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Dissertation title: Determinants of Successful Worker-Autonomy Teaming in Future Construction Workplaces

Dissertation abstract:

Construction work involves collaborative tasks, requiring workers to operate in teams to meet specific performance criteria and successfully complete projects. The concept of a high-performing team is crucial for this success. Jones ((Jones 2002), p.8) defines a high-performing team comprising members "*whose talents and abilities are complementary, and whose effectiveness is underpinned by continuous team building that facilitates high-quality teamwork*". Effective team functioning hinges on several key components: a shared purpose, mutual trust, clear roles and responsibilities, and robust communication levels (Ahiaga-Dagbui et al. 2020; Engebø et al. 2022; Solis et al. 2013).

In today's increasingly competitive design and construction markets, strong teamwork is essential for an organization to thrive (Kuprenas and Nasr 2000). Rapid technological advancements are transforming the construction industry, with cutting-edge technologies like automated agents, drones, and artificial intelligence (AI) aimed to revolutionize the sector. These technologies are expected to become integral components of future construction sites. As construction integrates more autonomous technologies, human workers will continue to play a vital role, working alongside these technological advances, which necessitates the development of effective worker-autonomy teams. The integration of autonomy on job sites could significantly enhance efficiency and promote automation in the construction industry. However, establishing successful worker-autonomy teaming is crucial, as future construction scenarios will require workers to interact with robots, communicate with AI systems, and coordinate with autonomous agents.

Research across various fields highlighted three critical components of successful human-autonomy teaming: (i) trust-building (Akash et al. 2020; Rheu et al. 2020), (ii) effective communication (Bonarini 2020; Maurtua et al. 2017a), and (iii) safety management (Maurtua et al. 2017b; You et al. 2018). Studies such as those by Akash et al. (2020) and Rheu et al. (2020) emphasize the importance of trust in fostering human acceptance and the effective deployment of auto-agents. Similarly, effective communication, as highlighted by Bonarini (2020) and Maurtua et al. (2017a), is essential for seamless interactions between humans and auto-agents. Furthermore, safety management remains crucial, as noted by Maurtua et al. (2017b) and You et al. (2018), particularly because auto-agents cannot be guaranteed to perform flawlessly. Situational awareness (SA) is necessary to compensate for the potential imperfections in auto-agent performance and ensure safety (Desai et al. 2013; Honig and Oron-Gilad 2018). Thus, in the dynamic, demanding, and hazardous environment of construction sites, workers must foster trust in, facilitate effortless communication with, and maintain SA of their autonomous partners. These efforts are crucial to achieve superior human-autonomy performance and ultimately enhance the productivity and safety of construction operations.

However, no conclusive research has been carried out to empirically examine the above-mentioned components, the influence of factors related to workers, auto-agents, and construction sites, and the multifaceted nature of these entities involved in the relationship, further complicating the establishment of successful worker-autonomy teaming in future construction. Therefore, the overarching goal of this doctoral dissertation is to develop the theoretical foundation and practical implications of successful worker-autonomy teaming in future construction workplaces, as shown in Figure 1.

To accomplish the overall goal, the following specific objectives will be addressed:

1) Determine the factors affecting worker-autonomy trust-building in future construction.

2) Investigate the effects of worker-autonomy communication and interaction levels on worker well-being and task performance in safety-critical construction environments.
3) Assess the extent to which time pressure, multitasking, and the inherent safety-critical nature of construction tasks impact workers' situational awareness (SA) when interacting with dynamic auto-agents .
4) Explore the inclusivity of the future construction industry by focusing on workers with Attention-Deficit/Hyperactivity Disorder (ADHD).
5) Develop a worker-centered AI system to enhance successful worker-autonomy teaming in future construction.

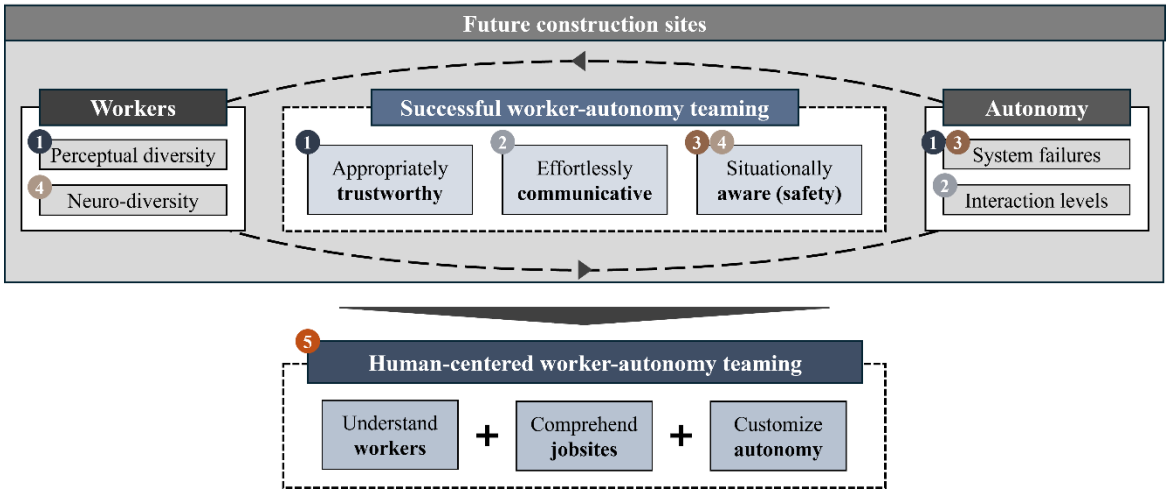

Figure 1. Graphical overview of this doctoral research proposal.

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