a foundational understanding of the envisioned AI capabilities, setting the stage for a more nuanced exploration of individual features.

The choice of the Digital Twin feature for in-depth analysis was strategic, allowing for a detailed exploration of the complexities and potentials of AI in creating inclusive environments. Further, it represents a feature with existing expectations around it. User interviews provided valuable insights into the concerns and thoughts of the employees. This step was pivotal in refining and enriching the feature description, ensuring that the AI is not envisioned in isolation but as a collaborative partner.

The application of Value-Sensitive Design (VSD) framework served as a suitable means to translate interview insights into design requirements, ensuring that the development of autonomous agents is rooted in ethical considerations and respects the social dynamics of team collaboration. This approach not only facilitated critical reflection on value translations but also fostered constructive discussions among the end-users, emphasizing the importance of ongoing evaluation and dialogue in the development of AI systems.

The autonomy analysis provided a structured understanding of how AI systems function and interact with human teammates, highlighting the importance of designing AI systems with appropriate levels of autonomy that respect human autonomy and match task requirements and human skills. This nuanced investigation, based on established frameworks, ensured a more meaningful and accurate analysis, contributing to the feasibility and desirability reflection of the AI tools integrated into teams.

The detailed interaction flow and user interfaces developed in the final step of the in-depth analysis offered tangible insights into potential user behaviors and interactions, translating complex functionalities into concrete action steps and design prototypes. Using User Interfaces as artefacts, enabled to visualise the practical implementation of the feature, allowing for a more tangible and comprehensive exploration of its potential impacts on team effectiveness.

However, the shown analysis steps are not strictly defined in its purpose or order. They exemplify how extracted features can be analysed in the context of this thesis. Since most functions offer a variety of more or less complex interactions and functionalities, each one requires a tailored approach to analysis, including possible rounds of iteration.

Discussion

The research presented in this thesis has delved into the intricate realm of collaboration within interdisciplinary teams, particularly focusing on the potential for Artificial Intelligence (AI) to enhance team effectiveness. The findings from the literature review underscored the complexity of collaboration, the critical role it plays in organisations, and the emerging possibilities offered by AI and autonomous systems. In the subsequent empirical research phase, the study uncovered significant barriers to effective collaboration, including Improper Facilitation, Lack of Clarity, and Lack of Alignment, which often intertwine and contribute to the challenges faced by teams.

The concepts explored throughout this thesis have unveiled a thought-provoking dimension in the integration of AI technology within collaborative teams. Notably, it has become apparent that not every facet of collaboration necessarily demands the sophistication of AI. In some instances, achieving similar outcomes may be attainable through the use of less advanced technology or even without technology altogether. This observation raises a significant scientific question regarding the precise level of AI integration that best serves the needs of collaborative teams. This insight aligns well with ongoing research in this field, as researchers and practitioners seek to strike the ideal balance between human and machine contributions to team collaboration.
However, it is also important to acknowledge that not all collaboration challenges are comparable due to their complex nature and complex environment they are often embedded in. For socially challenges such as creating safe spaces for open dialogue, maintaining visibility across distributed teams or effectively managing conflict within a group, the need for equally complex and sophisticated technology becomes apparent. These challenges demand more than routine automation or basic technological support; they necessitate the nuanced capabilities of AI and advanced sense-making capabilities. However, in such contexts, AI can play a pivotal role in augmenting human efforts by providing advanced analysis, facilitating communication, and offering innovative solutions. As organizations like Thoughtworks and researchers in this field continue to explore the potential of AI in team collaboration, they must navigate this balance to ensure that technology serves as a valuable team member, addressing the intricacies of collaborative work without overshadowing the human that remains at its core.

Practical Implications

AI developers can leverage the research findings as a guiding resource. A comprehensive grasp of the distinct requirements and hurdles within the domain of team collaboration helps them to develop AI solutions characterized with contextual relevance and strong user-centricity. Equipped with these insights, AI professionals are better positioned to develop highly efficient and pragmatic AI tools for real-world scenarios, aligning with the needs of organisations and teams. Furthermore, leaders and decision-makers can extract valuable strategies and frameworks for the integration of AI into their teams, with a focus on ensuring seamless, ethically sound, and productivity-enhancing human-AI collaboration.

For Thoughtworks, the value of the insights gained extends beyond academic research. Thoughtworks places great emphasis on mastering the art of facilitation and recognises its central role in effective collaboration. By uncovering and addressing their internal collaboration challenges, they can not only cultivate awareness but also enhance their ability to assist clients in overcoming similar obstacles. In the realm of consultancy, where facilitating productive teamwork is essential, Thoughtworks' ability to harness AI to support collaboration provides valuable perspectives. These insights into the potential of AI to improve team effectiveness provide Thoughtworks with a powerful tool for both internal improvement and external consultancies, demonstrating their expertise and innovative approach to optimising collaboration through technology while fostering environments of psychological safety.

Addressing the defined Research Guidelines

The following concludes how the defined research guidelines at the beginning of this thesis were addressed by the outcome, aiming to ensure meaningful contribution to this field of Human-Autonomy Teams:

1. Emphasise Function over Imitation:
The research of this thesis shall emphasise the functionality and capabilities of AI in enhancing team effectiveness rather than aiming to imitate human teammates.
This was achieved through the generation of a variety of features that do not center around the paradigm to mimic humans. Further, some even employ exotic abilities such as telekinesis, allowing to imagine so far unknown ways of communication.

2. Respect Uniqueness:
The research of this thesis shall respect and highlight the unique nature of AI driven systems.
This is addressed by focusing on the unique abilities of AI such as analysis, visualization or data handling acknowledging the distinct values AI can bring to team dynamics, differing from human-human interactions. The exploration of values like trust in the context of AI also aligns with this proposition, as it recognizes the different ways trust is constructed and defined in HATs compared to human-human teams.

3. Implement Human Expectations:
The research of this thesis shall understand and address the concerns, thoughts, and values of humans.
By conducting user interviews and exploring concerns and thoughts of employees of Thoughtworks, your approach is addressing the management of human expectations in HATs. Understanding and addressing the concerns, thoughts, and values of humans working with AI is crucial in managing expectations and enhancing the performance of HATs. The creation of interaction flows and design

Limitations

Several limitations are inherent to the outlined approach, particularly in the context of Human-AI teams.

First, The study primarily relies on theoretical insights and scenario creation to illustrate AI's role in enhancing team collaboration. The lack of empirical validation of the proposed AI-driven solutions limits the ability to test their effectiveness and feasibility in real-world settings.

Second, the research, while grounding its research in a real-world context, remains fundamentally speculative, relying heavily on futuristic and abstract concepts. n via Telekinesis, are speculative by nature, making it difficult to ground them in practical, real-world applications and to assess their feasibility and impact accurately. This is amplifies by the general utopian view of AI, imagining systems that can accomplish everything. Outcomes such as digital twins or communicatio This speculative stance might lead to overestimations of AI capabilities and underestimations of the complexities involved in implementing such advanced technologies, potentially resulting in unrealistic expectations and unmet needs.

Third, the employed methods such as user interviews or Value Sensitive Design might struggle with resolving conflicts between different values and stakeholders, potentially leading to ethical dilemmas and compromises in value prioritization. The approach might also face challenges in translating abstract values into concrete design requirements, potentially resulting in vague and ambiguous guidelines, lacking practical applicability.

Lastly, the interaction analysis, while offering tangible insights into potential user behaviors and interactions, might not fully capture the complexity and variability of human behaviors. The approach might struggle with predicting and addressing the unintended consequences and emergent behaviors that arise from the interaction between humans and AI, potentially leading to unanticipated challenges and risks.

8. Reflection on Using ChatGPT

In the process of crafting this thesis, significant portions were either directly authored by ChatGPT or developed collaboratively with ChatGPT, an advanced language processing AI developed by OpenAI. To employ this tool in for this context, permissions were obtained. Its application encompassed various roles, each making distinct contributions to the thesis' development.
While the thesis delved examinations of AI's role in enhancing team collaboration, the following reflects on the collaboration with ChatGPT as a writing tool and provides some additional insights into the collaboration AI within an academic context.

Reflecting on my writing process with ChatGPT, I found a nuanced interplay between utility and cognitive load. Primarily, I used ChatGPT to enable a quick overview of all kinds of written content, a foundation on which to distil my thoughts and refine my formulations. Formulating ideas and thoughts, I cautiously relied on the AI as it often threatened to cause additional cognitive overload or break fragile chains of thought. Once my thoughts were solidified, ChatGPT became a valuable tool to refine them. This was expecially helpful in exploration phases.

Over time, I noticed that I developed a "throw-in-first" approach that describes pasting in initial, often unclear or incomplete thoughts into the tool and observing how it handles it. This seemingly rudimentary method facilitated deeper immersion, enabled to build initial mental models of the subject matter, and encouraged richer, more nuanced thinking. By generating text on seemingly unrelated keywords, ChatGPT served as a springboard that allowed me to develop ideas and gradually draw more coherent conclusions, which proved particularly useful, again, during the exploratory stages of my research.

Once this thesis gained its holistic structure, the tool became less useful as it often lacked understanding of the broader context. Creating extensive prompts to provide that context helped, but was often tedious and distracting rather than manageable. However, crafting longer prompts were particularly useful when trying to plan a workshop for example. Describing to ChatGPT how a workshop connects to the bigger picture helped to refine its structure, focus and choosen methods. Further, it allowed to anticipate and simulate possible workshop outcomes, helping me to grasp how potential outcomes might fit into my research. Still, there was a fear to rely too much on ChatGPTs output, being based on false assumption about human behaviour.

In essence, my journey with ChatGPT was a delicate dance between improvement and obstruction, a journey of learning to use the tool's capabilities while overcoming its limitations, and a constant quest for a balance between trust and independent thinking. It was a symbiotic relationship in which the AI served as both a mirror for my thoughts and a canvas on which I could paint them with greater clarity and depth.

Additional insights

1. The Dynamics of Interaction:
The relationship I developed with ChatGPT is reminiscent of a master-slave dynamic. I often felt like the master, directing the AI to think and generate content, even when I lacked expertise in the subject matter. This top-down perspective, however, is not without its pitfalls. Overreliance on ChatGPT sometimes led me to confusing endpoints, where I felt I had lost ownership of my train of thought. This made it challenging to trace back or continue my line of reasoning.

2. A New Approach to Literature and Research:
Using plugins, ChatGPT allowed to "chat" with documents such as scientific papers or newspaper articles. This transformed my interaction with literature. It felt as though I was conversing with a document, giving it a „soul." This novel approach to research made me ponder the implications of attributing consciousness to software and other objects. Could we be on the cusp of a paradigm shift where we „chat" with various digital entities or physical objects?

3. Custom AI
In my effort to maintain a balanced relationship with ChatGPT, I often adapted my prompts to respect my personal strengths and weaknesses. In order not to be too influenced by the AI's results, I sometimes structured my prompts in such a way that ChatGPT only provided bullet points and not full paragraphs. This approach allowed me to maintain my standards and integrity in my work and ensure that the support I received from the AI complemented my thought process and was not dictatorial. By customising my interaction with ChatGPT in this way, I was able to use the AI's capabilities to enhance my strengths and reduce the risk of producing undesirable work due to overconfidence or laziness. This nuanced interaction potentially opens up pathways to a deeper understanding of oneself and allows for a more harmonious integration of AI support tailored to individual needs and preferences, fostering a symbiotic relationship in which AI becomes a catalyst for enhancing personal strengths and maintaining high standards of work.

