Collaboration in Action: A Multi-Grounded Analysis of Academia-Industry Partnerships in Interaction Design

Jonathan Källbäcker[1[0009-0009-0361-0449]] Åsa Cajander[1[0000-0001-7472-2215]]and Catharina van den Driesche[2[0000-0003-0759-7973]]

[1] Department of Information Technology, Uppsala University, Uppsala, Sweden
[2] University of Amsterdam: Amsterdam, NL
jonathan.kallbacker@it.uu.se

Abstract. Academia-industry collaborations are vital for tackling complex, real-world challenges in Interaction Design. This paper explores the collaborative process of a project focused on integrating digital tools and automation in the aviation industry. Using the Multi-Grounded Action Research (MGAR) framework, we analyse how theoretical, empirical, and practical dimensions informed and shaped the collaboration. Emphasising the process over specific research outcomes, the paper provides insights into stakeholder engagement, iterative decision-making, and integrating diverse knowledge sources. The findings reveal that while socio-technical systems theory and participatory design principles guided the collaboration, practical implementation often required navigating competing priorities and addressing usability issues. Empirical data from aviation workers and managers highlighted the benefits of digital tools, such as reduced cognitive load and ergonomic improvements and their limitations, including increased technostress and operational inefficiencies. The study also explores how the fixed project plan occasionally conflicted with the iterative demands of action research and Interaction Design. The paper concludes with lessons for fostering impactful academia-industry collaborations, emphasising the importance of flexibility, stakeholder alignment, and actionable research outcomes. These insights contribute to bridging the gap between academic research and industry practice, offering a model for future projects seeking to advance Interaction Design through collaborative methodologies.

Keywords: Interaction Design, Multi-Grounded Action Research, Academia-Industry Collaboration, Human-Centered Design, Socio-Technical Systems

1 Introduction

Interaction Design is at the intersection of technological innovation and human behaviour, making it increasingly vital to address real-world challenges through collaborative efforts between academia and industry. Designing functional, usable, and inclusive systems becomes paramount as automation and digital tools transform workplaces. While these transitions offer opportunities for efficiency and innovation, they also pose significant challenges, including technostress [1,2], usability issues, and work environment problems [3].

The TARA project exemplifies this intersection by focusing on the aviation industry's ground personnel. In a sector grappling with economic challenges and operational pressures [4], TARA investigates how new technologies—from autonomous vehicles to digital scanning devices—impact worker health, efficiency, and ergonomics. The project aims to increase knowledge about the implementation and effects of these technologies on workplace conditions and to identify ways to mitigate potential risks, such as technostress and repetitive strain injuries, while supporting sustainable practices in the industry.

This paper delves into the collaborative dynamics of the TARA project, analysing how academia and industry partnered to navigate the complexities of introducing new technologies in the workplace. Using the Multi-Grounded Action Research (MGAR) [5–7] framework as an analytical lens, the paper focuses on the collaborative process rather than the specific outcomes of the research studies. It examines how theoretical, empirical, and practical insights were integrated to ensure the partnership's success. MGAR is well-suited to addressing Interaction Design's iterative and participatory demands in collaborations between academia and industry.

The paper contributes to the ongoing discourse on academia-industry collaboration by:

- Analysing the TARA project's collaborative process through the MGAR framework.
- Highlighting strategies for effective stakeholder involvement, iterative decision-making, and knowledge integration.
- Offering insights and recommendations for structuring future collaborations in Interaction Design.

The paper begins with a background section contextualising Interaction Design and introducing the TARA project. The methodology section outlines the application of MGAR to analyse the collaboration process. This is followed by the results section, which discusses theoretical, empirical, and practical grounding findings. The discussion reflects on lessons learned and their broader implications for academia-industry partnerships, while the conclusion summarises the key insights and suggests directions for future research.

2 Background

2.1 Collaboration in Interaction Design

Interaction Design focuses on designing intuitive and meaningful interactions between people and technology, particularly in contexts where usability and user experience are critical [8]. In recent years, integrating digital tools and automation into complex workplace environments has amplified the need for effective academia-industry collaborations. These partnerships leverage academic expertise in Interaction Design theories and socio-technical systems alongside industry practitioners' practical knowledge, fostering innovative and human-centred solutions.

Collaboration between academia and industry in Interaction Design is increasingly recognised as vital for translating research into innovative products and services. According to Sjöö and Hellström [9], university-industry partnerships are essential for creating and applying new knowledge, relying on trust, shared incentives, and effective knowledge transfer processes. This shift aligns with a broader emphasis on academic entrepreneurship and the university's "third mission" to drive societal and economic progress. Research shows that frequent communication between industry professionals and academics improves knowledge transfer, with personal relationships often more impactful than formal mechanisms such as technology transfer offices [9]. While research excellence is less critical when forming partnerships, it nonetheless impacts the quality of the collaborative outcomes, underlining the importance of aligned goals and robust networks in facilitating impactful collaborations between academia and industry in interaction design [9].

