

People and Robots in Warehouses – Factors Determining Cooperation (Case Study)

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Abstract

Industrial robotization is reshaping logistics systems, moving human-robot interaction (HRI) to the core of workplace operations. This paper examines how employees and managers in warehouse environments experience human-robot cooperation, focusing on perceived roles, trust, responsibility, and system reliability. Utilizing an exploratory qualitative multiple-case study design, empirical data were gathered from two distinct warehouse settings: one in Poland operating with the Geek+ system and another in the UK utilizing the AutoStore system. In-depth interviews were conducted with frontline warehouse workers and managers coordinating daily operations. The findings reveal a significant perception gap between organizational roles. While managers consistently view robotic systems as mere optimization tools for efficiency and attribute operational errors solely to human workers, employees often describe robots in quasi-relational terms – as “co-workers” – driven by strong task interdependence. Furthermore, system failures directly erode worker trust and cause operational frustration, whereas both groups tend to anthropomorphize non-humanoid robots through naming and diminutive references. The study demonstrates that companies rarely evaluate employee attitudes or include HRI considerations in implementation strategies, leading to misaligned expectations regarding error responsibility and safety. Effective human-robot cooperation in logistics depends not only on technical deployment, but on active management of trust, transparency, safety, and proper worker preparation. Consequently, organizations must extend robotization strategies beyond technical metrics to encompass the socio-technical dynamics of daily human-robot collaboration.

Keywords

human robot interaction, robots as teammates, robots in warehouses.

Introduction

Industrial robotisation is no longer a marginal phenomenon but a structural component of contemporary production and logistics systems. As increasingly autonomous systems are introduced into warehouses, factories, and distribution centres, robotisation should be understood not only as a technical investment, but also as a profound organisational change affecting the design of work, team relations, and managerial practice. Warehousing provides a particularly relevant context for examining these changes. In warehouse operations, robotic systems are no longer limited to isolated automation cells but increasingly operate in

close temporal and procedural interdependence with human workers. As a result, the quality of cooperation between humans and robots becomes a practical issue affecting efficiency, safety, trust, and the everyday experience of work. Earlier studies have shown that the implementation of collaborative systems in logistics depends not only on technical performance but also on communication, leadership, organisational culture, and workers' acceptance of change. This shift has increased the importance of research in human–robot interaction (HRI) and human–robot collaboration (HRC). Existing literature emphasises that successful cooperation is contingent on more than robot capability alone; it also involves trust, perceived safety, transparency, and the worker's understanding of how the system operates. Trust, in particular, has consistently been identified as one of the key prerequisites for effective human–robot cooperation. Insufficient trust may lead workers to avoid relying on the system, whereas excessive trust may result in overreliance despite the system's errors or limitations. At the same time, an important research gap remains. Much of the literature examines

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HRI either from a technical perspective or through general discussions of adoption and acceptance, whereas fewer studies focus on how robotisation is interpreted by different organisational actors in real workplaces. This is particularly important in warehouse environments, where managers and frontline employees may experience the same robotic system in fundamentally different ways. The present paper addresses this gap through an exploratory qualitative study of two warehouse cases: one in Poland using the Geek+ system and one in the United Kingdom using AutoStore. The aim of the study is not to propose a new general theory of human–robot interaction, but to provide an empirically grounded account of how known HRI factors are experienced and interpreted in warehouse practice. The main contribution of this paper is to demonstrate a perception gap between managers and employees regarding the role of robots, responsibility for errors, and the organisational preparation of human–robot cooperation. In particular, while managers consistently frame robots as tools for optimisation and efficiency, some employees describe them in more relational terms, as something close to a co-worker because of their strong task interdependence. This distinction is important because it suggests that the organisational meaning of robotisation cannot be reduced to technical parameters alone. It also indicates that the implementation of robotic systems should include not only operational and engineering considerations, but also explicit attention to employee perceptions, trust, and responsibility structures. The remainder of the paper is structured as follows. First, the paper briefly reviews the literature on human–robot cooperation, trust, and teamwork. Next, it formulates the research questions and explains the qualitative multiple-case study methodology. It then presents the results of the two warehouse case studies and discusses them in relation to current literature. Finally, the paper outlines the theoretical and managerial implications, limitations, and directions for future research.