4. Data Interaction and Analytical Approach:
My experience with ChatGPT significantly altered my approach to data and analysis. Given its capability to analyse data at varying levels of abstraction, I found myself maintaining a breadth of data that I would typically aim to reduce at the earliest opportunity. This approach allowed by ChatGPT enabled me to engage with the data in the process for a longer period and produce additional results (e.g. Ethical Considerations or Near-Future Value for every feature). However, working this way occasionally led to results that were less comprehensive as well, presenting additional challenges in the analytical journey. This shift in data interaction and analytical approach prompted reflections on the balance between depth and breadth in data analysis, and the role of AI in shaping our analytical narratives and conclusions.

9. References

1. Andrews, R. W., Lilly, J. M., Srivastava, D., & Feigh, K. M. (2022). The role of shared mental models in human-AI teams: a theoretical review. Theoretical Issues in Ergonomics Science, 1–47. https://doi.org/10.1080/1463922x.2022.2061080

2. Å. Fasth et al., „Development of production cells with regard to physical and cognitive automation: A decade of evolution," 2011 IEEE International Symposium on Assembly and Manufacturing (ISAM), Tampere, Finland, 2011, pp. 1-6, doi: 10.1109/ISAM.2011.5942316.

3. Agres, A., Vreede, G. J. de, Briggs, R. O., „A Tale of Two Cities: Case Studies of GSS Transition in Two Organizations," Group Decision and Negotiation, 14, 256-266, 2005.

4. Aydin, O., & Karaarslan, E. (2023). Is ChatGPT Leading Generative AI? What is Beyond Expectations? Social Science Research Network. https://doi.org/10.2139/ssrn.4341500

5. Al-Mafrji, A. a. M., Hamodi, Y. I., Hassn, S. G., & Mohammed, A. B. (2023). Analyzing the use of expert systems in improving the quality of decision-making. Eastern-European Journal of Enterprise Technologies, 1(3 (121)), 73–80. https://doi.org/10.15587/1729-4061.2023.274584

6. Beranek, Margaret & Beise, Catherine & Niederman, Fred. (1993). Facilitation and group support systems. 199 - 207 vol.4. 10.1109/HICSS.1993.284182.

7. Bonczek, R. H. &. H. C. W. &. W. a. B. (1981). Foundations of Decision Support Systems. ideas.repec.org. https://ideas.repec.org/b/eee/monogr/9780121130503.html

8. Bao, Y., Gong, W., & Yang, K. (2023). A Literature Review of Human–AI Synergy in Decision Making: From the Perspective of Affordance Actualization Theory. Systems, 11(9), 442. https://doi.org/10.3390/systems11090442

9. Begerowski, S. R., Hedrick, K. N., F, W., Mears, L., & Shuffler, M. L. (2023). The forgotten teammate: Considering the labor perspective in human-autonomy teams. Computers in Human Behavior, 145, 107763. https://doi.org/10.1016/j.chb.2023.107763

10. Briggs, R. O., De Vreede, G., & Nunamaker, J. F. (2003). Collaboration Engineering with ThinkLets to Pursue Sustained Success with Group Support Systems. Journal of Management Information Systems, 19(4), 31–64. https://doi.org/10.1080/07421222.2003.11045743

11. Badke-Schaub, P., Neumann, A., Lauche, K., & Mohammed, S. (2007). Mental models in design teams: a valid approach to performance in design collaboration? CoDesign, 3(1), 5–20. https://doi.org/10.1080/15710880601170768

12. Barczak, G., & Wilemon, D. (2001). Factors influencing product development team satisfaction. European Journal of Innovation Management, 4(1), 32–36. doi:10.1108/14601060110365556

13. Blaskovich, J. L. (2008). Exploring the effect of distance: An experimental investigation of virtual collaboration, social loafing, and group decisions. Journal of Information Systems, 22(1), 27–46. doi:10.2308/jis.2008.22.1.27

14. Blut, M., Wang, C., Wünderlich, N. V., & Brock, C. (2021). Understanding anthropomorphism in service provision: a meta-analysis of physical robots, chatbots, and other AI. Journal of the Academy of Marketing Science, 49(4), 632–658. https://doi.org/10.1007/s11747-020-00762-y

15. Bonito, J. A. (2004). Shared cognition and participation in small groups: Similarity of member prototypes. Communication Research, 31(6), 704–730. doi:10.1177/0093650204269406

16. Bisantz, Ann., and Emilie. Roth. 2007. „Analysis of Cognitive Work." Reviews of Human Factors and Ergonomics 3 (1): -43. doi:10.1518/155723408X299825.

17. Bouchard, T. (1972). „Training, Motivation and Personality as Determinants of the Effectiveness of Brainstorming Groups and Individuals," Journal of Applied Psychology, Vol. 56, pp. 418-421.

18. Bose, U. (2015). Design and evaluation of a group support system supported process to resolve cognitive conflicts. Computers in Human Behavior, 49, 303–312. https://doi.org/10.1016/j.chb.2015.03.014

19. Briggs, R. O., Vreede, G.J. de, Duivenvoorde, G. P. J., & Kolfschoten, G. L., „Practitioners vs. Facilitators a Comparison of Participant Perceptions on Success," in Hawaii International Conference on System Science, Waikoloa, 2009.

20. Bedwell, W. L., Wildman, J. L., DiazGranados, D., Salazar, M. R., Kramer, W. S., & Salas, E. (2012). Collaboration at work: An integrative multilevel conceptualization. Human Resource Management Review, 22(2), 128–145. https://doi.org/10.1016/j.hrmr.2011.11.007

21. Bostrom, R., Anson, R., and Clawson, V. (1993). „Group Facilitation and Group Support Systems," in Group Support Systems: A New Frontier, Jessup, L. Valacich, J., (Eds.), pp. 146-168.

22. Briggs, R. O., Kolfschoten, G. L., Vreede, G. J. de, „Toward a Theoretical Model of Consensus Building," in Americas Conference on Information Systems, Omaha, 2005.

23. Briggs, R. O., Vreede, G. J. de, Nunamaker, J. F., „Collaboration Engineering with ThinkLets to Pursue Sustained Success with Group Support Systems," Journal of Management Information Systems, vol. 19, 31-63, 2003.

24. Casakin, H., & Badke-Schaub, P. (2015). Mental Models and Creativity in Engineering and Architectural Design Teams. In Springer eBooks (pp. 155–171). https://doi.org/10.1007/978-3-319-14956-1_9

25. Chen, G., & Klimoski, R. J. (2003). The impact of expectations on newcomer performance in teams as mediated by work characteristics, social exchanges, and empowerment. Academy of Management Journal, 46(5), 591–607. https://doi.org/10.2307/30040651

26. Chidambaram, L., & Tung, L. L. (2005). Is out of sight, out of mind? An empirical study of social loafing in technology-supported groups. Information Systems Research, 16(2), 149–170. doi:10.1287/isre.1050.0051

27. Coutu, D. (2015, July 15). Why Teams Don't Work. Harvard Business Review. https://hbr.org/2009/05/why-teams-dont-work

28. Crawford, E. R., & Lepine, J. A. (2013). A Configural Theory of Team Processes: Accounting for the Structure of Taskwork and Teamwork. Academy of Management Review, 38, 32-48. https://doi.org/10.5465/amr.2011.0206

29. Chilberg, J. C. (1989). „A Review Of Group Process Designs For Facilitating Communication In Problem-Solving Groups,"Management Communication Quarterly, Vol. 3, No. 1, pp. 51-71.

30. Clawson, V. K., Bostrom, R. P., & Anson, R. (1993). The Role of the Facilitator in Computer-Supported Meetings. Small Group Research, 24(4), 547–565. https://doi.org/10.1177/1046496493244007

31. Converse, Sharolyn, J. A. Cannon-Bowers, and E. Salas. 1993. „Shared Mental Models E. in Expert Team Decision Making." Individual and Group Decision Making: Current Issues 221 (1993): 221- 246.

32. Cooke, Nancy J., Eduardo ., Salas, Janis A Cannon-Bowers, and Renée J. Stout. 2000. „Measuring Team Knowledge." Human Factors 42 (1): 151-173. doi:10.1518/001872000779656561.

33. Carneiro, J., Alves, P., Marreiros, G., & Novais, P. (2021). Group decision support systems for current times: Overcoming the challenges of dispersed group decision-making. Neurocomputing, 423, 735–746. https://doi.org/10.1016/j.neucom.2020.04.100

34. Dennis, A. R., Wixom, B. H., & Vandenberg, R. J. (2001). Understanding Fit and Appropriation Effects in Group Support Systems via Meta-Analysis. Management Information Systems Quarterly, 25(2), 167. https://doi.org/10.2307/3250928

35. DeSanctis, G., & Gallupe, R. B. (1987). A foundation for the study of group decision support systems. Management Science, 33(5), 589–609. https://doi.org/10.1287/mnsc.33.5.589

36. Driskell, J. E., & Salas, E. (1992). Collective Behavior and Team Performance. Human Factors, 34(3), 277–288. https://doi.org/10.1177/001872089203400303

37. Driskell, J. E., Salas, E., & Driskell, T. (2018). Foundations of teamwork and collaboration. American Psychologist, 73(4), 334–348. https://doi.org/10.1037/amp0000241

38. De Vreede, G., Niederman, F., & Paarlberg, I. (2002). Towards an Instrument to Measure Participants' Perceptions on Facilitation in Group Support Systems Meetings. Group Decision and Negotiation, 11(2), 127–144. https://doi.org/10.1023/a:1015225811547

39. De Dreu, C. K. W. (2007). Cooperative outcome interdependence, task reflexivity and team effectiveness: A

motivated information processing approach. The Journal of Applied Psychology, 92(3), 628–638. doi:10.1037/0021-9010.92.3.628

40. Endsley, M. R. (2017). Toward a theory of situation awareness in dynamic systems. In Situational awareness (pp. 9–42). Milton, Park, England: Routledge.

41. Endsley, M. R. (2023). Supporting Human-AI Teams: Transparency, explainability, and situation awareness. Computers in Human Behavior, 140, 107574. https://doi.org/10.1016/j.chb.2022.107574

42. Elwart-Keys, M., Halonen, D., Horton, M., Kass, R., and Scott, P. (1990). „User Interface Requirements For Face-to-Face Groupware," in Proceedings of the CHI 1990 Conference, pp. 295-301.

43. Ford, M., & Johnson-Laird, P. N. (1985). Mental models: towards a cognitive science of language, inference, and consciousness. Language, 61(4), 897. https://doi.org/10.2307/414498

44. Fiore, S. M., Salas, E., & Cannon-Bowers, J. A. (2001). Group dynamics and shared mental model development . In London, M. (Ed.), How People Evaluate Others in Organizations (pp. 309–336). Mahwah, NJ: Lawrence Erlbaum Associates.

45. F. G. Filip, "Decision support and control for large-scale complex systems," Annual Reviews in Con-trol, Vol. 32, No. 1, pp. 61-70, 2008.

46. Gmeiner, F. (2022, July 6). Team Learning as a Lens for Designing Human-AI Co-Creative Systems. arXiv.org. https://arxiv.org/abs/2207.02996v1

47. Graham, J. R., & Barter, K. (1999). Collaboration: A Social Work Practice Method. Families in society-The Journal of Contemporary Social Services, 80(1), 6–13. https://doi.org/10.1606/1044-3894.634

48. Hansen, M.T., Nohria, N., 2004. How to build collaborative advantage. MIT Sloan Management Review 46 (1), 22e30.

49. Hauptman, A. I., Schelble, B. G., McNeese, N. J., & Madathil, K. C. (2023). Adapt and overcome: Perceptions of adaptive autonomous agents for human-AI teaming. Computers in Human Behavior, 138, 107451. https://doi.org/10.1016/j.chb.2022.107451

50. He, C., & Li, Y. (2017). A Survey of Intelligent Decision Support System. 7th International Conference on Applied Science, Engineering and Technology (ICASET 2017). https://doi.org/10.2991/icaset-17.2017.38

51. Hackman, J., and Kaplan, R. (1974). „Interventions Into Group Process: An Approach to Improving The Effectiveness Of Groups," Decision Sciences, Vol. 5, pp. 459-480.