Wohlin et al. [10] highlight the importance of long-term commitment, clearly defined objectives, and equitable power relationships for successful academia-industry collaborations. Their analysis reveals that the industry prioritises the company's management and the researcher's dedication to providing concrete support, while academia emphasises the collaborators, including the key champion within the company. The top two success factors for industry-academia collaboration are company management support and an on-site collaboration champion. These findings suggest that the industry's active commitment is crucial for successful partnerships, with the primary benefit often realised at the organisational level. Conversely, academia tends to focus on individual researchers or students gaining value, and short-term outcomes for universities are less critical. This underscores that industry seeks measurable organisational benefits, whereas academic value is often more personal or project-specific.

However, the success of such collaborations often hinges on overcoming significant challenges. One common difficulty is aligning goals: while academia may prioritise theory-building and long-term research, industry partners are often driven by immediate, practical outcomes. Communication gaps between stakeholders from diverse professional and cultural backgrounds can impede collaboration [11]. For example, researchers, engineers, and end-users may interpret priorities, constraints, and outcomes differently, complicating the design process. Finally, ensuring that theoretical insights translate into practical applicability requires iterative methods incorporating stakeholder feedback and maintaining flexibility as new challenges emerge.

Despite these challenges, collaboration in Interaction Design offers immense potential for effectively addressing real-world needs. By drawing on academic and industry perspectives, these partnerships can lead to functional and usable systems and processes, improving usability, efficiency, and overall user satisfaction. With insights from these types of collaboration, the TARA project aims to improve the work environment of the ground handling staff at airports. The insights from collaborations in interaction design are also central for understanding the management of interdisciplinary integration and the establishment of knowledge commons in collaborative projects, which is a focus of this specific paper.

Furthermore, with a lack of perspectives from ground handling staff as end users when new technology is introduced [12], gaining insights in how to develop the collaboration between academia and industry to integrate interaction design perspectives becomes especially important.

2.2 Extending Collaboration in Interaction Design with Knowledge Commons

In the context of collaboration in interaction design, establishing 'knowledge commons' is essential for leveraging diverse forms of knowledge: practical, theoretical, and experiential [13]. Knowledge commons refers to a shared pool of resources—theoretical frameworks, personal experiences, and collected insights —that participants collaboratively build, maintain, and utilise [14]. By critically analysing and synthesising shared knowledge contributions, participants can achieve a nuanced understanding of the problem domain and harness their collective expertise [15]. Knowledge Commons also offers a mechanism to align the goals of academia, industry, and end-users, ensuring that both immediate and long-term objectives are addressed through co-creation methodologies.

However, achieving an integration of knowledge commons for collaboration in interaction design is inherently challenging. Therefore, not only the design or research methodologies must align with interaction design collaboration, but also the architecture of the research process itself. This architecture should actively support collaborative partnerships for the concept of 'knowledge commons' to emerge within the collaboration process [16].

In conclusion, addressing complex and multi-layered challenges for interaction design collaboration requires an accessible and deliberative approach that actively co-creates the collaborative process. Hence, according to this theory, the collaboration process must be intentionally designed, consistently monitored and co-created to redefine all participants' relationships, roles, and goals.

2.3 The TARA Project

The TARA project exemplifies a collaborative effort between academia and industry, aiming to explore the impact of new technologies on the workplace conditions of aviation ground personnel. The project emerged in response to the aviation industry's critical challenges, including labour shortages, increased automation, and sustainable operational practices [4,17]. With a focus on roles such as baggage handlers, aircraft technicians, and refuelling staff, TARA investigates how technologies like digital scanning devices and autonomous vehicles influence workers' health, ergonomics, and overall efficiency.

The collaboration involves researchers from Uppsala University and the Transportfackens Yrkes- och Arbetsmiljönämnd (TYA), a Swedish organisation focused on workplace safety and competence development in the transport sector. This partnership leverages the strengths of academia and industry: academic expertise in socio-technical systems and Interaction Design and industry insights into the practical realities and challenges of implementing workplace technologies.

Moreover, the TARA project involved diverse stakeholders to ensure the collaboration was inclusive and addressed multiple perspectives. A reference group comprising representatives from unions, employers, managers, and end-users was established to provide strategic input and ensure the project's relevance to all parties. Additionally, the project team included members from TYA, the union Transportarbetarförbundet, and the organisation Transportarbetaren, alongside senior and junior researchers. This multidisciplinary composition enabled the project to integrate academic insights with practical expertise.

The TARA project aims to address knowledge gaps surrounding technology-induced challenges, such as technostress [1,2] and repetitive strain injuries, through participatory methods, such as contextual inquiries, interviews, and workshops [18]. The project aligns with interaction design principles by focusing on these issues, emphasising user-centred approaches and the interplay between humans and technology in real-world settings. Ultimately, TARA improves workplace design while providing actionable insights for the aviation industry.