Literature review

Teamwork occurs when a set of activities and tasks is assigned to a specific group of people. Team members are directly interdependent and therefore each member of the group contributes to the achievement of the goal (Jagoda, 2011). Modern technologies, such as autonomous robots and artificial intelligence systems, have prompted researchers to reconsider the role of these technological tools in employee teams. This raises the question of whether such technologies remain

merely tools used by humans or whether autonomous robots are increasingly assuming a different role, for example, as team members. A team is a specific group of employees generating positive synergy and performing collective work that requires joint efforts, and the level of team work efficiency exceeds the sum of the work input of its members (Myjak, 2017). To clarify the function of technological tools in working groups, some researchers introduce a distinction between technology and an artificial agent or robot. Under this classification, the term technology is reserved for devices or software that support team performance and improve team processes, serving essentially as an augmenting tool. A robot, therefore, functions as technology when it merely increases human efficiency without making a unique contribution. Conversely, it operates as an agent – a full team member – when it plays a distinct role and delivers unique contributions to the team’s work (Larson & DeChurch, 2020). Importantly, this distinction highlights a historical shift in how technology is perceived and operationalized in the workplace, rather than a static change in definitions. Analyzing four distinct historical phases of leadership and technology, Larson and DeChurch (2020) trace this evolution: while the first three perspectives (1990–2000, 2000–2010, and 2010–2020) viewed technology primarily as a supportive tool or a factor impacting teamwork from the outside, the most recent perspective (since 2020) reflects a fundamental transition. Today, technology is no longer viewed merely as a means of limiting or extending human capabilities, but as an entity capable of acting as an equal co-worker within the team. Trust has long been regarded as a key prerequisite for effective human–robot teamwork. Researchers have noticed certain analogies between human-human and human-robot team interactions and have identified trust as a prerequisite for successful human-robot interaction (Simon, Neuhofer & Egger, 2020). Simone et al. (2020) emphasise that human-robot collaboration assumes that they work and cooperate on a task in which both the human and the robot can execute certain steps of the planned activity. Since humans and robots operate in a common environment, it is necessary to identify ways to facilitate the integration of robots into human teams to enable effective and successful human-robot interaction. Studies have shown that before valuable interactions between humans and robots can take place, humans must first build trust in robots.

Trust in HRI is the belief that the robot will follow the instructions of human team members (You, Robert, 2018). For a human-robot team to achieve its goal, the human team members must be able to trust that the robot team member protect one another’s interests and well-being.

This means that for a human-robot interaction to be successful, trust must be calibrated appropriately. It can range from over-trust and abuse to complete lack of trust and misuse. The level of trust in any robot partner will be particularly critical in high-risk situations, such as combat missions (Hancock et al., 2011).

Hancock et al. (2011) emphasise that an inappropriate level of trust can have negative consequences, such as over-reliance on the system and misuse (in the case of very high levels of trust) or complete lack of use of the system (in the case of very low levels of trust). Robots are different from most other automated systems in that they are mobile, sometimes designed to resemble humans or animals (Hancock et al., 2011).

If we assume that trust is key to human-robot interaction, it is important to know the factors that influence the emergence of trust, increase or decrease trust of people in robots.

Hancock et al. (2011) in their article “A Meta-Analysis of Factors Affecting Trust in Human-Robot Interaction” identified the factors of trust development in human-robot interaction. These factors were identified a priori through a literature review and the advice of subject matter experts. Trust in HRI can be dynamically influenced by three categories of factors: [1] factors related to the robotic system/robot itself, [2] factors related to the operational environment, and [3] the nature and characteristics of the relevant human team members (Hancock et al., 2011). They are presented in Figure 1.

The study by Hancock et al. (2011) also demonstrates that the studies reviewed were among the first systematic analyses to determine the effects of human trust in robots. They revealed that the characteristics of the robot, and in particular factors related to its performance, have the greatest influence on perceived trust in HRI. Therefore, manipulating various aspects of the robot’s performance has the greatest impact on trust. It was indicated that greater trust is associated with greater reliability. This finding is also supported by the results of the present study, described below.

An analysis of factors influencing the development of human trust in robots was also conducted by Sanders et al., in the text: “A Model of Human-Robot Trust: Theoretical Model Development”. Hancock is a co-author of the above paper by Sanders, in which three groups of factors important for building trust are described in detail.

The first table (Tab. 1) presents a description of factors, characteristic features of the robot, and their impact on creating trust in HRI (Sanders et al., 2011).

The second table (Tab. 2) describes human characteristics and their impact on trust in HRI (Sanders et al., 2011).

The last table (Tab. 3) describes the third group of factors, those related to the environment (Sanders et al., 2011).