52. Hayne, S. C. (1999). The facilitators perspective on meetings and implications for group support systems design. ACM Sigmis Database, 30(3–4), 72–91. https://doi.org/10.1145/344241.344246

53. Hengst, M. den, Weimar, L., Hengst, S. den, „How to increase GSS transition? A case study at a Dutch Police Force," in Hawaii International Conference on System Sciences, 2007, 1-10.

54. Hernández, A. K. L., Fernández-Mesa, A., & Edwards-Schachter, M. (2018). Team collaboration capabilities as a factor in startup success. Journal of Technology Management & Innovation, 13(4), 13–23. https://doi.org/10.4067/s0718-27242018000400013

55. Higgins, D., & Johner, C. (2023). Validation of Artificial Intelligence Containing Products Across the Regulated Healthcare Industries. Therapeutic Innovation & Regulatory Science, 57(4), 797–809. https://doi.org/10.1007/s43441-023-00530-4

56. Hirokawa, R.¥., and Gouran, D. (1989). „Facilitation of Group Communication: A Critique of Prior Research And an Agenda for Future Research," Management Communication Quarterly, Vol. 3, No. 1, pp. 71-92.

57. Hanumantharao, S., & Grabowski, M. (2006). Effects of introducing collaborative technology on communications in a distributed safety-critical system. International Journal of Human-computer Studies. **https://doi.org/10.1016/j.ijhcs.2006.02.008**

58. Harris, E., & Woolley, R. (2009). Facilitating innovation through cognitive mapping of uncertainty. International Studies of Management & Organization, 39(1), 70–100. doi:10.2753/IMO0020-8825390104

59. Hoegl, M., & Gemuenden, H. G. (2001). Teamwork quality and the success of innovative projects: A theoretical concept and empirical evidence. Organization Science, 12(4), 435 449. doi:10.1287/orsc.12.4.435.10635

60. Hoegl, M., K., Weinkauf, H., & Gemuenden, G. (2004). Interteam coordination, project commitment, and teamwork in multiteam R&D projects: A longitudinal study. Organization Science, 5(1), 38–55. doi:10.1287/orsc.1030.0053

61. Hengst, M. D., & Adkins, M. S. (2007). Which collaboration patterns are most challenging: A global survey of facilitators. https://doi.org/10.1109/hicss.2007.614

62. Hernandez, A. K., Fernández-Mesa, A., & Edwards-Schachter, M. (2018). Team collaboration capabilities as a factor in startup success. Journal of Technology Management & Innovation, 13(4), 13–23. https://doi.org/10.4067/s0718-27242018000400013

63. Huber, G. P., & Lewis, K. (2010). Cross-understanding: implications for group cognition and performance. Academy of Management Review, 35(1), 6–26. doi:10.5465/AMR.2010.45577787

64. Ilgen, D. R., Hollenbeck, J. R., Johnson, M. K., & Jundt, D. K. (2005). Teams in Organizations: From Input-Process-Output Models to IMOI Models. Annual Review of Psychology, 56(1), 517–543. https://doi.org/10.1146/annurev.psych.56.091103.070250

65. Iqbal, T., & Riek, L. D. (2018). Human-Robot Teaming: Approaches from Joint Action and Dynamical Systems. In Springer eBooks (pp. 2293–2312). https://doi.org/10.1007/978-94-007-6046-2_137

66. Johnson, M., and Vera, A. H. (2019). No AI is an island: the case for teaming intelligence. AI Mag. 40, 16–28. doi: 10.1609/aimag.v40i1.2842

67. Jay, A. (1976). „How To Run A Meeting," Harvard Business Review, pp. 43-57.

68. Jolak, R., Wortmann, A., Liebel, G., Umuhoza, E., & Chaudron, M. M. (2021). Design thinking and creativity of colocated versus globally distributed software developers. Journal of Software. https://doi.org/10.1002/smr.2377

69. José Castillo, Edith Galy, Pierre Thérouanne, and Raoul Do Nascimento. 2019. Study of the mental workload and stress generated using digital technology at the workplace. In H-Workload 2019: 3rd International Symposium on Human Mental Workload: Models and Applications (Works in Progress). 105.

70. J.P. Shim, M. Warkentin, J.F. Courtney, D.J. Power, R. Sharda and C. Carlsson, "Past, present, and future of decision support technology", Decision Support Systems 33, 2002.

71. Kaner, S., & Lind, L. (1996). Facilitator's Guide to Participatory Decision-Making. https://ci.nii.ac.jp/ncid/BB18447524

72. King, A. A., & Lakhani, K. R. (2013). Using open innovation to identify the best ideas. MIT Sloan Management Review, 55(1), 41–48. https://dialnet.unirioja.es/servlet/articulo?codigo=4409901

73. Kozlowski, S. W. J., & Ilgen, D. R. (2006). Enhancing the Effectiveness of Work Groups and Teams. Psychological Science in the Public Interest, 7(3), 77–124. https://doi.org/10.1111/j.1529-1006.2006.00030.x

74. Krishnan, M. S., Kriebel, C. H., Kekre, S., & Mukhopadhyay, T. (2000). An Empirical analysis of productivity and quality in software products. Management Science, 46(6), 745–759. **https://doi.org/10.1287/mnsc.46.6.745.11941**

75. Kocsis, D. J., Vreede, G.-J. D., & Briggs, R. O. (2015). Designing and Executing Effective Meetings with Codified Best Facilitation Practices. The Cambridge Handbook of Meeting Science, 483–503. doi:10.1017/cbo9781107589735.021

76. Kettunen, P. (2009). Adopting key lessons from agile manufacturing to agile software product development—A comparative study. Technovation, 29(6–7), 408–422. https://doi.org/10.1016/j.technovation.2008.10.003

77. Kassab, M. (2016, October 26). Software Quality - Traditional vs. Agile: an Empirical Investigation. arXiv.org. https://arxiv.org/abs/1610.08312v2

78. Kim, G. J. (2015). Human-computer interaction: Fundamentals and practice. Boca Raton, FL: CRC press.

79. Kozlowski, S. W. J., and Bell, B. S. (2003). "Work groups and teams in organizations," in Handbook of Psychology: Industrial and Organizational psychology, Vol. 12, eds W. C. Borman, D. R. Ilgen, and R. J. Klimoski (New York, NY: Wiley-Blackwell), 333–375. doi: 10.4324/9781315805986-21

80. Krausman, A. S., Neubauer, C., Forster, D. E., Lakhmani, S., Baker, A. L., Fitzhugh, S. M., Gremillion, G. M., Wright, J. L., Metcalfe, J. S., & Schaefer, K. E. (2022). Trust Measurement in Human-Autonomy Teams: Development of a conceptual toolkit. ACM Transactions on Human-robot Interaction, 11(3), 1–58. https://doi.org/10.1145/3530874

81. Laitinen, A., & Sahlgren, O. (2021). AI systems and respect for human autonomy. Frontiers in Artificial Intelligence, 4. https://doi.org/10.3389/frai.2021.705164

82. Larson, L. E., & DeChurch, L. A. (2020). Leading teams in the digital age: Four perspectives on technology and what they mean for leading teams. Leadership Quarterly, 31(1), 101377. https://doi.org/10.1016/j.leaqua.2019.101377

83. Lyons, J. B., & Stokes, C. K. (2011). Human–Human reliance in the context of automation. Human Factors, 54(1), 112–121. https://doi.org/10.1177/0018720811427034

84. Linda Argote. 1999. Organizational Learning: Creating, Retaining, and Transferring Knowledge (1st. ed.). Kluwer Academic Publishers, USA.

85. Liu, Y. W., Chakrabarti, A., & Bligh, T. P. (2003). Towards an 'ideal' approach for concept generation. Design Studies, 24(4), 341–355. https://doi.org/10.1016/s0142-694x(03)00003-6

86. Mittleman, D. D., Briggs, R. O., Murphy, J., Davis, A., (2008), Toward a Taxonomy of Groupware Technologies, in: Briggs, R. O., Antunes, P., Vreede, G. J. de, Read, A. S., (2008), Groupware: Design, Implementation, and Use, Proceedings of CRIWG 2008, Berlin: Springer-Verlag, 305-317.

87. Mosvick R., and Nelson, R. (1992). We've Got to Start Meeting Like This! A Guide to Successful Business Meeting Management, Glenview, IL: Scott, Foresman.

88. Maedche, A., Legner, C., Benlian, A., Berger, B., Gimpel, H., Hess, T. M., Hinz, O., Morana, S., & Söllner, M. (2019). AI-Based Digital Assistants. Business & Information Systems Engineering, 61(4), 535–544. https://doi.org/10.1007/s12599-019-00600-8

89. Maier, N. and Hoffman, L.R. (1960). „Using Trained Developmental Discussion Leaders To Improve Further The Quality Of Group Decisions," Journal of Applied Psychology, Vol. 44, No. 2, pp. 47-251.

90. Maier, N. and Maier, R.A. (1957). „An Experimental Test Of The Effects Of Developmental vs. Free Discussions On The Quality Of Group Decisions," Journal of Applied Psychology, Vol. 41, No. 5, pp. 320-323.

91. Mandiwalla, M., Gray, P,. and Olfman, L. (1997). „The Meta Environment: A New Group Support System Structure," Journal of Organizational Computing and Electronic Commerce, Vol. 7, No. 1, pp. 35-55.

92. Mollick, E. (2022, December 14). ChatGPT Is a Tipping Point for AI. Harvard Business Review. https://hbr.org/2022/12/chatgpt-is-a-tipping-point-for-ai

93. Mohammed, S., Klimoski, R. and Rentsch, J.R., The measurement of team mental models: we have no shared schema. Organiz. Res. Meth., 2000,3(2), 123 – 165.

94. MacMillan, J., Entin, E. E., & Serfaty, D. (2004). Communication overhead: The hidden cost of team cognition. In Salas, E., & Fiore, S. M. (Eds.), Team cognition: Understanding the factors that drive process and performance (pp. 61–82). Washington, DC: American Psychological Association. doi:10.1037/10690-004

95. McNeese, N. J., Demir, M., Cooke, N. J., & Myers, C. W. (2017). Teaming With a Synthetic Teammate: Insights into Human-Autonomy Teaming. Human Factors, 60(2), 262–273. https://doi.org/10.1177/0018720817743223

96. Miles, J. R., & Kivlighan, D. M. (2010). Co-leader similarity and group climate in group interventions: Testing the co-leadership, team cognition-team diversity model. Group Dynamics, 14(2), 114–122. doi:10.1037/a0017503

97. Miranda, S. M., & Saunders, C. S. (2003). The social construction of meaning: An alternative perspective on information sharing. Information Systems Research, 14(1), 87–107. doi:10.1287/ isre.14.1.

98. Mathieu, J.E., Heffner, T. S., Goodwin, G. F., Salas, E., & Cannon-Bowers, J. A. (2000). The influence of shared mental models on team process and performance. Journal of Applied Psychology, 85(2), 273–283. doi:10.1037/0021-9010.85.2.273

99. McGrath J.E. (1964). Social psychology: A brief introduction. New York: Holt, Rinehart, & Winston.

100. Norman, Donald A. 1987. Some observations on mental models. Human-computer interaction: multidisciplinary approach. Morgan Kaufman Publishers Inc., San Francisco, CA, USA, 241- 244. https://dl.acm.org/doi/10.5555/58076.58097

101. Nunamaker, J.F., Dennis, A., Valacich, J., Vogel, D., and George, J. (1991). „Electronic Meeting Systems To Support Group Work," Communi- cations of the ACM, Vol. 34, No. 7, pp. 40-61.