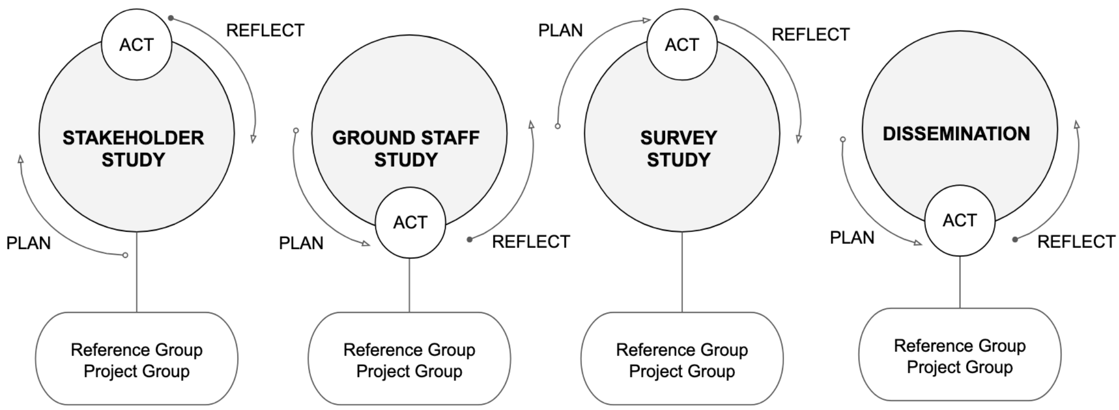

Fig. 1. An Overview of the project's milestones.

2.4 Multi-Grounded Theory and Multi-Grounded Action Research

Multi-Grounded Theory (MGT) offers a methodological framework for developing theories grounded in empirical data, aligned with existing theoretical constructs, and applicable to practical contexts. Proposed by Goldkuhl and Cronholm [6,7], MGT expands upon traditional Grounded Theory by incorporating three complementary dimensions of grounding:

- Empirical Grounding: Ensures the theory is supported by data collected from observed phenomena.
- Theoretical Grounding: Aligns the theory with established frameworks and prior research.
- Practical Grounding: Emphasizes the applicability and usefulness of the theory for real-world challenges.

This iterative process involves data collection, analysis, and validation cycles to refine theoretical constructs and enhance their relevance and coherence.

Multi-Grounded Action Research (MGAR) [5] extends the principles of MGT into the action research domain [19]. MGAR combines the structured grounding dimensions of MGT with the iterative and participatory characteristics of action research. It emphasises co-creation with stakeholders to ensure that interventions and outcomes are theoretically informed, empirically validated, and practically relevant. The approach balances theoretical insights, empirical findings, and practical applications, fostering a dynamic and adaptive process for addressing complex, real-world issues.

In a systematic review, Oberschmidt et al. [20] synthesised best practices and lessons learned from 40 AR projects in eHealth design and implementation. These findings underscore AR's versatility and effectiveness, providing insights that extend beyond the eHealth domain. Key practices include fostering stakeholder collaboration through transparent communication, building stakeholder confidence and skills, and embedding flexibility into project processes through ongoing evaluation and adaptation. The review also highlighted the value of employing diverse methods—such as personas and journey mapping—and disseminating findings in accessible formats to maximise impact and applicability.

These practices are transferable to other AR settings, including education, community development, and organisational change. The collaborative and cyclical nature of AR lends itself to addressing complex, multi-stakeholder challenges across diverse contexts. The emphasis on iterative adaptation and stakeholder empowerment ensures relevance and sustainability, regardless of the specific application domain. In the TARA project, the MGAR framework provided a structured approach for analysing and guiding our academia-industry collaboration.

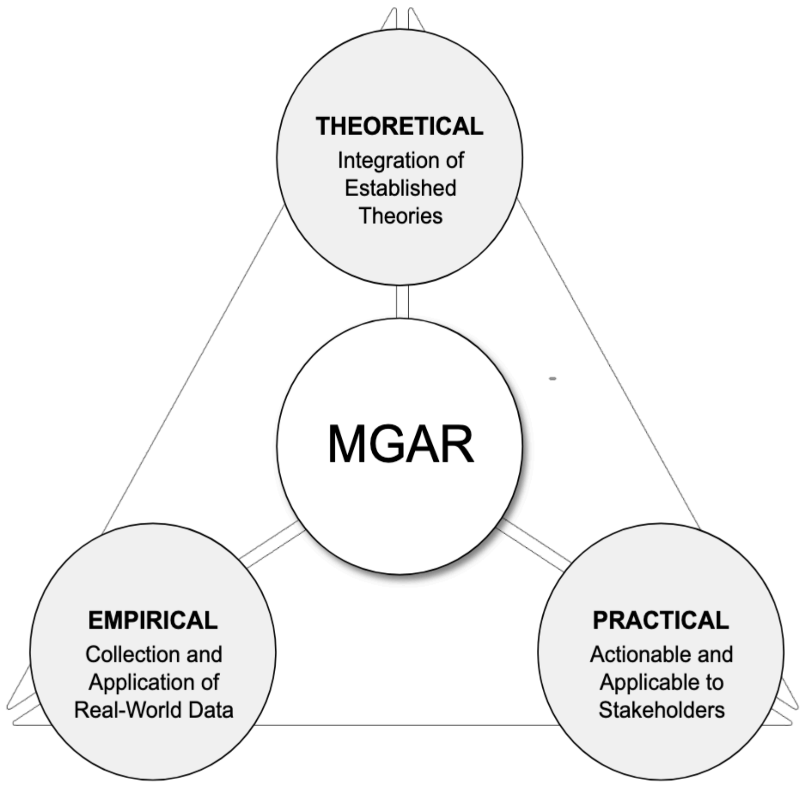

Figure 2. The Multi-Grounded Action Research (MGAR) framework is adapted from [6,7].