Other authors also point to factors such as the appearance of the robot. When integrating a robot into a human environment, both its physical form and functions of the robot are crucial to facilitate appropriate

HUMAN-RELATED	ROBOT-RELATED	ENVIRONMENTAL
Ability-Based	Performance-Based	Team Collaboration
Attentional Capacity/Engagement	Behavior	In-group Membership
Expertise (Amount of Training)	Dependability	Culture
Competency	Reliability of Robot	Communication
Operator Workload	Predictability	Shared Mental Models
Prior Experiences	Level of Automation	Tasking
Situation Awareness	Failure Rates	Task Type
Characteristics	False Alarms	Task Complexity
Demographics	Transparency	Multi-tasking Requirement
Personality Traits	Attribute-Based	Physical Environment
Attitudes towards Robots	Proximity/Co-location	
Comfort with Robot	Robot Personality	
Self-confidence	Adaptability	
Propensity to Trust	Robot Type	
	Anthropomorphism	

Fig. 1. Trust Development Factors in Human-Robot Interaction

Table 1
Factors that affect trust: robot characteristics

Characteristics	Effect
Behavior/Robot Type/Anthropomorphism	• Trust is increased when the robot's behaviour, appearance, and type match what is expected. • A companion robot should be considerate, proactive, non-intrusive, flexible, and competent to strive for a relationship of trust and confidentiality with a human. • Robots should demonstrate social behaviour (e.g., use of polite phrases, express emotions) in order to be trustworthy. • Anthropomorphism is correlated with trust.
Reliability/Predictability/Reliability	• Lack of self-awareness of the robot in dangerous situations leads to distrust from human team members. • Increased reliability, predictability and reliability of robot actions increase trust.
Level of automation/adaptability	• Increased trust leads to increased reliance on automation. • To give machines autonomy, we need to be able to trust the underlying processes and mechanisms, as well as the ways in which errors are detected. • Trust increases when humans have the ability to adjust the level of automation.
Proximity	People trust robots more when they are co-located (closely located).
Robot "personality"	It is easier to like a robot that responds actively, the level of engagement correlates with trust.

Table 2
Factors that influence trust: human characteristics

Characteristics	Effect
Demographics	• Older adults show lower trust in robots than younger adults. • Trust in robots does not appear to be correlated with gender.
Mindfulness/Engagement	A significant increase in mindfulness and engagement does not necessarily lead to greater trust.
Expertise/Prior Experience	• Trust can increase with experience. • Novice users trust robots; expert users trust robots when the level of automation can be adjusted.
Operator workload	High workload leads to over-reliance on robot information to aid decision-making. Workload and stress are variable and unpredictable; interaction of humans with multiple robots causes additional workload.
.Situational Awareness	Situational awareness is about trusting the robot and the information obtained from the robot.
Personality traits/self-confidence	• Personality traits correlate with trust. • When trust exceeds self-confidence, individuals rely more on robots.
Comfort of working with robots	Comfort of working with a robot is correlated with trust in the robot.
Propensity to trust	It is related to the initial trust in the system.

social interactions with humans. They also emphasize the importance of the anthropomorphic interface between humans and robots. Anthropomorphism, understood either as a human-like appearance or human-like social functions, has an impact on building trust in HRI, which in turn increases people's willingness to

engage in interactions with robots (Duffy, B.R. 2003).

The predictability of robots' actions is an important factor in building trust and results directly from system transparency, defined as the extent to which the robot's decision-making processes are understandable to human users, fostering better understanding and

Table 3
Factors influencing trust: environmental characteristics

Characteristics	Effect
Culture/Group Membership	• Trust in robots varies across cultures. • Communication, trust, effort, and commitment are all enhanced by group membership. • Because robots do not have a unique point of view, they cannot be trusted in the same way as humans.
Communication	• Distrust of robot team members is caused by robot communication failures. • In some cultures, implicit communication increases trust, while in other cultures, explicit communication increases trust.
Mental Models	Trust is influenced by human assumptions about robot behaviour and initiative (mental models).
Task Types	The type of task affects the level of trust in the robot.

thus increasing trust. Such trust is maintained even if the robot is not completely reliable, as long as the human knows when to intervene (Backer et al., 2018).