102. Oppenheim, L. (1987). „Making Meetings Matter: a Report to the 3M Corporation," 3M Meeting Management Institute, P.O. Box 2963, Austin, TX.

103. O'Neill, T. A., Flathmann, C., McNeese, N. J., & Salas, E. (2023). Human-autonomy Teaming: Need for a guiding team-based framework? Computers in Human Behavior, 146, 107762. https://doi.org/10.1016/j.chb.2023.107762

104. Park, G., Spitzmuller, M., & DeShon, R. P. (2013). Advancing Our Understanding of Team Motivation. Journal of Management, 39(5), 1339–1379. https://doi.org/10.1177/0149206312471389

105. Paulus, P. B., Dzindolet, M. T., & Kohn, N. W. (2012). Collaborative Creativity—Group Creativity and Team Innovation. In Elsevier eBooks (pp. 327–357). https://doi.org/10.1016/b978-0-12-374714-3.00014-8

106. Pearson, J. M., & Shim, J. P. (1995). An empirical investigation into DSS structures and environments. Decision Support Systems, 13(2), 141–158. https://doi.org/10.1016/0167-9236(93)e0042-c

107. Poole, M. S. (2003). Group Support systems. In Elsevier eBooks (pp. 501–507). https://doi.org/10.1016/b0-12-227240-4/00083-6

108. Poole, M. S., & DeSanctis, G. (1990). Understanding the use of Group Decision Support Systems: The Theory of Adaptive Structuration. In SAGE Publications, Inc. eBooks (pp. 173–193). https://doi.org/10.4135/9781483325385.n8

109. Phillips-Wren, G. (2011). Intelligent agents in decision support systems. In IGI Global eBooks (pp. 505–513). https://doi.org/10.4018/978-1-59904-843-7.ch058

110. Patel, H., Pettitt, M., & Wilson, J. R. (2012). Factors of collaborative working: A framework for a collaboration model. Applied Ergonomics, 43(1), 1–26. https://doi.org/10.1016/j.apergo.2011.04.009

111. Perlow, L. A. (2017, June 26). Stop the meeting madness. Harvard Business Review. https://hbr.org/2017/07/stop-the-meeting-madness

112. Phillips, L.D., and Phillips, M.C. (1990). „Facilitating Work Groups: Theory and Practice," Technical Report, Decision Analysis Unit, London School of Economics and Political Science, Houghton Street London NC2

113. Quintas, P. (1994). Programmed Innovation? Trajectories of Change in Software Development. Information Technology & People, 7(1), 25–47. https://doi.org/10.1108/09593849410074016

114. Rai, A. et al. (2019). Emerging Concepts in Bacterial Taxonomy. In: Satyanarayana, T., Johri, B., Das, S. (eds) Microbial Diversity in Ecosystem Sustainability and Biotechnological Applications. Springer, Singapore. https://doi.org/10.1007/978-981-13-8315-1_1

115. Rasker, P. (2002). Communication and performance in teams. https://pure.uva.nl/ws/files/1661473/50669_Thesis.pdf**

116. Rieder, T. N., Hutler, B., & Mathews, D. J. H. (2020). Artificial Intelligence in Service of Human Needs: Pragmatic First Steps Toward an Ethics for Semi-Autonomous Agents. Ajob Neuroscience, 11(2), 120–127. **https://doi.org/10.1080/21507740.2020.1740354**

117. Rayed, C. A. (2013). Developing an Expertise Interaction Meta-Model for Group Decision Support System (GDSS). Computer Science and Information Technology, 1(2), 105–110. https://doi.org/10.13189/csit.2013.010205

118. Resick, C. J., Dickson, M. W., Mitchelson, J. K., Allison, L. K., & Clark, M. A. (2010). Team composition, cognition, and effectiveness: Examining mental model similarity and accuracy. Group Dynamics, 14(2), 174–191. doi:10.1037/a0018444

119. Rezwana, J., & Maher, M. L. (2022). Designing Creative AI Partners with COFI: A Framework for Modeling Interaction in Human-AI Co-Creative Systems. ACM Transactions on Computer-Human Interaction. https://doi.org/10.1145/3519026

120. Sigaud, O., Caselles-Dupr'e, H., Colas, C., Akakzia, A., Oudeyer, P., & Chetouani, M. (2021). Towards Teachable

Autonomous Agents. ArXiv, abs/2105.11977.

121. Stefanidi, E., Bentvelzen, M., Woźniak, P. W., Kosch, T., Woźniak, M. P., Mildner, T., Schneegass, S., Müller, H., & Niess, J. (2023). Literature Reviews in HCI: A Review of Reviews. CHI '23: Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems. https://doi.org/10.1145/3544548.3581332

122. Stulgiene, A., & Ciutiene, R. (2014). COLLABORATION IN THE PROJECT TEAM. Ekonomika Ir Vadyba. https://doi.org/10.5755/j01.em.19.2.5719

123. Seeber, I., Bittner, E. a. C., Briggs, R. O., De Vreede, T., De Vreede, G., Elkins, A., Maier, R., Merz, A. B., Oeste-Reiß, S., Randrup, N. L., Schwabe, G., & Söllner, M. (2020). Machines as teammates: A research agenda on AI in team collaboration. Information & Management, 57(2), 103174. https://doi.org/10.1016/j.im.2019.103174

124. Smulders, F., & Dorst, K. (2007). Towards a co-evolution model of the NPD-manufacturing interface. ResearchGate. https://www.researchgate.net/publication/288414235_Towards_a_co-evolution_model_of_the_NPD-manufacturing_interface

125. Suomala, P., & Jokioinen, I. (2003). The patterns of success in product development: a case study. European Journal of Innovation Management, 6(4), 213–227. https://doi.org/10.1108/14601060310500931

126. Todoros, O., & Todoros, O. (2023). Revolutionizing Teamwork in 2023: How AI is Reshaping the Future of Work. Spike. https://www.spikenow.com/blog/productivity/revolutionizing-teamwork-in-2023-how-ai-is-reshaping-the-future-of-work/

127. Van den Bossche, Piet, Wim Gijselaers, Mien Segers, Geert Woltjer, and Paul Kirschner. 2011. „Team Learning: building Shared Mental Models." Instructional Science 39 (3): 283-301. doi:10.1007/s11251-010-9128-3.

128. Vagia, M., Transeth, A. A., & Fjerdingen, S. A. (2016). A literature review on the levels of automation during the years. What are the different taxonomies that have been proposed? Applied Ergonomics, 53, 190–202. https://doi.org/10.1016/j.apergo.2015.09.013

129. Van De Poel, I. (2013). Translating Values into Design Requirements. In Philosophy of engineering and technology (pp. 253–266). https://doi.org/10.1007/978-94-007-7762-0_20

130. Wageman, R., Hackman, J. R., & Lehman, E. (2005). Team Diagnostic Survey. The Journal of Applied Behavioral Science, 41(4), 373–398. https://doi.org/10.1177/0021886305281984

131. Zhang, R., McNeese, N. J., Freeman, G., & Musick, G. (2021). "An Ideal Human." Proceedings of the ACM on Human-computer Interaction, 4(CSCW3), 1–25. https://doi.org/10.1145/3432945

132. Zollo, M., & Winter, S. G. 2002. Deliberate learning and the evolution of dynamic capabilities. Organization Science, 13(3), 339–351.