3 Methodology

This study focuses on analysing the collaborative process of the TARA project using the Multi-Grounded Action Research (MGAR) framework [5–7]. The primary aim is not to evaluate the research results but to understand how the collaboration was structured, iterated, and grounded in three key dimensions: theoretical, empirical, and practical contexts. By examining the interplay of these dimensions, this study seeks to uncover actionable insights into the dynamics of academia-industry partnerships.

The Multi-Grounded Action Research (MGAR) framework offers an iterative approach to studying and refining collaborative processes. Central to MGAR are three interconnected forms of grounding: theoretical, empirical, and practical. This triad ensures that collaboration processes are systematically informed, validated, and adjusted to meet diverse stakeholder needs.

Theoretical Grounding: MGAR integrates established theories—such as socio-technical systems, participatory design, and Interaction Design principles—into the collaborative process. These theories provide a foundation for understanding and guiding stakeholder interactions, technology integration, and user-centred practices.

Empirical Grounding: The framework emphasises the collection and application of real-world data, such as interviews, field studies, and observations. This data shapes the collaborative process, offering insights into stakeholders' lived experiences and validating the relevance of theoretical assumptions.

Practical Grounding: MGAR ensures the collaboration's outcomes are actionable and applicable to stakeholders. This involves aligning the project's results with the practical needs of industry partners and end-users, ensuring that theoretical and empirical insights translate into meaningful, usable recommendations.

In the TARA project, MGAR served as both a reflective lens and a methodological guide for enhancing the collaboration. It facilitated an iterative process where theoretical constructs, empirical findings, and practical relevance were continuously aligned and refined.

Preliminary findings were presented and discussed with representatives from TYA and participating researchers. This step ensured the accuracy of interpretations and the alignment of results with stakeholder expectations and needs.

Researchers reflected on their roles throughout the process, acknowledging potential biases and documenting their influence on the collaboration. This reflexivity enhanced the credibility of the analysis and ensured that multiple perspectives were considered.

4 Results

Table 1 provides an overview of key project activities mapped to their corresponding MGAR dimensions to illustrate how the multi-grounded action research (MGAR) framework guided the TARA project. This structure highlights the interplay between theoretical insights, empirical findings, and practical applications throughout the project lifecycle.

Table 1. An overview of how the Multi-Grounded Action Research (MGAR) framework was applied in the TARA project.

Grounding Dimension	Description	Examples from the TARA Project
Theoretical Grounding	Integration of established theories to inform and guide the collaborative process.	Applied socio-technical systems theory to explore human-technology interactions; used participatory design principles to structure stakeholder involvement.
Empirical Grounding	Collection and validation of real-world data to shape and adjust the research.	Conducted field studies, interviews, and observations to understand challenges like technostress and usability issues in aviation workplaces.
Practical Grounding	Alignment of findings with the needs and priorities of stakeholders to ensure actionable outcomes.	Engaged with unions and employers to validate insights; planned the development of brochures, training materials, and implementation studies for workplace solutions.

4.1 Theoretical Grounding

The TARA project's collaborative process was guided by established theories that provided a foundation for aligning academic and industry perspectives. These theories, including socio-technical systems (STS) [21,22], participatory design [23], User-Centred Systems Design [24] and Interaction Design principles [8], informed the project's approach to stakeholder involvement, usability considerations, and iterative decision-making. Together, these frameworks ensured the collaboration was theoretically robust and practically relevant. We also had discussions in the project to make these theories a part of knowledge commons.

Theoretical Foundation from Research Expertise. While the TARA project did not include an explicit literature review, it benefited significantly from the project leader's extensive research background in action research and digital work environments [24–27]. This expertise brought a deep understanding of existing theories and frameworks related to workplace design and human-technology interaction. Previous work on improving the digital work environment informed the project's focus on usability, technostress, and the impacts of new technologies.

Socio-Technical Systems Theory. Socio-technical systems theory [21,22] was central to the TARA project's approach, emphasising the interconnectedness of technical systems and human factors in the workplace. This theory provided a framework for analysing how new technologies—such as hand scanners and autonomous vehicles—affect workers' physical and cognitive environments. By optimising the relationship between humans and technology, STS theory guided discussions on mitigating technostress, reducing repetitive strain injuries, and ensuring that technological interventions improved overall workplace ergonomics.

Participatory Design. Participatory design principles [23] were instrumental in structuring the collaboration, ensuring that diverse stakeholders—from aviation workers to industry representatives—were actively involved in shaping the project's direction. This approach emphasised co-design and inclusivity, enabling stakeholders to contribute their expertise and perspectives throughout the project. The participatory design also guided the design of workshops and feedback loops, creating spaces where stakeholders could reflect on findings, share insights, and refine objectives collaboratively.

Interaction Design Principles. Theories from Interaction Design [8], particularly those focusing on usability and user-centred systems design, informed the project's attention to how technologies are integrated into workers' routines. These principles emphasised the need to design systems that are intuitive, accessible, and aligned with user needs. In the TARA project, this translated into a focus on minimising cognitive load, improving interface usability, and ensuring that technological solutions were adaptable to the diverse contexts of aviation workplaces.

Work environment Theories connected to work environment and technology were also a fundamental part of the project [1,2,3]. These include theories like the technostress and demand resource model, which can identify different stressors and mediators, as well as how technology can be a tool for support or strain in the work environment. These theories were part of how the interview guides were formed to identify the potential issues and advantages associated with the ground handling staff's technology.