In fact, the concept of transparency, as applied to human-system interaction, can also be operationalized in one of these two functionally distinct categories, based on the notions of seeing through and seeing in (Ososky et al., 2014). Ososky et al. explain that an example of the first interpretation of system transparency, in which the system is seen by the user or is invisible to him, is the modern web browser, making the browser interface transparent, almost transparent and invisible to the users, allowing them to feel as if he were interacting directly with the interface of web pages (and not with the browser). Similar levels of transparency and seeing through are encountered in the use of robots in surgery or in the remote manipulation and teleoperation of robotic systems. The second example of transparency (seeing in) of interest to HRI concerns the disclosure of information to the user and the complementation of expected outputs that reveal how the system works and/or what it does. In such cases, users can immediately understand what the system is doing and how. The key is to support the user's understanding of how the system works. To illustrate this type of transparency, Ososky et al. recommendation systems such as those found at Netflix and Amazon. Recommender systems examine a user's behaviour (e.g., viewing, purchasing, browsing) to provide intelligent suggestions for other items they might be interested in. Transparency is demonstrated by the user being provided with a rationale for the recommendation (e.g., "You may be interested in product X, based on your recent purchase of product Y" or

"People who bought Y also bought X"). The way transparency functions in human-robot systems is evolving in parallel with the transition of robotics from tools to collaborators. Looking to the future, robots will be expected to collaborate with humans in gathering information and making decisions, and to complement and extend the natural abilities of humans. As such, robotic systems will require features that help the user understand what the system is doing or what its functional status is. Similarly, the human user must be able to recognize and correctly interpret the robot's transparency features as part of their overall situational awareness of the environment. Understanding the robot's status and what it is doing helps calibrate and maintain trust in the robot's reliability and its ability to support the team in successfully completing a given task (Schuster, et al., 2013). Reliability is another important determinant of successful human-robot teamwork. Human perceptions of reliability should be appropriately calibrated to the robot's capabilities and the level of human trust in the robot. The user's perception of the robot's effectiveness and reliability is crucial to building trust, just as the user's perception of their own effectiveness or self-confidence plays a significant role. If the user is confident that they can perform a task on their own, they may choose to retain manual control and not develop trust in the robot. In contrast, people with lower self-confidence may find it easier to trust and rely on the robot. Users switch to manual control when their self-confidence replaces low trust in the robot. They use the robot when trust is high and replaces self-confidence (Lee & Moray, 1994).

Performance and its evaluation are also factors that have a major impact on trust and collaborative work

between humans and machines. We need to understand the boundaries that exist between human and robot capabilities, beliefs, intentions, and control. Only in this way can we begin to design an effective human-robot team that can work together effectively. Effective coordination between team members is a critical factor in enabling task allocation. In order to work together, humans and robots need to collaborate and coordinate their actions effectively (Drenjanac, Tomic, 2015). Arslan et.al notes that managers need to carefully communicate and manage the expectations of employees regarding the execution of tasks with their AI-equipped robot colleagues to maintain the spirit of cooperation (Arslan et al., 2021). One of the most difficult managerial challenges in the aforementioned article is the assessment of performance in teams where both humans and robots work side by side. According to the authors, there is a lack of existing frameworks or assessment models to analyze the performance of humans in the same context as robots.

Despite the growing body of literature on HRI and trust in automation, fewer studies examine how robotic systems are interpreted by different organisational actors in real warehouse settings. In particular, limited attention has been given to the possible divergence between managerial and employee perspectives regarding the role of robots, responsibility for errors, and the social meaning of cooperation with robotic systems. This gap provides the rationale for the present study.

Research Questions

Drawing on the broader research design and adapting it to the two warehouse cases analysed in this paper, the study addresses the following research questions:

RQ1. How are robotisation processes implemented in warehouse organisations, particularly with regard to employee preparation for working with robotic systems?

RQ2. How do managers and employees perceive the role of robots in everyday warehouse work: as tools, teammates, or something in between?

RQ3. Which factors are perceived as most important for effective human-robot cooperation in warehouse environments?

RQ4. How are trust, safety, decision-making, and responsibility for errors understood in everyday human-robot cooperation?

RQ5. What differences can be observed between managerial and employee perspectives on robotisation and cooperation with robots?

Materials & Methods

This study adopted an exploratory qualitative multiple-case study design. Such an approach was appropriate because the research focused on a contemporary organisational phenomenon examined in its real-life context, and because the boundaries between the technology itself and the organisational conditions of its use are difficult to separate analytically. The study was designed to generate an in-depth understanding of how human-robot cooperation is experienced in practice rather than to provide statistical generalisation.

Case selection

Two warehouse cases were selected purposively. The first case was a warehouse in Poland operating with the Geek+ robotic system supported by AMR technology. The second case was a warehouse in the United Kingdom operating with the AutoStore system. Both cases were selected because they involved everyday cooperation between human workers and autonomous robotic systems in warehouse processes. In both cases, human work was directly dependent on the proper functioning of the robotic system, which made them suitable environments for analysing cooperation, trust, and the perceived role of robots in everyday work.