10. Appendix

Survey Results

Nr.	Please think of a recent collaborative activity. What was its main purpose? What were the objectives?	Challenge 1	How often does this challenge occur?	Theme	Challenge 2	How often does this challenge occur?	Theme	Challenge 3	How often does this challenge occur?	Theme	Communicator (7)	Stakeholder Manager (2)	Leader (4)	Decision Maker (5)	Problem Solver (5)	Architect (5)	Creative Thinker (1)	Critical Thinker (3)	Knowledge Builder (10)	Why did you choose this specific superpower for yourself?	I would have possessed this superpower for myself to...	Why did you choose this specific superpower for an AI team member?	I would have allocated this superpower to an AI teammate to...
1	We did a value proposition canvas exercise with a potential clients. The purpose was to uncover potential opportunities driven by their customer needs.	Us as facilitators had never run this particular exercise before	4	Lack of Facilitation	The session took way longer than anticipated	3	Sparsity of Time	At the end of the workshop, we weren't completely clear on next steps yet	4	Unclear Process		For myself						AI Teammate	It was the most crucial element needed for this session (and most other sessions with clients)	Needed in general	As a facilitator in action, you either have the knowledge or you don't. There's not always time for you to process new information and make sense of it on the spot. I can imagine AI helping with that.	standardise/automate tasks
2	It's purpose is discover together the responsibilities of a new role or function	Because it's an abstract thing that we can to describe in a concrete way it's difficult to align between people what is the best way to start that discovery	3	Explanation/ Description Issues	It was a meeting on zoom but we all have our cameras on, sometimes is challenging to understand someone's facial expression or with his/her body, same as in person, and that expression could be interpreted wrongly by someone else	4	Unclear Ways of Working/Communication								AI Teammate	For myself				Because it's difficult to guide and facilitate a conversations about complex and abstract matters	facilitate better	To show what is missing so humans can make decisions	summarize & extract information
3	brainstorm and uncover the purpose, value and activities of a business function	get all participants to understand the objective	5	Unclear Problem Definition	support the conversations with a Mural to bring structure to the endevour	4	Lack of Facilitation	group similar thoughts - as shared on a post-it - and merge the responses into one summary	5	Lack of Facilitation	AI Teammate							For myself		because I think we should leave Critical thinking to the humans	Resistance towards technology	it's a super power that can be applied to standardise processes	standardise/automate tasks
4	A threat modelling session. Ideate and brainstorm potential risks in proposed product delivery	Getting team to provide a hollistic view of threats that may occur, rather than just one type - ie security	4	Unclear objective/outcome	Team input was sometimes lacking and required facilitation	4	Lack of Participation						For myself						AI Teammate	This superpower should help me facilitate better	facilitate better	This superpower should free up cognitive load for more threat ideation	reduce cognitive load
5	I worked on spike recently.	Since there was lot of things to explore we divided and then kind of missed keeping each other up-to date with the findings.	4	Unclear Roles & Responsibilities	I think other person lacked ownership since I was primary owner of ticket.	4	Unclear Roles & Responsibilities											For myself	AI Teammate	I think as human I can do critical thinking more effectively.	Resistance towards technology	AI team member can make sense of vast knowledge more effectively.	reduce cognitive load
7	The purpose was to build a proposal for a new client/prospect. This proposal needed to include information gathered by everyone involved up until that point, specific subject matter expert view points and time lines for the corresponding tasks and it needed to be approved by people not involved previously.	It was unclear who is responsible for what and someone needed to step up an make that decision - it was unclear who that someone is.	4	Unclear Roles & Responsibilities	Given the different areas of expertise, it was impossible for me to judge the quality or completeness of certain parts of the proposal. It was also difficult to define a timeline for something you don't understand.	4	Unclear Roles & Responsibilities	When many people work on a storyline it's always weak - some agreement beforehand, on what we want to convey at least, would be useful.	3	Unclear Problem Definition					For myself	AI Teammate				There's always problems so problem solving should be the best skill to have :)	Needed in general	Because it's not the most interesting part of this process but it's still crucial. I feel that some automation and delegation to an AI team member would be extremely helpful.	standardise/automate tasks
8	LDJ workshop	getting and keeping the whole group on the same page	4	Unclear Problem Definition	grouping and prioritizing topics and ideas	4	Lack of Facilitation	Converting written stickies to digital assets	5	Inadequate Documentation Methods				For myself					AI Teammate	It's all about finding the right moment for decision making and making the right ones. Balancing brainstorming, drawing conclusions and making decisions.	facilitate better	Converting random texts, ideas, scribbles in something meaningful to process later (knowledge) is tedious work and might be made simpler and faster with an AI assistant	summarize & extract information
9	The purpose of the meeting was to select a list of Tech Trends from the TW Global Tech Strategy, according to the intersection between: Global recommendations, Market needs in NL and TWer willingness. Each person selected 5 Tech Trends individually, per each "lens" (6 in total), at the end we have discussed which ones we should filter based on most selected Tech Trends.	Not all the Tech Trends were clear from their title, many times we needed to switch tabs and manually search for their definition. This slowed us down.	3	Explanation/ Description Issues	For Tech Trends where we could not agree immediately, the discussion sometimes went too far, because people felt passionate about defending one particular Tech Trend. So we took extra time to find agreements for some of the trends.	4	Lack of Facilitation	From the 4 people involved in the activity, 1 of them was less engaged than the others. We tried to ask some specific questions to the person, to try and make them participate more. It could be related to the fact that person was "less technical" than the others and did not comprehend all the Tech Trends.	2	Lack of Participation				For myself					AI Teammate	The session was all about making decisions on which Tech Trends to choose. So in order to cover a big number of Tech Trends, it was important to maximize the efficiency on decision making. Even though I think I could do it, I could easily see as an advantage to have it as a "super power".	facilitate better	As we spent too much time understanding the definitions, then listening to each other, interpreting and building up on top, it seems an AI could do this better and allow us to focus more on the interesting part of decision making.	reduce cognitive load
10	Collaboration with a client to continue into phase 2 of a project. The aim was to continue the project	Communication. The client team and TW team did not seem aligned	5	Unclear Ways of Working/Communication							For myself								AI Teammate	Because clearly there was a difficulty for the two teams to understand each other, so communication should have been improved	communicate effectively	Because it would be useful to have the whole context at hand	summarize & extract information
11	To create a platform that makes easier to find volontaires.	Scoping	4	Lack of Facilitation	time crunch	5	Sparsity of Time	LAck of clarity of who does what	2	Unclear Roles & Responsibilities	For myself	AI Teammate								Because my example suffered from extreme time crunch. So to be a super hero level communicator would be great	communicate effectively	Because of how time consuming it is. The ting we had little of.	increase efficiency of meeting
12	set of goals, bets and initiatives to focus on	time constraints to capture the ideas, process them and convey in a common set of prioritized list	4	Sparsity of Time	Differences of opinion that require more discussion and negotiation to choose a win-win or win-loose option	3	Lack of Facilitation	misalignment on outcome and expectations of the meeting understanding, either takes time to align at the beginning or impacts in discussion topics unrelated or that could been potentially moved to a parking lot	3	Unclear objective/outcome	AI Teammate					For myself				Because of my role and experience, it is expected that I guide the team to the north star	Part of my role/skillset	Because I bet that with some continuous condensation of information and clarity of agreed focus on the meeting purpose, like keeping everyone on the same page with good communication will help us to accomplish the expected result during the time reserved	increase efficiency of meeting
13	coming up with an external event to raise awareness on how to design apps taking account accessibility	external blockers	1	External Blockers	unsure about what was the next step	3	Unclear Process	missing somebody driving the conversation	1	Unclear Roles & Responsibilities				For myself	AI Teammate					because sometimes I'm afraid to take the decision in case I make a mistake	Part of my role/skillset	to help us solve the issue at hand	increase efficiency of meeting
14	redesigning the execution of a business critical function	create clarity on the purpose of the activity	3	Unclear objective/outcome	create alignment on the process of getting to the outcome	4	Unclear Process	to summarise a person's verbal input to the discussion in a few written sentences to keep for later reference	5	Inadequate Documentation Methods	AI Teammate		For myself							due to the lack of clarity on the purpose and of alignment of the process, people started to loose focus and trust in the facilitation of the session.	facilitate better	we needed an assistent to write notes, a scribe, who doesn't need too much context or subject matter expertise to be able to execute the task at hand	summarize & extract information
15	Closing Idealworks. The objective was to land this customer before the end of Q1	Pricing	5	External Blockers	Decision making that we couldn't influence	5	External Blockers	and timeline.	3	Sparsity of Time			For myself				AI Teammate			I think development around Leadership is always needed. Every situation requires a different leadership style	Needed in general	Outside the box thinking goes better with AI	gain new perspectives
16	Activity to define the roles and responsibilities for a function	Collaboration	3	Unclear Ways of Working/Communication	Direction of session - How are we going to achieve the goal?	3	Unclear Process						For myself		AI Teammate					For any collaboration I think the ability to get people to align & move forward is key. Otherwise it just ends up being a lot of conversation with out any result	Needed in general	The ability to look at a problem & think about it from multiple perspectives is necessary for an activity. For humans this generally requires a dedicated focus time which is separate from the collaboration exercise. If an AI can parallelize this during the activity & surface the info, it'll greatly help the facilitator.	standardise/automate tasks
17	Sprint retrospective and planning for goals for next project phase	Getting a shared understanding of where to head next	4	Unclear Process	Agreeing on ways of working between client and TW team	4	Unclear Ways of Working/Communication				For myself								AI Teammate	Effective communication is key in these meetings and hence has to be handled properly	communicate effectively	AI can assist in bringing in perspectives and aiding decision making.	gain new perspectives
19	Co-creation of a slide deck, aiming to prepare some material to share with potential clients and making it accessible also for those who are not AI-tech savvy	Align on communication style	4	Unclear Ways of Working/Communication							AI Teammate			For myself						Because I would prefer not to delegate these superpowers to a statistical learning system (I find this word more realistic and representative compared to AI) in this specific context	Resistance towards technology	By exclusion due to constraints in the column. I think it is also important for our job to become great communicators as persons given that it requires empathy, emotions, wisdom and would prefer not to delegate these tasks to a statistical learning system.	Resistance towards technology
20	align team norms and agree on a way of working	Provide space for everyone to share their ideas but facilitate that agreements are set	4	Lack of Facilitation	Capture the agreements and communicate them, give follow visibility of them	5	Inadequate Documentation Methods											For myself	AI Teammate	Because I feel that it is a key part of facilitating the session and to bring the awareness of biases as a human	facilitate better	I think that highlighting agreements based on the input from people would help to convey ideas	summarize & extract information
21	to come up with a decision for a technical problem	the different level of experiences	3	Divergent team knowledge/experience	some people were more quiet and we had to be intentional to get their opinion	3	Lack of Participation	getting everyone to agree on one option	2	Lack of Facilitation					AI Teammate	For myself				so that I could make the most of that meeting	increase effectivity of meeting	so that it would give us the knowledge we need in order to make a decision	summarize & extract information
22	Figure out a knowledge sharing/training plan for Responsible Tech topics in TW NL	Async brainstorming	3	Lack of Facilitation	Passive participation	2	Lack of Participation									For myself			AI Teammate	In the specific problem context, I believe guiding & facilitating to get the best inputs from the group and lead them to the said goal would have been ideal & for that the Architect superpower seems to be aligned	facilitate better	In brainstorming sessions, colalting, grouping & building the big picture & validating if it serves our North start would be a great assist & we can save time in such analysis & spend more in generating creative solutions.	standardise/automate tasks
23	To align on a role which the responsibilities will need to be split across operational functions	No structure in the meeting	4	Unclear Process	Poor facilitation	4	Lack of Facilitation	Long meeting - no outcomes	4	Lack of Facilitation				For myself					AI Teammate	So that we could have come out of the meeting with outcomes	increase effectivity of meeting	might help with giving a base for us to move forward with	increase efficiency of meeting

10. Appendix

Survey Occurrence Analysis (1 of 2)

Challenge	How often does this challenge occur?	Theme	Average Occurrence	Average Occurrence
get all participants to understand the objective	5	Unclear Problem Definition	Task Model	4
getting and keeping the whole group on the same page	4	Unclear Problem Definition	Task Model	4
When many people work on a storyline it's always weak - some agreement beforehand, on what we want to convey at least, would be useful.	3	Unclear Problem Definition	Task Model	4
Given the different areas of expertise, it was impossible for me to judge the quality or completeness of certain parts of the proposal. It was also difficult to define a timeline for something you don't understand.	4	Unclear Problem Definition	Task Model	4
misalignment on outcome and expectations of the meeting understanding, either takes time to align at the beginning or impacts in discussion topics unrelated or that could been potentially moved to a parking lot	3	Unclear objective/outcome	Task Model	3,3
create clarity on the purpose of the activity	3	Unclear objective/outcome	Task Model	3,3
Getting team to provide a hollistic view of threats that may occur, rather than just one type - ie security	4	Unclear objective/outcome	Task Model	3,3
Because it's an abstract thing that we can to describe in a concrete way it's difficult to align between people what is the best way to start that discovery	3	Explanation/ Description Issues	Task Model	3
Not all the Tech Trends were clear from their title, many times we needed to switch tabs and manually search for their definition. This slowed us down.	3	Explanation/ Description Issues	Task Model	3
No structure in the meeting	4	Unclear Process	Process Model	3,7
Getting a shared understanding of where to head next	4	Unclear Process	Process Model	3,7
create alignment on the process of getting to the outcome	4	Unclear Process	Process Model	3,7
At the end of the workshop, we weren't completely clear on next steps yet	4	Unclear Process	Process Model	3,7
unsure about what was the next step	3	Unclear Process	Process Model	3,7
Direction of session - How are we going to achieve the goal?	3	Unclear Process	Process Model	3,7
time crunch	5	Sparsity of Time	Process Model	3,8
time constraints to capture the ideas, process them and convey in a common set of prioritized list	4	Sparsity of Time	Process Model	3,8
The session took way longer than anticipated	3	Sparsity of Time	Process Model	3,8
and timeline.	3	Sparsity of Time	Process Model	3,8
group similar thoughts - as shared on a post-it - and merge the responses into one summary	5	Lack of Facilitation	Process Model	3,8
Us as facilitators had never run this particular exercise before	4	Lack of Facilitation	Process Model	3,8
Provide space for everyone to share their ideas but facilitate that agreements are set	4	Lack of Facilitation	Process Model	3,8
support the conversations with a Mural to bring structure to the endevour	4	Lack of Facilitation	Process Model	3,8
Team input was sometimes lacking and required facilitation	4	Lack of Facilitation	Process Model	3,8
Poor facilitation	4	Lack of Facilitation	Process Model	3,8
Scoping	4	Lack of Facilitation	Process Model	3,8
grouping and prioritizing topics and ideas	4	Lack of Facilitation	Process Model	3,8
For Tech Trends where we could not agree immediately, the discussion sometimes went too far, because people felt passionate about defending one particular Tech Trend. So we took extra time to find agreements for some of the trends.	4	Lack of Facilitation	Process Model	3,8
Long meeting - no outcomes	4	Lack of Facilitation	Process Model	3,8
Differences of opinion that require more discussion and negotiation to choose a win-win or win-loose option	3	Lack of Facilitation	Process Model	3,8
getting everyone to agree on one option	2	Lack of Facilitation	Process Model	3,8
Async brainstorming	3	Lack of Facilitation	Process Model	3,8
Communication. The client team and TW team did not seem aligned	5	Unclear Ways of Working/Communication	Interaction Model	4
Align on communication style	4	Unclear Ways of Working/Communication	Interaction Model	4
Agreeing on ways of working between client and TW team	4	Unclear Ways of Working/Communication	Interaction Model	4
It was a meeting on zoom but we all have our cameras on, sometimes is challenging to understand someone's facial expression or with his/her body, same as in person, and that expression could be interpreted wrongly by someone else	4	Unclear Ways of Working/Communication	Interaction Model	4