4.2 Empirical Grounding

Empirical grounding was critical in the TARA project, ensuring that decisions and strategies were firmly rooted in real-world data. The project gathered extensive insights into aviation ground personnel's experiences, challenges, and needs through field studies, interviews, and surveys.

Stakeholder interviews were conducted to understand the implementation process of new technologies in aviation workplaces. These interviews captured diverse perspectives from ground staff and managers in various positions in airport operations. The interviewed stakeholders included union representatives, airport managers, managers working at technical departments as well as managers responsible for the work environment. The perspectives from these stakeholders provided valuable insights on the integration of technologies such as mobile devices, belt loaders, and vacuum lifters. These studies revealed:

- Diverse Stakeholder Interests: Safety, regulatory compliance, and economic factors emerged as primary drivers in implementing new technologies, often balancing against work environment concerns.
- Role of External Stakeholders: Airlines, regulatory bodies, and suppliers were pivotal in influencing technological choices, often prioritising efficiency and compliance over user-centred design.
- Barriers to Effective Implementation: Misalignment between managerial decisions and ground staff needs underscored challenges in incorporating user perspectives while adopting new systems.

Field observations and interviews were conducted at multiple aviation workplaces to capture the day-to-day interactions between the ground handling workers and new technologies, such as digital scanning devices and autonomous vehicles. These studies examined the existing technologies and the consequences of using them. Technologies included scanner devices, expandable belt loaders for loading and offloading luggage, iPad tablets for planning the loading tasks, and vacuum lifters used during luggage sorting. Physical positives could be identified, such as reducing the need to lift luggage in uncomfortable positions with the belt loaders and supporting lifting with the vacuum lifters. However, with the hand-held scanners, scanning with one hand and lifting the luggage with the other could cause strain. These scanners could also reduce the cognitive load by automatically keeping track of the number of luggage packed, but having multiple devices with separate passwords for planning loading was identified as a negative in terms of cognitive load.

These findings informed the project's focus on usability and worker well-being, prompting adjustments to research priorities and stakeholder engagement strategies. For example, issues related to connectivity were prioritised in discussions with TYA representatives to identify potential technical solutions.

Finally, the reference group played a pivotal role in the empirical grounding of the TARA project and in creating knowledge commons. Comprised of stakeholders from unions, employers, managers, and workers, the group provided critical insights into workplace challenges, validated the relevance of preliminary findings, and contributed to the focus of forthcoming studies. Their contributions ensured that the research remained connected to the realities of aviation workplaces, shaping iterative adjustments to the project's focus and methods.

4.3 Practical Grounding

Practical grounding in the TARA project ensures that the research findings are academically significant, actionable, and relevant to stakeholders. While much of the work has focused on theoretical and empirical grounding, several efforts have been made—and more are planned—to translate the project outcomes into practical benefits. A significant part of the practical grounding is thus to make the most out of the established knowledge commons developed between the stakeholders in the project.

Dissemination. To effectively communicate the project's findings and ensure their practical applicability, a variety of dissemination activities have been undertaken or are in progress:

- Media Engagement: A series of interviews in transportation-focused and work environment magazines has shared the project's key themes with industry professionals, raising awareness about workplace challenges and promoting the practical implications of the research.
- Information Campaigns: A short information campaign has been conducted to communicate early findings to a broader audience, ensuring preliminary results inform ongoing discussions in the aviation sector.
- Stakeholder Presentations: Results have been presented at critical forums such as Transportarbetarförbundet's annual meeting and TYA's industry council ("branschråd"). These presentations have provided opportunities for direct discussions with key stakeholders, enhancing the project's practical relevance.
- Marketing Materials: A concise report and brochure summarising the project's findings and recommendations are being prepared. These materials will be distributed to unions, industry representatives, and aviation workplaces to promote awareness and support implementation efforts.

Collaboration with Industry Partners. The project team works closely with TYA's communications department to design a targeted marketing initiative. This collaboration aims to raise awareness among key stakeholders about workplace challenges such as technostress and repetitive strain injuries, ensuring that actionable insights reach industry decision-makers.

Future Practical Applications. The TARA project has identified several practical goals outlined in its project application. These efforts will further enhance the practical grounding of the research findings:

- Training and Educational Resources: Plans include developing training materials, including micro-lectures, to help workers and managers adapt to new technologies and better address workplace challenges.
- Collaborative Refinement Workshops: Additional workshops with stakeholders will focus on refining and validating recommendations, ensuring that proposed solutions align with the aviation sector's specific needs and constraints.