The selection logic was consistent with the broader research assumptions of the doctoral project from which this paper is derived. The key criterion was the existence of actual operational cooperation between humans and robots, rather than fully separated industrial automation.

Participants

The empirical material consisted of 11 in-depth semi-structured interviews. In the Polish warehouse, interviews were conducted with two managers and four employees. In the UK warehouse, two managers and three employees were interviewed. Respondents were selected because they either coordinated the work of humans and robots or cooperated with robotic systems on a daily basis. This made it possible to compare the perceptions of two organisational groups directly involved in robotised warehouse work.

Data collection

The interviews were carried out in October 2022 in Poland and in November 2022 in the United Kingdom. Two versions of the interview guide were developed: one for managers and one for employees. Both versions

retained the same overall structure to ensure comparability across interviews, while allowing the questions to be adapted to the respondent's organisational role.

The interviews were semi-structured and based on previously prepared scenarios. This format was chosen because it made it possible to combine comparability of themes across cases with openness to respondents' own experiences and interpretations.

The research questionnaire was created based on the template presented in the article: 'In-depth interview as a research technique. Possibilities of using IDI in evaluation research' by Radomir Minsky.

Interview guide

The interview guide was organised around three analytical areas:

1. Reality – questions concerning the rationale for robotisation, the implementation process, the organisation of everyday work with robots, and the respondent's understanding of how the system works.
2. Results / threats / problems – questions concerning factors influencing cooperation, including trust, safety, responsibility for errors, decision-making, and perceived strengths and weaknesses of working with robots.
3. Expectations – questions concerning the future development of robotisation in the company and respondents' expectations regarding future human-robot relations.

Example questions included:

- Why did your organisation decide to implement robotisation?
- How were employees prepared for this change?
- Do you understand how the robot/system works?
- Do you treat the robot as a co-worker?
- Who is responsible for errors occurring during human-robot cooperation?
- How is the issue of trust in machines discussed in your organisation?
- How do you imagine the future development of robotisation in your company?

The interview scenarios were designed to remain open enough to allow respondents to describe their own experience in detail. At the same time, the common thematic structure enabled comparisons between the two warehouse cases and between employees and managers.

Data analysis

The interview material was analysed qualitatively using thematic comparison across cases and respondent groups. First, the interviews were organised according

to the main analytical areas embedded in the interview guide: implementation of robotisation, the perceived role of robots, trust and safety, responsibility and decision-making, and future expectations. Next, responses from managers and employees were compared within each case and across the two cases to identify recurring patterns and meaningful divergences. This analytical strategy made it possible to capture not only which factors mattered for cooperation, but also how the same phenomenon was interpreted differently depending on organisational position. Particular attention was paid to differences between managerial and employee accounts concerning the role of robots, responsibility for errors, and organisational preparation for robotisation.

Given the exploratory qualitative design and the purposive sample, the findings should be interpreted as analytically transferable rather than statistically generalisable. The goal of the study was not to measure the prevalence of specific attitudes, but to understand how warehouse robotisation is experienced and interpreted by actors directly involved in human-robot cooperation.

The research was carried out in two companies, a warehouse located in Poland (October 2022) and a warehouse located in Great Britain (November 2022). The logistics center in Poland is equipped with the Geek+ system, AI robotics technology, an automated e-commerce logistics platform. The system is supported by Geek+ AMR technology.

The main assumption of working with the system is to change the rules of order picking. In the first phase, employees fill the shelves with goods, and then place the goods on shelves located in a meshed space where AMR robots operate. In the second process, employees pick orders. They stand at stations to which AMR robots drive autonomously, carrying shelves with goods. The employees' task is to pick orders in accordance with the intelligent order system. According to the KUKA classification, this is level IV, in which the robot and operator must work together to complete the task, but not on the same activity. The second study was carried out at GSL (Gold Star Leisure), in Paington, Great Britain. The study concerned the analysis of work with the AutoStore™ robotic system. AutoStore™ robots called: R5™, R5+™, R5 Pro™ or R5+ Pro™ support optimal order fulfillment in retail. The robots create a vertical warehouse. Robots managed by the system are assigned to tasks based on their location, always performing the nearest task by the shortest route. According to the KUKA classification of cooperation levels, this is level IV, in which the robot and operator must work together to perform the task, but not on the same activity.

The analysis focused especially on recurring similarities and differences between employees' and managers' interpretations of the same organisational phenomena.