10. Appendix

Survey Occurrence Analysis (2 of 2)

Challenge	How often does this challenge occur?	Theme	Average Occurrence	Average Occurrence
Collaboration	3	Unclear Ways of Working/Communication	Interaction Model	4
Since there was lot of things to explore we divided and then kind of missed keeping each other up-to date with the findings.	4	Unclear Roles & Responsibilities	Interaction Model	3,6
It was unclear who is responsible for what and someone needed to step up an make that decision - it was unclear who that someone is.	4	Unclear Roles & Responsibilities	Interaction Model	3,6
I think other person lacked ownership since I was primary owner of ticket.	4	Unclear Roles & Responsibilities	Interaction Model	3,6
Given the different areas of expertise, it was impossible for me to judge the quality or completeness of certain parts of the proposal. It was also difficult to define a timeline for something you don't understand.	4	Unclear Roles & Responsibilities	Interaction Model	3,6
LAck of clarity of who does what	2	Unclear Roles & Responsibilities	Interaction Model	3,6
missing somebody driving the conversation	1	Unclear Roles & Responsibilities	Interaction Model	3,6
Team input was sometimes lacking and required facilitation	4	Lack of Participation	Interaction Model	2,8
some people were more quiet and we had to be intentional to get their opinion	3	Lack of Participation	Interaction Model	2,8
Passive participation	2	Lack of Participation	Interaction Model	2,8
From the 4 people involved in the activity, 1 of them was less engaged than the others. We tried to ask some specific questions to the person, to try and make them participate more. It could be related to the fact that person was "less technical" than the others and did not comprehend all the Tech Trends	2	Lack of Participation	Interaction Model	2,8
Capture the agreements and communicate them, give follow visibility of them	5	Inadequate Documentation Methods	Interaction Model	5
Converting written stickies to digital assets	5	Inadequate Documentation Methods	Interaction Model	5
to summarise a person's verbal input to the discussion in a few written sentences to keep for later reference	5	Inadequate Documentation Methods	Interaction Model	5
the different level of experiences	3	Divergent team knowledge/experience	Interaction Model	2,5
From the 4 people involved in the activity, 1 of them was less engaged than the others. We tried to ask some specific questions to the person, to try and make them participate more. It could be related to the fact that person was "less technical" than the others and did not comprehend all the Tech Trends	2	Divergent team knowledge/experience	Interaction Model	2,5
Pricing	5	External Factors		3,7
Decision making that we couldn't influence	5	External Factors		3,7
external blockers	1	External Factors		3,7

Observation Results

Insight Description	Disrupted SMM	Theme
24 - team member struggles to understand a particular sticky note	TASK	Explanation/Description Issues
11 - session had no pre-defined objective	TASK	Lack of Clarity (Session Objective/Outcome)
1 - outcomes of last session were not entirely agreed on	TASK	Lack of Clarity (Session Objective/Outcome)
2 - not everybody was fully aware of the outcomes of the last session	TASK	Lack of Clarity (Session Objective/Outcome)
10 - team members not sure about overall purpose of beach project	TASK	Lack of Clarity (Session Objective/Outcome)
16 - team member not certain about objective of current session	TASK	Unclear Objective/Outcome
17 - team member not certain how outcome of current session will look like	TASK	Unclear Objective/Outcome
19 - team members struggle to understand outcomes of last session	TASK	Unclear Objective/Outcome
25 - team members question overall purpose of project	TASK	Unclear Objective/Outcome
33 - session leader cannot recall problem statement that justified the session	TASK	Unclear Problem Definition
34 - session leader confused by own project description	TASK	Unclear Problem Definition
6 - suggested design method caused confusion (conflicting best practices)	PROCESS	Inappropriate method
8 - Co-Creation method is inappropriate for session objective	PROCESS	Inappropriate method
21 - co-creation method is inappropriate for task objective	PROCESS	Inappropriate method
3 - team member not sure how process of this session relates to overall process	PROCESS	Unclear Process
4 - team members not sure how the overall design process should look like (time-wise and steps)	PROCESS	Unclear Process
13 - team couldn't make progress due to uncompleted tasks	PROCESS	Unclear Process
15 - not everyone was aware of the sessions' requirements	PROCESS	Unclear Process
29 - session facilitator did not seek alignment in advance of overall process	PROCESS	Unclear Process
9 - team member does not know how much time to spend on a specific task	PROCESS	Unclear use of method
18 - team members confused about sub-task description of co-creation method	PROCESS	Unclear use of method
20 - co-creation method lead to ambiguous outcomes	PROCESS	Unclear use of method
22 - co-creation method resulted in slightly different contributions than expected	PROCESS	Unclear use of method
23 - team members struggled to understand how to work with co-creation method	PROCESS	Unclear use of method
26 - team member struggled to understand how task outcome contributes to session objective	PROCESS	Unclear use of method
5 - recently joined team member not fully aware of existing design processes	INTERACTION	Divergent team knowledge/experience
7 - team not sure what recently joined team member knows about processes/methods	INTERACTION	Divergent team knowledge/experience
28 - team members not fully aware of facilitators co-creation intentions	INTERACTION	Divergent team knowledge/experience

10. Appendix

Detailed Outcome for Empirical Research I Workshop

Safe Space (WO1)

being open-minded and caring for team members, opportunity space to collaborate with clear boundaries, give visibility to everyone, make sure everyone has space to interact, safety, protector, making everyone participate and feel heard, allow emotions to emerge, enable brain dump

- participants stated that the emergence of this cluster surprised them the most. Lisa said this is probably related to companies values, we focus on that a lot, which is supported by the conversations and sharings we have at the office. Rixt adds "cause we believe if you dont create that [safe space] we wouldn't notice that people are centering inside themselves that it would be stupid if I say this or would be laughing at me"
- give visibility to everyone: some people are more outspoken than others, so the facilitators have to make sure that everyone has the chance and feels okay to speak up
- Rixt: creating safe spaces [and facilitation in general] only works as a group: adhering to guidelines, ground rules, etc.

Process Guidance (WO2)

Focus, Driver, from diverge to converge, providing guidance, provide guidance to get towards an outcome, driving a group towards better understanding and alignment, structuring a meeting, parking lot

- rabbit hole: end up talking about something related but not necessarily bringing helping to move on, endless topic without conclusion or agreement, sometimes happens when diverging, facilitator needs to detect and set focus or put on parking lot
- energy regulator: sensing how much energy participants have and whether or not energisers/breaks are required

Mediation (WO3)

Mediation, Disagreement, supercharged or emotional, Insecurities are addressed, make sure concerns are addressed, handing conflict

- "I like mediation as its more general and focusses on conflict, disagreement, expectation management, insecurities."
- Insecurities are addressed: can be stakeholders or participants
- supercharged or emotional: some discussions tend to be supercharged or emotional, facilitator should keep these emotions in mind

Enable Conversation (WO4)

conversation guider, enable conversation, conversation, conversations are smoothened

Alignment (WO5)

get to alignment, alignment, opportunity to increase shared understanding in a safe space, context, opportunity for problem-solving

Spidey Sense (WO6)

being comfortable to pivot when the situation requires it, being okay to go off script

Outcome Focused (WO7)

Meeting outcomes, understanding the goal/desired outcome

Responsibility Allocation (WO8), Fun (WO9), Large Impact (WO10), enable creativity (WO11), Energy Regulator (WO12), enable wisdom of the crowds (WO13), Group Setting (WO14), Time Keeping (WO15)

Conclusion: What can be facilitated?
- communication
- problem-solving
- processes (growth, change process, problem-solving)
- workshops
- alignment
- conversation
- mediation
- environment
- conflict resolutions

10. Appendix

Detailed Outcome for Empirical Research I Workshop

BEFORE

Supportive Factors (WO16)

Agenda: "I link that to not having a clear outcome or alignment. Having an agenda ensures a clear outcome. Clarifies expectations. Supports the natural process that every facilitation session has (→diverging, converging). Default, proven agenda for brainstorming, problem solving, etc. would help"

Secrets of Facilitation (Book)

Default Agenda

Attendance Confirmation

Colleagues providing input on your plan

Copy/Model great facilitators

Having enough time to prepare

Obstructive Factors (WO17)

Lack of context: affects motivations, people from client side not always knowing why attend. sometimes people also spontaneously get asked to join project and facilitate a session, have little time to prepare, not aware of prior progress/knowledge

Not knowing how people may respond

stakeholders being unclear

request for facilitation comes too late, time pressure

DURING

Supportive Factors (WO18)

Having a facilitation buddy (time keeper, etc.)

Cooperation: "willingness to cooperate, if facilitator wants to give visibility to everybody, everybody needs to mutually (and implicitly) agree as some people keep to speak out loud. Resistance is energy-draining. there needs to be a shared understanding that we will work together"

Group/People taking responsibility for the outcome: "when facilitating a session/workshop you want people to own the outcome, not just being spectators. As a facilitator you own the process, not the outcome."

Active Participation: How to strengthen: make them feel heard, manage energy levels by balancing types of activities (individual or group work) and physical states (standing or sitting)

Positive Vibes

Resistance

Breaks

Taking Notes

Positive Feedback

Participants are engaging in fruitful discussions

People building upon each others ideas

Obstructive Factors (WO19)

Having to guess what the blockers are: collaboration is sometimes affected by factors such as people not liking each other, politics, lack of funding, unclarity about end goals, etc. Knowing this beforehand helps you structure the session

Concerns about losing personal goals/impact: some participants have their personal agenda/stake which they want to actively protect. How to weaken: understand their stake, collect information about them to know how to structure the conversation to make them feel safe and not threatened

People talking over each other: challenges of zoom: not knowing when someone wants to speak, often many side discussion within the chat. some people also need more time to process and contribute

People trying to convince others of their POV

Distractions

Remote camera off

People not listening to each other

No safety because of hierarchy

participants are not engaged

Low Energy

One person speaking the whole time

Crowd not focussing

10. Appendix

Detailed Outcome for Empirical Research I Workshop

AFTER

Supportive Factors (WO20)

Follow-ups

Owners for Action Items

Summary of the meeting: Assessing whether or not the group accomplish its goals according to agenda and clarify follow ups are required. Almost like a checklist not just something that you send to others. Strengthen: Intermediate Summary to strengthen the confidence of the group

Positive feedback from participants

Obstructive Factors (WO21)

not having a clear outcome or alignment

People forgetting about the outcomes and the next steps

unclear meeting outcomes, no conclusion

not clear what to do from here

unforeseen outcomes

IMPROPER FACILITATION - SCENARIO II

TerraTune Navigator

CHALLENGE

In an hour, you have to facilitate a session for a project unfamiliar to you. How might AI support the facilitator to manage the situation?

INSIGHTS SUPPORTING CHALLENGE CONTEXT

- **CS6 -** No structure in the meeting
- **CS8 -** getting and keeping the whole group on the same page
- **CS27 -** Poor facilitation
- **CS48 -** misalignment on outcome and expectations of the meeting understanding, either takes time to align at the beginning or impacts in discussion topics unrelated or that could been potentially moved to a parking lot
- **CO29 -** session facilitator did not seek alignment in advance of overall process
- **PFV1 -** Alignment
- **FV4 -** Shared Understanding
- **FV3 -** Spidey Sense

DESCRIPTION

The TerraTune Navigator represents a room designed and orchestrated by the AI, helping to cope with the unexpected facilitation of a session.