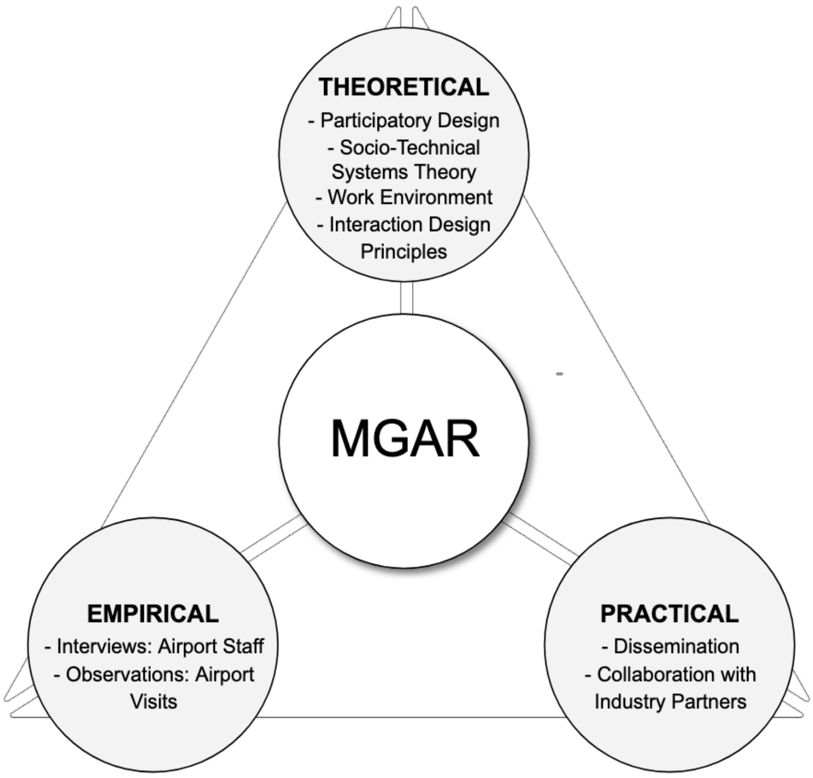

Figure 3. The MGAR framework adapted to the TARA project.

5 Discussion

5.1 Challenges in Publishing Research Results

A challenge faced in the TARA project was the difficulty in positioning the research findings within a single academic field. The project's interdisciplinary nature—spanning interaction design, workplace ergonomics, and socio-technical systems—meant that the results did not fully align with the established expectations of any specific research domain. While this interdisciplinarity enriched the project’s insights, it also created barriers to publishing, as journals in each field often seek highly specialised contributions.

To address this, the findings can be framed for different research communities. The study’s focus on technostress and ergonomics contributes to work and occupational health research, while usability and participatory design insights align with human-computer interaction (HCI). Additionally, findings on automation’s impact on aviation workers are relevant to aviation and transport research.

However, for a PhD student working within a specific field such as HCI, the broad disciplinary spread of potential publication venues raises strategic questions. While interdisciplinary dissemination increases the research’s reach and impact, it may also challenge establishing a clear academic profile and meeting field-specific expectations. This highlights the tension between interdisciplinary relevance and the need for a coherent publication strategy within a defined research domain.

Additional challenges can also be due to boundaries of the field of HCI in relation to the airport context. For example, there are many different types of technologies that can be examined in the airport context. Attempting to write and publish papers that include different relevant technologies, not exclusively computers, can make it more difficult to publish in HCI.

This issue can also be connected to lacking or unfocused research questions. The difficulties in establishing research questions for papers in this project and the project in general may be due to the difficulty of understanding the airport context itself. Because of the vastness of the industry, and the close to unlimited research possibilities of interaction design and work environment, it can be difficult to establish a clear goal. Ultimately this leads to a difficulty of prioritization of the papers' research questions and focus.

The challenges of publishing can also relate to the lack of understanding of other fields, like information systems or work environment studies. This can lead to not knowing what results are interesting in each field, risking generic results for one field, even though it might be interesting in another. Making this prioritization and handling the navigation between fields was also challenging.

5.2 The Diffuse Nature of Action Research

Heron and Reason [19] describe two complementary inquiry cultures in action research: the Apollonian, which is rational, linear, and systematic, and the Dionysian, which is expressive, spiralling, and tacit, with reflection as an improvised sense-making process. The TARA project aligns more with the Dionysian approach due to the complexity of the problems it addressed, evolving through overlapping and iterative data collection cycles, stakeholder engagement, and analysis. However, structured reflections and stakeholder meetings occasionally reflected an Apollonian character, creating a dynamic balance between the two inquiry cultures.

This flexible process was both a strength and a challenge. On the one hand, it allowed the project to remain responsive to emerging issues, such as the ergonomic impacts of handheld scanners, which became a focal point only after initial field studies. On the other hand, the absence of well-defined phases sometimes created confusion on what to do next.

The TARA project demonstrates that action research need not adhere strictly to predefined steps to be effective. Instead, its iterative and adaptive nature can offer significant value in complex, multi-stakeholder contexts, where evolving priorities and unforeseen challenges demand flexibility and ongoing recalibration.

Another challenge encountered during the TARA project was the fixed nature of the project plan, due to funding agency stipulations, which conflicted with the inherently iterative and adaptive approaches of both action research and Interaction Design. The rigid plan limited the team's ability to respond to emergent findings and evolving stakeholder needs, creating tension between the need for flexibility and the predefined objectives and timelines. This highlights the importance of designing project structures that accommodate iterative processes, particularly in collaborative, user-centred research.

An additional challenge was found in the intersection between theoretical and practical knowledge between researchers and practitioners, and how to communicate the study outcomes. An example can be taken from one of the reference group meetings with the airport stakeholders when suggestions for communicating the study results were presented to the stakeholders. The concepts "UX" and "Usability Studies" were used when presenting the take-home messages. The usage of these theoretical concepts, very familiar in a research context, leads to a discussion centred more around the concepts rather than how to work according to their principles. This example shows that not only can there be challenges in publishing results based on this kind of project, but making sure to get the most out of the insights in a practical setting might need some adjustments to the theoretical language most commonly used in academic contexts, pointing at a need for researchers in academia-industry projects to develop competences in this method of research communication.