A condensed version of the interview guide be included as an appendix to improve methodological transparency and replicability

Results

The two companies analysed have introduced similar robotic systems, in principle, to assist warehouse employees in their work. In both companies, a similar approach to the areas studied was observed during interviews with employees and managers. The results are summarised in the following tables (Tab. 4 & 5).

Discussion

The findings show that warehouse robotisation should not be treated as a purely technical implementation project. Rather, it is a socio-technical change process that reshapes work organisation, dependencies between actors, and the meaning of cooperation itself. This interpretation supports the view that HRI in workplace settings should be analysed as an organisational phenomenon, not merely a technological one.

The paper's most important contribution lies in the perception gap between managers and employees. Managers consistently described robots as tools of optimisation, productivity, and efficiency. Employees often did the same, but some of them went further and

Table 4
Interviews with warehouse staff – findings

Interviews with warehouse staff – findings	
Interview area	Summary, employees:
the purpose of robotisation	• They realise that the implementation of robots is aimed at speeding up and optimising work. • They repeat their superiors' arguments about increasing space, better customer service, making work easier, etc.
robot as team member	• The robot is not a team member for most, just a smarter tool. • Although there are some employees who, when asked, reply that they treat the robot as a team member.
trust	• Trust the robots, in the sense of the work that the robots do. • There are individuals who always check the work of the robots – to be sure.
anthropomorphism	• Workers strongly anthropomorphise robots. • They give them names, they refer to them in diminutive terms, they attribute to them human behaviour and sometimes even intentions. • None of the machines tested were close to humanoid in shape, the robots showed at most a certain level of autonomy.
failure rate of robots	• System failures, malfunctions of robots arouse irritation in employees, increase frustration levels and, consequently, lead to an attitude of passive acceptance. This is because nothing can be done about it. • System availability is, along with trust, one of the very important factors in HRI.
responsibility	• Employees, as opposed to managers, do not believe that the responsibility for failures should always be placed on the employees. • Rather, it should be 50–50. Because if a system breaks down, stops frequently or robots run erroneously, it is not always necessarily the direct fault of the employees working with it.
security	• Workers, like managers, have an organic trust in machines when it comes to safety. • When workers have experienced or witnessed a situation where a dangerous situation that had no right to happen has occurred. • Managerial action is not taken to help workers rebuild this level of trust.

Table 5
Interviews with managers in warehouses – findings

Interviews with managers in warehouses – findings	
Interview area	Conclusion, managers:
the purpose of robotisation	• Efficiency, productivity, effectiveness, optimisation are the given reasons for robotization. • Cost and efficiency analysis of processes are emphasized during robotization.
preparation for robotisation	• None of the companies carried out an analysis of how the robotisation process was perceived by employees. • People were trained to use the system.
robots don't take jobs	• The implementation of robots does not eliminate work for humans, some workers are reallocated to other tasks, • When this process is not properly prepared, it arouses resistance and even fear among workers.
robot as team member	• Managers do not perceive the deployed robots as members of a team, they wrongly assume that their employees think so too. • Managers do not see the need to make changes in management practices when people work with autonomous robots.
failure rate of robots	• Robot failure rate affects the level of acceptance of and trust in the system. • Expectations at the system implementation stage are too high and optimistic.
responsibility	• Responsibility for mistakes always lies with the human side. • The system, drone or cobot is not to blame. • Mistakes happen, due to human errors and oversights. • Systems are not wrong, it is people who generate errors. • It is important that employees working with autonomous systems do not switch off their thinking, check and reflect. • This is ultimately linked to the responsibility for errors, which falls on people.
anthropomorphism	• Do not treat robots as team members, tend to anthropomorphise machines. • Diminutively naming them and sometimes attributing human characteristics or behaviours to them.
trust-security	• Trust systems or robots to do their job properly. • Have limited confidence in the security of systems. • Attach great importance to compliance with security rules.

described the system in quasi-relational terms, as something close to a co-worker. Importantly, this perception did not result from humanoid appearance; rather, it appeared to emerge from task interdependence. When workers' ability to complete tasks depends directly on the system's smooth functioning, the robot becomes socially meaningful in everyday work practice.

This finding adds an important workplace-based nuance to current discussions on robots as teammates. The results suggest that "team member-like" perception may emerge even in practical warehouse settings and even in the case of non-humanoid robotic systems. In other words, the social meaning of the robot is shaped not only by its physical form, but also by the structure of the work process and the dependence of human performance on system reliability.

A second important finding concerns trust. The study confirms previous HRI research showing that trust is a central condition of effective human-robot cooperation, but it also demonstrates that in warehouse practice trust is shaped in a highly operational way. Respondents linked trust not to abstract beliefs about technology, but to system reliability, availability, predictability, and the consequences of failures for daily workflow. When failures cause downtime, frustration, or waiting time, they directly weaken trust in the system.