Given the urgency of the situation, the system will not only quickly review previous meetings relevant to the upcoming one, but also immediately send out ***Swarm Holograms*** to do short Q&As with relevant stakeholders, gathering knowledge and individual objectives crucial for the meeting ahead. All of this will be then used to generate an interactive briefing for the facilitator, in which the relevant knowledge is presented. Further, the ***Dynamic Activity Builder*** feature will seek to agree with the human facilitator on a preliminary activity agenda, clarifying processes and responsibilities. This ability offers multiple approaches with activities tailored to the session's goals.

As soon as the meeting begins, the AI visually constructs the context of the meeting in real-time. As participants think and interact, the AI picks up cues directly from their brains via a ***Brain Connection Interface***, further refining the context and ensuring it remains relevant to the participants' objectives and concerns.

To enhance understanding, a ***Digital Twin*** of primary stakeholders is created, even if they were not initially invited or cannot be present. This twin holds the foundational knowledge and context of the project and serves as an on-demand guide throughout the session. This way, facilitators not familiar with the project can quickly get up to speed by interacting with the digital twin, drawing upon its reservoir of knowledge.

During the session, the AI constantly checks the alignment of the session's activities against the intended outcomes. If it senses a deviation, the AI suggests course corrections, ensuring the end goal remains in sight.
To further support the facilitator, the room dynamically modifies itself through ***Spatial Adaptation***– adjusting ambiance, spatial layout and provided required materials as activities change or evolve. This not only enhances participant engagement but also ensures optimal conditions for every stage of the meeting.

Finally, to improve the human facilitators capabilities in the long-term the AI acts as a ***Shadow Tutor***, learning the facilitator's style over multiple sessions. If the facilitator is ever unsure of how to proceed in unfamiliar territory, the AI can suggest approaches or activities that align with the facilitator's natural style.

Extracted Features

SUB-CHALLENGE	FEATURE
Gathering Meeting Context	Swarm Holograms

FEATURE DESCRIPTION
The AI reviews previous meetings and uses sends out a swarm of holograms for short Q&As with stakeholders. The information is then organized into an interactive briefing for the facilitator.

NEAR FUTURE VALUE
Interactive chatbots or AI-driven interview tools could be used to collect insights from stakeholders and feed them into a system for real-time analysis and data visualisation. This would allow facilitators to quickly understand the key objectives and concerns of stakeholders.

ETHICAL IMPLICATIONS
The AI must ensure that the information gathered from stakeholders accurately represents their viewpoints and is not taken out of context. Misrepresentation could lead to flawed meeting agendas and misinformed decision-making.

SUB-CHALLENGE	FEATURE
Defining Activity Agenda	Dynamic Activity Builder

FEATURE DESCRIPTION
A capability that actively collaborates with the human facilitator to draft a preliminary activity agenda, allocate responsibilities, keep alignment with the intended outcomes and suggest course corrections when necessary.

NEAR FUTURE VALUE
Advanced recommendation systems could be integrated into digital facilitation tools, providing suggestions based on proven methodology, historical data and success metrics of ThoughtWorks Amsterdam.

ETHICAL IMPLICATIONS
Ethical concerns may arise if the AI system begins to overly dictate the structure and flow of the meeting, sidelining human judgment and implicitly favouring specific topics or individuals. To balance this, the system should be designed to be as neutral and unbiased as possible.

SUB-CHALLENGE	FEATURE
Ensuring Alignment of Objectives	Brain Connect

FEATURE DESCRIPTION
The AI picks up cues directly from participants' brains to adapt and update the meeting context in real-time. This way the facilitator can be supported in keeping the meeting relevant to stakeholders objectives.

NEAR FUTURE VALUE
While direct brain interfaces might be far-off, technologies like sentiment analysis, voice tone recognition, or even basic feedback mechanisms can help in gauging and adapting to participants' feelings and concerns in real-time.

ETHICAL IMPLICATIONS
Harvesting brain data poses risks of unauthorized access and misuse. Clear guidelines around consent, storage, and data security are essential. Moreover, ethical quandaries around personal autonomy and the potential for unintended psychological impact should be considered.

Extracted Features

SUB-CHALLENGE
Preparing Meeting Environment

FEATURE
Spatial Adaptation

FEATURE DESCRIPTION
The room can dynamically modify its environment – from lighting to spatial layout – based on the nature and progress of the session, relieving the facilitator from the burden to prepare the meeting adequately.

NEAR FUTURE VALUE
Implementing AI into current collaboration tools such as Mural or Miro would allow to dynamically adjusting the virtual workspace based on the needs and interactions of the meeting participants, making real-time changes according to the conversation's flow.

ETHICAL IMPLICATIONS
It might be misinterpreting the meeting progress creating environments that are uncomfortable or distracting for some participants. Finding a balance between aiding the session in sync with the facilitator while ensuring effectivity and focus will be crucial.

SUB-CHALLENGE
Enhancing Facilitation Skills

FEATURE
Shadow Tutor

FEATURE DESCRIPTION
An AI capability that learns the facilitator's style over multiple sessions, offering guidance and training to improve navigating unfamiliar territories by simulating facilitation sessions.

NEAR FUTURE VALUE
Use machine learning algorithms to analyze the facilitator's past meetings for effectiveness and engagement to point out strengths & weaknesses. This might help in developing an individual facilitation style outlining preferred topics or activities.

ETHICAL IMPLICATIONS
As this feature learns the facilitator's style, there could be issues around data ownership and potential misuse of this sensitive information. Further, if the AI shapes the facilitator's approach too rigidly, it could stifle creativity or lead to overreliance on AI's suggestions.

SUB-CHALLENGE
Integrating Stakeholder Knowledge

FEATURE
Stakeholder Twin

FEATURE DESCRIPTION
The AI can generate an interactive digital replica of primary stakeholders, holding and presenting foundational knowledge about the project, providing the facilitators access to their knowledge bases, even when they were not invited initially.

NEAR FUTURE VALUE
Create detailed virtual profiles for stakeholders, integrating key project information, previous decisions, collaboration type and relevant expertise that can be accessed during the meeting.

ETHICAL IMPLICATIONS
Ethical concerns include data ownership and consent, especially if the stakeholder is not present or aware that their digital twin is being used. The digital twin must be a faithful representation, or it could misguide the meeting

LACK OF CLARITY- SCENARIO II

ClarityConnect

CHALLENGE

A project manager struggles to articulate the project requirements clearly, leading to misunderstandings and unsatisfied information needs of the disciplines attending. How might AI help the PM to express and communicate themselves better?

INSIGHTS SUPPORTING CHALLENGE CONTEXT

- **CS2 -** Because it's an abstract thing that we can to describe in a concrete way it's difficult to align between people what is the best way to start that discovery
- **CS12 -** time constraints to capture the ideas, process them and convey in a common set of prioritized list
- **CS28 -** Given the different areas of expertise, it was impossible for me to judge the quality or completeness of certain parts of the proposal. It was also difficult to define a timeline for something you don't understand.
- **CS8 -** getting and keeping the whole group on the same page
- **FV4 -** Shared Understanding
- **CV6 -** Enablement
- **CV7 -** Indvidual Growth
- **CV9 -** Empowerment

DESCRIPTION

In the envisioned future scenario, ClarityConnect significantly enhances the project manager's capacity to express and communicate their thoughts and project requirements clearly.

Clarity Connect implements a ***Brain Connection Interface***, which enables the direct exchange of thoughts and ideas between the project manager and team members, removing conventional barriers of verbal or written communication, thus eliminating the potential for misunderstandings.

To ensure that transferred information is not random or chaotic, the AI system steps in as an ***Intelligent Mind Mapper***. It organizes the dispersed and unstructured information obtained from each participant's brain, creating comprehensive mind maps relevant to each disciplines knowledge affordances. These mind maps serve as clear visual representations of the project requirements, aiding everyone in understanding the complete picture.

Further, the AI system acts as a proactive ***Information Gap Detector*** that can pinpoint missing pieces of information within these mind maps. It subsequently either searches for this information autonomously or assigns the task to find this missing information to specific team members. This way, the AI ensures that no crucial information falls through the cracks.

In this scenario, ClarityConnect is also envisioned as a an ***artificial coach***, aiding the project manager in refining their thought articulation and ordering processes through personalized coaching. It does so by creating simulated scenarios tailored for the PM to practice handling different situations. Over time, this helps the project manager to enhance their communication skills in a risk-free manner, making their articulation clearer and more precise.

Extracted Features

SUB-CHALLENGE
Overcoming Articulation Barriers

FEATURE
Brain Flow

FEATURE DESCRIPTION
A direct exchange system for thoughts and ideas that bypasses traditional methods of communication, removing misunderstandings and promoting clearer expression.

NEAR FUTURE VALUE
Considering the rise of brain-computer interface startups like Neuralink, businesses may explore collaboration tools that can tap directly into our thoughts, making communication seamless. For instance, plugins for platforms like Slack or Teams which offer "thought-to-text" capabilities could be developed.

ETHICAL IMPLICATIONS
Harvesting brain data poses risks of unauthorised access and misuse. Clear guidelines around consent, storage, and data security are essential. Moreover, ethical quandaries around personal autonomy and the potential for unintended psychological impact should be considered.

SUB-CHALLENGE
Structuring Dispersed Information

FEATURE
Intelligent Mind Mapper

FEATURE DESCRIPTION
An AI system that organizes and structures information from participants' brains into comprehensive and discipline-specific mind maps.

NEAR FUTURE VALUE
Current mind mapping tools like MindMeister could use AI to automatically group and categorize brainstormed ideas based on keywords, ensuring a structured output from brainstorming sessions.

ETHICAL IMPLICATIONS
There is a need to ensure AI does not mis-categorize or sideline certain ideas, which could undermine the collaborative process.

SUB-CHALLENGE
Revealing Missing Information

FEATURE
Information Gap Detector

FEATURE DESCRIPTION
The AI identifies missing information within the mind maps and either autonomously gathers this info or assigns someone to fetch it.

NEAR FUTURE VALUE
Seamless integration with tools like Knowledge Management Systems (e.g. Confluence) to auto-suggest relevant articles or documents during team discussions. Additionally, clips of previous meetings could be shown as a pop-up, enriching the context in real-time.

ETHICAL IMPLICATIONS
Over-dependence on the system could lead to neglecting thorough manual checks, and potential false positives/negatives from the system need to be considered.

Extracted Features

SUB-CHALLENGE
Improving Communication Skills

FEATURE
PM Coach

FEATURE DESCRIPTION
The system provides coaching to the project manager, helping them refine their articulation and thought ordering processes over time by simulating scenarios.

NEAR FUTURE VALUE
Current voice analysis and language processing tools could be integrated into virtual meetings to evaluate the expression of the PM, giving recommendations on how to improve based on their personal goals. Critical meeting situations of previous meetings can be reviewed, acting as training and reflection material.

ETHICAL IMPLICATIONS
Feedback should be constructive and optional. Over-reliance could stifle individual communication styles, making it crucial to ensure that the AI does not reinforce communication stereotypes.

LACK OF ALIGNMENT - SCENARIO II

CollaboGuard

CHALLENGE

At some point of the ongoing project you notice that the clients' way of collaborating and communicating is toxic and not aligned with TW ambitions to build safe spaces. How might AI help to improve communication and maintain a safe space?

INSIGHTS SUPPORTING CHALLENGE CONTEXT

- **CS19 - Align on communication style**
- **CS37 - Agreeing on ways of working between client and our team**
- **CS48 - misalignment on outcome and expectations of the meeting understanding, either takes time to align at the beginning or impacts in discussion topics unrelated or that could been potentially moved to a parking lot**

Aspects that relate to the future scenario:

- **CV2 - Emotional Security**
- **CV3 - Mental Health**
- **CV5 - Inclusive Participation**

DESCRIPTION

The CollaboGuard is dedicated to facilitate conversations in a meeting environment where everyone feels safe.