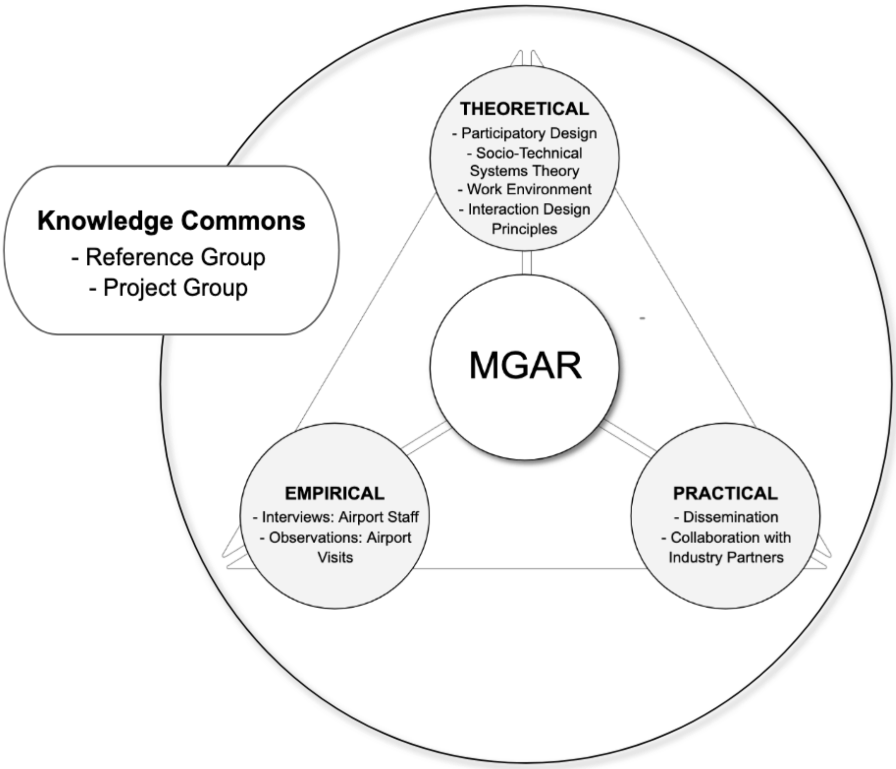

Figure 4 Knowledge commons related to the TARA-adapted MGAR framework.

The concept of Knowledge Commons, as discussed in Chapter 2, can serve as a practical and critical framework for addressing the recurring challenges in academia-industry partnerships. By collectively sharing a pool of resources from the outset, stakeholders can more effectively integrate diverse knowledge streams, ensuring that academic and practical outcomes are achieved in various forms and mutually reinforcing each other. Incorporating Knowledge Commons as a guiding framework facilitates cross-disciplinary synthesis and the creation of outputs accessible to both academic and practitioner audiences.

The perspectives of MGAR and Knowledge Commons can be combined in the practical case of TARA. One perspective that can be identified is a lack of Knowledge Commons at the beginning of a project. The researchers have theoretical knowledge, the industry has practical knowledge and access to empirical data, and together, the goal is to generate new theoretical and practical knowledge. In the case of TARA, as illustrated in Figure 4, this was done via project and reference group meetings. With a basis in MGAR and combining different data collection methods and collaboration with the industry, researchers should aim to build knowledge commons, ensuring that immediate practical and long-term theoretical objectives are met.

5.3 Critical Reflection on Multi-Grounded Action Research (MGAR)

While MGAR provided a structured framework for integrating theoretical, empirical, and practical insights, the method also presented challenges in collaboration with industry partners. The iterative nature of MGAR sometimes clashed with the fixed project plans and deadlines expected by industry stakeholders. Additionally, MGAR is a relatively complex approach that requires extensive reflection and theoretical grounding, which made it challenging to communicate effectively to practitioners.

Other possible methodological choices included Design-Based Research (DBR), which emphasises iterative design cycles in applied contexts, and Pragmatic Action Research (PAR), which focuses on direct interventions in practice. However, MGAR was chosen because it allows for an interplay between theoretical constructs and real-world constraints, ensuring that industry-relevant knowledge production is grounded in empirical data and informed by existing theory.

5.4 Implications for Future Research

The TARA project highlights important lessons for structuring and managing future academia-industry collaborations. These lessons can be summarized in three core recommendations to consider in collaborations such as TARA. The first recommendation is to establish the various MGAR dimensions in one's project. The second recommendation is to based on the MGAR dimensions create a plan on how to translate these dimensions to knowledge commons and a common language between stakeholders in the project. The final recommendation is to have clear goals and expectations at the outset, but be prepared to adapt throughout the project.

Aligning the academic priorities of generating theoretical insights with the industry's demand for actionable and practical outcomes proved challenging during the project. Future collaborations should dedicate time early to co-develop shared objectives, balancing theoretical contributions with stakeholder needs. This approach can help mitigate potential mismatches in priorities and ensure that both parties benefit from the partnership. Establishing clear, domain-specific research questions at the outset could help align academic and industry expectations more effectively. Early co-creation of research goals among all stakeholders — including researchers, industry partners, and practitioners — would ensure that the theoretical contributions are sufficiently robust for academic dissemination, while also remaining actionable and relevant for practical application. Such an approach may help mitigate interdisciplinary publishing challenges by clearly articulating the project's academic positioning while retaining the flexibility needed for real-world problem solving.