The results therefore support the argument that trust in human-robot cooperation is not static, but situational and experience-based. It is built or weakened through repeated interaction with the system in actual work conditions. This is especially visible in

warehouse environments, where the pace and continuity of work depend heavily on the robotic system functioning correctly.

The study also contributes to the discussion of responsibility in human–robot cooperation. Managers tended to attribute responsibility for errors almost exclusively to human workers, emphasising that systems are tools and that people remain responsible for operational outcomes. Employees presented a more distributed understanding of responsibility, especially in situations where system malfunction disrupted work or constrained their own actions. This divergence is significant because it suggests that responsibility in robotised workplaces is not experienced as purely individual, even if it is formally assigned that way.

Another noteworthy result concerns anthropomorphism. Both employees and managers showed a tendency to anthropomorphise robots by naming them, speaking about them in diminutive forms, or attributing intentions and human-like qualities to them. This is particularly important because the systems studied here were not humanoid robots. The finding therefore suggests that anthropomorphism in workplace HRI may arise not only from appearance but also from repeated interaction, task dependence, and the incorporation of the system into daily routines.

Safety further qualifies the picture of trust. Although respondents generally trusted robots to perform their operational tasks, neither managers nor employees expressed unconditional trust in their safety. Workers described a principle of limited trust and emphasised the need to follow procedures and monitor machine behaviour. This distinction between trusting the system to work and trusting it to be fully safe is analytically important. It suggests that trust in workplace HRI is multidimensional and that operational trust does not automatically translate into a full sense of safety.

Taken together, the findings support the view that the quality of human–robot cooperation in warehouses is shaped by a cluster of interrelated factors: trust, reliability, responsibility, employee preparation, understanding of the system, and safety perception. The study does not claim to establish a new general theory of HRI; instead, it offers an empirically grounded contribution by showing how known HRI factors become meaningful in organisational practice and how they are interpreted differently by different groups of actors. For management research and practice, the implication is clear: introducing robots into warehouses requires not only technical deployment and training in system use, but also explicit attention to employee perceptions, responsibility structures, and the social dimension of cooperation. Organisations implementing robotic systems should therefore include HRI-related preparation

in the implementation process, rather than focusing exclusively on operational efficiency.

The study is exploratory and has limitations. It is based on two qualitative cases in warehouse environments and is intended to provide analytical insight rather than statistical generalisation. Future research could extend the comparison to additional warehouse contexts, include longitudinal observation of post-implementation adaptation, and combine qualitative data with basic descriptive quantitative measures of trust, safety perception, and robot teammate perception.

Conclusions

Referring again to Figure 1, we show that the research confirmed that factors such as robot reliability, failure rate, transparency, anthropomorphism and robot type have an impact on building trust in robots and human-robot cooperation. However, it is worth noting that certain factors have been attributed to humans and not to robots, e.g. anthropomorphism. Indeed, it was humans who anthropomorphised the robot in their opinions and stories. Also, the issue of understanding the principles of operation, defined as transparency, is a factor that we have attributed to humans. Although, in the field of HRI, transparency of a system is explained as the clarity of its principles of operation for the recipients (which was explained in the literature review), we assumed, according to the answers of the respondents, that it is the people who are supposed to understand the principles of operation of the system.

Therefore, when implementing a robotic system, managers should ensure that the principles of the system, all the advantages, but also the risks and areas of risk associated with the implementation are presented in a realistic way. To avoid the effect of disappointment among employees.

From the perspective of managing people-robot teams, the perception and evaluation of responsibility should be an area that managers need to review. The research results show a discrepancy in the perception of responsibility, between employees and managers. Managers, should talk to employees about bearing the consequences of mistakes, discuss individual cases. Together with employees, establish new rules, so that human workers have a sense of fairness in assessing responsibility.

From the point of view of work implementation, especially teamwork, it is important for managers to be aware of the impact and influence of anthropomorphism on work implementation in human-robot teams.

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Appendix A. Interview guide for managers

This appendix presents the condensed interview guide used in the qualitative study. The guide was designed as a semi-structured tool and organised around three analytical areas: reality, results / threats / problems, and expectations.