Before any meeting begins, the ***Safe Collaboration Module*** sends every participants a virtual introduction package to their personal devices. This package includes the meeting's ground rules, a brief primer on TW's ethos for safe collaboration, and a consent request to participate under the beacon's facilitation guidelines.

During the meeting, the a ***Toxicity Detector*** actively and subtly tracks the communication patterns of all participants. In the event of harmful communication, the AI intervenes to provide real-time feedback, highlighting the specific elements of the conversation that may be deemed toxic, and offers alternative phrasing that aligns with the goals of safe collaboration.

Should a participant persistently display behavior that negatively impacts the participants wellbeing, the system gently invites for introspection. With the aid of visuals, calming scents, and gentle auditory cues, the individual is seamlessly transitioned into an ***immersive alternative reality*** through a Brain Connection Interface. This environment is designed to be a safe space for reflection, where participants confront the consequences of toxic collaboration and identify their own biases.
Further, switching into other perspectives increases their empathy, making them receptive to alternative behaviours that are suggested.

Moreover, the ***Ethos Educator*** feature also takes on an educational role by connecting with the personal AI assistant of participants who have caught attention for collaborating in a harmful manner and confidentially suggesting resources, activities, or courses (e.g. against sexism) emphasizing particular values of collaboration.

Extracted Features

SUB-CHALLENGE	FEATURE
Aligning on Safe Collaboration	Safe Collaboration Module

FEATURE DESCRIPTION
Prior to any meeting, a virtual introduction package is sent to all participants. This package contains the meeting's rules, TW's ethos for safe collaboration, and a consent request to partake under these facilitation guidelines.

NEAR FUTURE VALUE
Pre-meeting information packages can help set the tone and expectations for upcoming collaborations, ensuring everyone starts on the same page. After each meeting, the AI assesses the overall collaborative atmosphere and adjusts the introductory package's content for future sessions.

ETHICAL IMPLICATIONS
Ensuring that AI does not invade privacy while creating personalised packages, and ensuring that the ethos and rules aren not forced but are truly consensual.

SUB-CHALLENGE	FEATURE
Mitigating Toxic Communication	Toxicity Detector

FEATURE DESCRIPTION
The AI tracks communication patterns during meetings. In the event of harmful communication, it provides immediate feedback, calls out toxic elements, and suggests safer phrasing.

NEAR FUTURE VALUE
If a participant uses a phrase or term that might be considered harmful or not in line with the collaboration's ethos, the tool can discreetly send a pop-up to the participant suggesting an alternate, more appropriate phrase.

ETHICAL IMPLICATIONS
Monitoring conversation patterns can raise privacy issues. It is essential to strike a balance between maintaining safety and ensuring privacy, avoiding a surveillance-like atmosphere.

SUB-CHALLENGE	FEATURE
Resolving Persistent Toxic Behaviour	Immersive Reflection Space

FEATURE DESCRIPTION
Participants displaying persistent harmful behavior are transitioned into an alternate reality via a Brain Connection Interface. This space allows for safe introspection and bias confrontation, fostering increased empathy.

NEAR FUTURE VALUE
Utilizing sentiment analysis tools, the AI system could detect overly negative or aggressive tones in speech and alert the facilitator. Pinpointing specific toxic communication helps the facilitators to intervene if needed and use a break-out room to discuss the matter.

ETHICAL IMPLICATIONS
The use of brain interfaces and immersive environments can be invasive. Participants should fully understand and consent to these measures, and there should be an assurance that the data processed remains confidential.

Extracted Features

SUB-CHALLENGE Aligning on Safe Collaboration	FEATURE Ethos Educator
FEATURE DESCRIPTION An educational tool that connects with a participant's personal AI assistant. It suggests resources, activities, or courses to participants identified as collaborating in a potentially harmful manner.	**NEAR FUTURE VALUE** A facilitation assistant can send a curated list of TW's articles, videos, and courses on effective and ethical collaboration to participants who have stood out negatively in the eye of the facilitator.

ETHICAL IMPLICATIONS

When implementing such a tool, it is crucial to consider implications surrounding user consent, data privacy, and the potential stigmatisation of individuals identified as collaborating in a potentially harmful manner, ensuring that the intervention is respectful, non-discriminatory, and genuinely supportive of individual growth and learning.

10. Appendix

Transcriptions

Transcripts of both Workshops (Empirical Research I & Empirical Research II) as well as User Interviews (Analysis Framework) can be found here:
www.shorturl.at/avGW8

Analysis of Roles & Abilities

Feature / Role	Coach	Communicator	Visualizer	Monitor	Synthesizer	Guide
Alternative Realities	1	2	3			
Awareness Engine		2		4		
Digital Twins		2	3		5	
Telekinesis Mode		2				
Dynamic Activity Builder		2		4	5	6
Shadow Tutor	1	2				
Stakeholder Twin		2	3			
Brain Connect		2			5	
Swarm Holograms		2	3		5	
Spatial Adaptation			3	4		6
Hypothesis Hopper			3		5	6
ClearPath Engine		2		4	5	6
Brain Power					5	
Intelligent Mind Mapper			3	4	5	6
PM Coach	1	2	3			
Information Gap Detector		2	3	4	5	6
Brain Flow		2		4	5	
Tension Diffuser		2		4		
Alignment Sphere		2	3		5	6
Stakeholder Profile Builder		2			5	
Immersive Reflection Space	1	2	3			6
Toxicity Detector	1	2		4		
Ethos Educator	1	2		4		
Safe Collaboration Module	1	2				6

Challenges from both Survey and Observations

Survey:

CS1 - Us as facilitators had never run this particular exercise before
CS2 - Because it's an abstract thing that we can to describe in a concrete way it's difficult to align between people what is the best way to start that discovery
CS3 - get all participants to understand the objective
CS4 - Getting team to provide a holistic view of threats that may occur, rather than just one type - ie security
CS5 - Since there was lot of things to explore we divided and then kind of missed keeping each other up-to-date with the findings.
CS6 - No structure in the meeting
CS7 - It was unclear who is responsible for what and someone needed to step up an make that decision - it was unclear who that someone is.
CS8 - getting and keeping the whole group on the same page
CS9 - Not all the Tech Trends were clear from their title, many times we needed to switch tabs and manually search for their definition. This slowed us down.
CS10 - Communication. The client team and our team did not seem aligned
CS11 - Scoping
CS12 - time constraints to capture the ideas, process them and convey in a common set of prioritized list
CS13 - external blockers
CS14 - create clarity on the purpose of the activity
CS15 - Pricing
CS16 - Collaboration
CS17 - Getting a shared understanding of where to head next
CS18 - Async brainstorming
CS19 - Align on communication style
CS20 - Provide space for everyone to share their ideas but facilitate that agreements are set
CS21 - the different level of experiences
CS22 - The session took way longer than anticipated
CS23 - It was a meeting on zoom but we all have our cameras on, sometimes is challenging to understand someone's facial expression or with his/her body, same as in person, and that expression could be interpreted wrongly by someone else
CS24 - support the conversations with a Mural to bring structure to the endeavor
CS25 - Team input was sometimes lacking and required facilitation
CS26 - I think other person lacked ownership since I was primary owner of ticket.
CS27 - Poor facilitation
CS28 - Given the different areas of expertise, it was impossible for me to judge the quality or completeness of certain parts of the proposal. It was also difficult to define a timeline for something you don't understand.
CS29 - grouping and prioritizing topics and ideas
CS30 - For Tech Trends where we could not agree immediately, the discussion sometimes went too far, because people felt passionate about defending one particular Tech Trend. So we took extra time to find agreements for some of the trends.
CS31 - time crunch
CS32 - Differences of opinion that require more discussion and negotiation to choose a win-win or win-loose option
CS33 - unsure about what was the next step
CS34 - create alignment on the process of getting to the outcome
CS35 - Decision making that we couldn't influence
CS36 - Direction of session - How are we going to achieve the goal?
CS37 - Agreeing on ways of working between client and our team
CS38 - Passive participation
CS39 - Capture the agreements and communicate them, give follow visibility of them
CS40 - some people were more quiet and we had to be intentional to get their opinion
CS41 - At the end of the workshop, we weren't completely clear on next steps yet
CS42 - group similar thoughts - as shared on a post-it - and merge the responses into one summary

CS43 - Long meeting - no outcomes
CS44 - When many people work on a storyline it‘s always weak - some agreement beforehand, on what we want to convey at least, would be useful.
CS45 - Converting written stickies to digital assets
CS46 - From the 4 people involved in the activity, 1 of them was less engaged than the others. We tried to ask some specific questions to the person, to try and make them participate more. It could be related to the fact that person was „less technical“ than the others and did not comprehend all the Tech Trends.
CS47 - Lack of clarity of who does what
CS48 - misalignment on outcome and expectations of the meeting understanding, either takes time to align at the beginning or impacts in discussion topics unrelated or that could been potentially moved to a parking lot
CS49 - missing somebody driving the conversation
CS50 - to summarise a person‘s verbal input to the discussion in a few written sentences to keep for later reference
CS51 - and timeline.
CS52 - getting everyone to agree on one option

Observations:

CO1 - outcomes of last session were not entirely agreed on
CO2 - not everybody was fully aware of the outcomes of the last session
CO3 - team member not sure how process of this session relates to overall process
CO4 - team members not sure how the overall design process should look like (time-wise and steps)
CO5 - recently joined team member not fully aware of existing design processes
CO6 - suggested design method caused confusion (conflicting best practices)
CO7 - team not sure what recently joined team member knows about processes/methods
CO8 - Co-Creation method is inappropriate for session objective
CO9 - team member does not know how much time to spend on a specific task
CO10 - team members not sure about overall purpose of beach project
CO11 - session had no pre-defined objective
CO12 - session facilitator did not check if the right people are attending the session
CO13 - team couldn‘t make progress due to uncompleted tasks
CO14 - session leader was not informed in advance about uncompleted tasks
CO15 - not everyone was aware of the sessions‘ requirements
CO16 - team member not certain about objective of current session
CO17 - team member not certain how outcome of current session will look like
CO18 - team members confused about sub-task description of co-creation method
CO19 - team members struggle to understand outcomes of last session
CO20 - co-creation method lead to ambiguous outcomes
CO21 - co-creation method is inappropriate for task objective
CO22 - co-creation method resulted in slightly different contributions than expected
CO23 - team members struggled to understand how to work with co-creation method
CO24 - team member struggles to understand a particular sticky note
CO25 - team members question overall purpose of project
CO26 - team member struggled to understand how task outcome contributes to session objective
CO28 - team members not fully aware of facilitators co-creation intentions
CO29 - session facilitator did not seek alignment in advance of overall process
CO30 - team member not fully aware of other team members experience
CO31 - team members lack ownership of task
CO32 - session leader not fully aware content of activity board
CO33 - session leader cannot recall problem statement that justified the session
CO34 - session leader confused by own project description
CO35 - team member not certain about own role in session

Revealed Values

Facilitation Values (FV):
Main Value:
Process Guidance

Sub Values:
FV1 - Alignment
FV2 - Time Keeping
FV3 - Spidey Sense
FV4 - Shared Understanding

Main Value:
Mediation

Sub-Values:
FV5 - Enable Conversation
FV6 - Conflict Management

Collaboration Values (CV):
Main Value:
Safe Spaces

Main Value:
CV1 - Visibility
CV2 - Emotional Security
CV3 - Mental Health
CV4 - Mutual Trust
CV5 - Inclusive Participation
CV6 - Enablement

Main Value:
Support

Main Value:
CV7 - Indvidual Growth
CV8 - Recognition
CV9 - Empowerment