Interdisciplinary collaborations, like the TARA project, underscore the value of integrating diverse disciplinary perspectives while exposing inherent challenges. The project's findings, which span Interaction Design, workplace ergonomics, and socio-technical systems, did not align perfectly with the publishing norms of any single field. This lack of fit complicates the dissemination of results in traditional academic outlets. Future projects could address this by identifying interdisciplinary publication platforms that accommodate cross-domain findings or creating tailored outputs for academic and practitioner audiences.

Another insight relates to the iterative nature of action research, which emerged as both a strength and a challenge in the TARA project. The flexibility of action research allowed the team to adapt to emerging priorities, such as addressing ergonomic issues identified during field studies. However, this diffuse process also challenges maintaining alignment among stakeholders and managing expectations. Future projects should embrace this iterative nature but structure it with regular reflection and feedback mechanisms to ensure coherence and alignment with project goals.

Although less emphasised in the TARA project, practical grounding remains critical for ensuring research impact. Future efforts should integrate practical applications throughout the project lifecycle rather than treating them as a final step. Stakeholder collaboration in co-developing solutions can help ensure the research effectively translates into actionable outcomes.

Future projects could incorporate the Co-creation of Collaboration as a foundational activity [15]. Such a framework emphasises designing the collaboration process, including participatory goal-setting exercises, iterative process monitoring, and adaptive organisational structures that allow for validated adjustments based on stakeholder feedback throughout the research lifecycle. This collaborative strategy could mitigate misaligned priorities, enhance sustained stakeholder engagement, and ensure the practical relevance of research outcomes. Moreover, it would contribute to advancing the broader discourse on Academia-Industry Collaborations by demonstrating the value of inclusive and adaptive project structures.

Finally, including diverse stakeholder groups, such as unions, managers, and end-users, enriched the project's findings and introduced complexities in balancing competing interests. Future collaborations should develop structured approaches for managing diversity and fostering inclusivity while focusing on shared objectives. The long-term impact could also be enhanced by creating follow-up plans to assess the effectiveness of implemented recommendations and by developing open-access resources that allow others to adapt and apply the findings in different contexts.

The key contributions and insights from this paper is that establishing MGAR dimensions of a project, having plans for creating knowledge commons, and defining clear goals at the outset with an understanding of action research complexities can foster meaningful connections between research and practice. By addressing these challenges and building on the strengths of the TARA project, future academia-industry partnerships can achieve more significant impact and relevance.

5.5 Limitations

While this study provides valuable insights into academia-industry collaborations and the application of the Multi-Grounded Action Research (MGAR) framework, several limitations should be acknowledged to contextualise the findings.

The project plan's fixed nature occasionally conflicted with the iterative and adaptive demands of action research and Interaction Design. This rigidity constrained the team's ability to fully respond to emergent issues or to explore unforeseen opportunities during the collaboration. As a result, certain aspects of the process may not have been as thoroughly examined as they could have been in a more flexible research setup.

Finally, the findings are context-specific, focusing on the aviation sector and its unique technological and organisational challenges. While some insights are likely transferable to other industries, the generalizability of the results may be limited. Future work should explore how similar methodologies and frameworks can be adapted to other contexts, such as logistics or manufacturing, to validate and extend the findings.

6 Conclusion

The TARA project is a valuable case study for exploring the complexities and potential of academia-industry collaborations in Interaction Design. By applying the Multi-Grounded Action Research (MGAR) framework, the project effectively integrated theoretical, empirical, and practical dimensions to address the challenges of implementing new technologies in aviation workplaces. Through iterative and participatory processes, the project highlighted critical issues such as technostress, usability challenges, and ergonomic risks while fostering meaningful engagement with diverse stakeholders, including unions, managers, and workers.

The contribution of this paper therefore centres around the complexities of action research projects, and provides insights how to establish a MGAR foundation for the co-creation of knowledge commons between stakeholders, in order to mitigate the action research complexities and get the most out of projects such as TARA.

The project illuminated the inherent challenges of such collaborations. Aligning academic research outputs with industry partners' immediate, actionable needs was a recurring tension. Furthermore, the interdisciplinary nature of the findings, while enriching, complicated the dissemination of results in traditional academic and industry-focused channels. These challenges underscore the need for flexible methodologies, adaptive communication strategies, and clear expectations and dissemination pathways agreements.

Despite these difficulties, the TARA project demonstrates the potential for academia and industry to collaboratively address complex workplace challenges, creating theoretically and practically relevant solutions. The insights gained from this project offer valuable guidance for structuring future collaborations, particularly in balancing theoretical exploration with stakeholder priorities and ensuring the broad dissemination of results.

Future work will focus on translating the project’s findings into tangible workplace interventions, such as educational resources, ergonomic recommendations, and practical tools for mitigating technostress. By continuing to build on the lessons learned, the TARA project exemplifies the transformative potential of academia-industry partnerships in advancing Interaction Design and improving workplace conditions.

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