A. Background information

- Company / case
- Date and place of interview
- Position of interviewee
- Type of robotic system used
- Length of experience working with the system

B. Reality

1. Robotisation in the organisation
 - Why did your organisation decide to implement robotisation?
 - How was the robotisation process planned and introduced?
 - What were the main expected benefits of robotisation?
 - How were employees prepared for this change?
 - Did the organisation analyse how employees perceived the robotisation process?
2. Everyday work with robots
 - Please describe the scope of cooperation between employees and the robotic system.
 - What tasks are performed by humans and what tasks are performed by robots?
 - How did work look before the implementation of the robotic system?
 - How do employees currently work with the system on a daily basis?

- Do managers and employees understand how the system works?

3. Robots in the team

- How are robots treated in the organisation: only as tools, or as something more?
- Do you perceive the robot/system as a member of the team?
- What role does the robot play in the team?
- Has the implementation of robots changed the way teams are managed?
- Do you think employees perceive the robot in the same way as managers do?

C. Results / threats / problems

4. Efficiency and work organisation

- How has robotisation influenced work efficiency and productivity?
- What happens when the robot/system does not work properly?
- What procedures are followed in the event of system failure?
- How do employees react when the system fails?

5. Decision-making and responsibility

- Who makes decisions in everyday work: people or the system?
- Who takes final decisions in non-standard situations?
- Who is responsible for errors occurring during human–robot cooperation?
- Can a robot/system perform work incorrectly?
- Has cooperation with robots increased or decreased the responsibility of employees?
- Who controls the process in practice: the human or the system?

6. Trust and safety

- Is the issue of trust discussed in your organisation?
- Are employees asked whether they trust machines with which they cooperate?
- How is the topic of trust in robotic systems addressed in managerial practice?
- Do employees trust the robot to perform the task correctly?
- Do employees trust the robot to be safe and not to harm them?
- What safety procedures are used in cooperation with robots?

- What happens when a dangerous or unexpected situation occurs?

D. Expectations

7. Future development of robotisation

- In what direction will robotisation develop in your organisation?
- Will it develop towards deeper cooperation with humans or rather towards replacing human work?
- Is HRI considered an important managerial area in the organisation?
- How do you imagine future relations between people and robots in the company?
- What actions should organisations take to improve human-robot cooperation in the future?

Appendix B. Interview guide for employees

This appendix presents the condensed interview guide used in the qualitative study. The guide was designed as a semi-structured tool and organised around three analytical areas: reality, results / threats / problems, and expectations.

A. Background information

- Company / case
- Date and place of interview
- Position of interviewee
- Length of employment in the organisation
- Length of experience working with the robotic system

B. Reality

1. Robotisation in the organisation

- How long have you worked in this organisation?
- How did the robotisation process take place in your company?
- Why do you think your organisation decided to introduce robotisation?
- How were employees prepared for the change?

2. Everyday work with robots

- Please describe your daily work with the robot/system.
- What tasks do you perform and what tasks are performed by the robot?

- How did your work look before robotisation?
- Do you understand how the robot/system works?
- Does anyone in the organisation consider the feelings and attitudes of people who work with robots?
- Is the quality of this cooperation ever evaluated?

3. Robot as team member

- What changed in your work after the robot was introduced?
- Do you treat the robot as a colleague at work?
- Please indicate your opinion:
strongly disagree / rather disagree / no opinion / rather agree / strongly agree
- What role does the robot play in your team?
- Is the robot only a machine, or something more?

C. Results / threats / problems

4. Efficiency and work experience

- How has robotisation influenced work efficiency?
- Are there productivity standards for humans and robots?
- What happens when the robot stops working properly?
- What are the procedures in the event of system failure?
- What do you feel when the robot/system breaks down?
- What consequences do failures have for your work?

5. Decision-making and responsibility

- Who makes decisions in everyday work: people or robots?
- Who is responsible for the correct execution of work by the robot/system?
- Who takes final decisions about how the work should be done?
- Who controls the work process in practice?
- Can the robot perform the work incorrectly?
- What happens if the work is done incorrectly?
- Who is responsible for errors that occur during human-robot cooperation?

6. Trust and safety

- Is the issue of trust discussed in your organisation?
- Are employees asked whether they trust the machines with which they cooperate?
- Do you trust this machine to perform the task correctly?
- Do you trust it to be safe and not to harm you?
- What safety procedures are connected with cooperation with robots?
- Have you ever witnessed a dangerous or unexpected situation involving the system?

D. Expectations

7. Future development of robotisation

- In what direction will robotisation develop in your company?
- Will it move towards cooperation with people or towards reducing human involvement?
- How do you imagine future relations between people and robots in the organisation?
- Do you think the area of human–robot interaction is treated as important in your company?
- What should be improved to make cooperation between people and robots better in the future?