ISSN 2510-2591

Reports of the European Society for Socially Embedded Technologies

volume 8 issue 3
2024

Proceedings of 22th European Conference on Computer-Supported Cooperative Work - Doctoral Colloquium

Guest Editors

Fabiano Pinatti, University of Oslo, Norway
Heloisa Candello, IBM Research, Brazil

Series Editor

Michael Koch

Impressum

The **'Reports of the European Society for Socially Embedded Technologies'** are an online report series of the European Society for Socially Embedded Technologies (EUSSET). They aim to contribute to current research discourses in the fields of 'Computer-Supported Cooperative Work', 'Human-Computer-Interaction' and 'Computers and Society'.

The 'Reports of the European Society for Socially Embedded Technologies' appear at least one time per year and are exclusively published in the Digital Library of EUSSET (https://dl.eusset.eu/). The main language of publication is English.

ISSN 2510-2591

https://www.eusset.eu/report-series/

The contents of the report series are made available in the EUSSET Digital Library at https://dl.eusset.eu/

EUSSET is an institute of Social Computing e.V., a non-profit association according to the German legal system – founded on November 13th 2012 in Bonn, Germany (Nordrhein-Westfalen Amtsgericht Bonn VR 9675).

c/o Prof. Dr. Volker Wulf
Fakultät III
Universität Siegen
57068 Siegen
E-Mail: volker.wulf@uni-siegen.de

Table of Contents

Doctoral Colloquium

Rutz, Philipp (2024): Supporting the Appropriation of ERP Systems in SMEs: A Practice-centred Approach. In: Proceedings of the 22nd European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centered Computing on the Design of Cooperation Technologies - Doctoral Colloquium Contributions, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.48340/ecscw2024_dc01

Supporting the Appropriation of ERP Systems in SMEs: A Practice-centred Approach

Philipp Rutz
University of Siegen
philipp.rutz@uni-siegen.de

Abstract. Enterprise resource planning (ERP) systems are pivotal in industrial settings, yet often underutilised due to users' inadequate training and understanding. Previous research has shown that this is to a certain extent due to current implementation practices of such systems, which focus on the go-live moment, rather on their continuous use afterwards. This research aims to address this gap by examining the ERPs appropriation process and designing practice-centred systems to facilitate their integration into work practices through facilitated training in SMEs. Drawing on a CSCW and business informatics perspective, this research seeks to bridge a clear gap in the literature through a practice-centred approach.

1 Introduction

Enterprise resource planning systems (ERPs) are among the most used operational software applications in industrial settings. ERPs are configurable software packages or multi-module software applications used to plan and control resources in a company (Xu et al., 2008). As they are complex systems, they are often not completely understood by their users and, consequentially, not used to their full potential, as demonstrated in the literature (Iskanius, 2009; Ben Laadar et al., 2019; Maas et al., 2014). This under usage often stems from limited system knowledge which, in many cases, lead to workarounds like using other tools, like Excel to accomplish things that could be accomplish from the ERP system itself (Rutz et al., 2023). This lack of knowledge, as this research suggests, often results from flawed training in the introduction phase and an absence of organised knowledge and expertise sharing (KES) during the usage phase therefore practice-centred digital support systems could be useful to facilitate these phases and enable users to overcome the hurdles that exists due to the SME context and the complexity of ERPs.

This research sets out to examine the appropriation process of ERPs and based on the findings design technologies to support the integration of ERPs into users work practices and facilitate the appropriation process in SMEs. Therefore, it proposes to shed light towards the following research questions:

- To what extent does current training processes contribute to the integration and appropriation of ERPs to work practices of SME workers?
- How can sustainable KES support the training of ERPs in SMEs?
- In what ways can digital technologies facilitate the introduction and appropriation of ERPs in the workplace?
- What should be observed in the design of such technologies so that they do not clash with the work practices of ERP users?

ERPs are highly cooperative systems and therefore present cases for many fundamental challenges in CSCW like high division of labour and articulation of cooperative work (Schmidt, 1994).Therefor this research connects to the established concepts in CSCW, like knowledge and expertise sharing (Ackerman et al., 2013; De Carvalho et al., 2018) and knowledge infrastructures (Karasti et al., 2010), and applies them, together with concepts from business informatics like critical success factors (Leyh, 2014), on the topic of ERPs which is underrepresented in CSCW (Valdebenito and Quelopana, 2018). It will focus on both sides of the documentation process to support the recipients as well as the data curators (Candello et al., 2022). In the following I will give insights into the chosen methodological approach and present the findings that emerged as to date followed by the current plan for future steps.

2 Research Context and Methodology

This research takes place within a governmental funded research project. The goal of the project is to use KES approaches for a more sustainable implementation and usage of ERPs with the aim to achieve a higher usage intensity. The projects consist of the university and four project partners spread over two industries; all partners are German SMEs. In each industry there is one ERPs consulting company and an ERPs application company. The two industries addressed in this study are from the metalworking and the beverage wholesale branches.

In general, the research design adopted is built upon the Design Case Study (DCS) framework proposed by Wulf et al. (2011). The framework consists of three phases that take place in the course of one design cycle. The cycle starts with the pre-study in which empirical methods are conducted to gather findings trough the analysis of the material. Based on these findings solutions and technologies are designed which are then evaluated in practice in the third phase the appropriation phase.

The contextual study carried out for the pre-study featured participants from different occupational roles to get a broader understanding of the underlying issues and get a deeper insight into the practices of members of the target group. This study brought together a wide range of stakeholders, spanning consultants, hot-line staff, project manager, key-users, end-users, and IT staff. This diversity allows for different perspectives to illuminate the research problem.

For data collection purposes, a combination of interviews, questionnaires, workshops and observations have been used. For the data analysis, the research has used Braun and Clarke's approach to thematic analysis (Clarke and Braun, 2017).

Following the analysis of the empirical data collected in the contextual study, I engage in a series of design activities concentrating on the training of ERPs. These activities led to the design a practice-centred e-learning platform for ERPs and involved interviews, observations and workshops with participants from the partner companies.

The appropriation study phase is currently ongoing in the two industries of the research project. Different use-cases were selected in which the designed prototypes could be tested in the field by the end-users. The two main use-cases will be described in more detail in the ongoing work section.

3 Findings

In this section, some findings concerning the contextual study carried out as part of the pre-study phase of the DCS framework are introduced. These findings are

the basis for the design of the practice-centred solution to address the research problem outlined above.

3.1 Issues of Implementing and Using ERPs in SMEs

During the contextual study it has been carried out in this research, observed the problematic ways in which ERPs are introduced in SMEs which leads to long term issues in the usage phase (Rutz et al., 2023). The findings stemming from the contextual study suggest that in German SMEs workers are often seen as *jack of all trades*, i.e., they are expected to work in different roles due to small departments and a lower degree of division of labour compared to bigger companies. These workers are knowledgeable about assorted work processes due to their engagement in various tasks, which in turn results in higher workloads.

Because of their extensive knowledge on work processes, they are often chosen as key-users for ERPs implementation projects to help to shape the system to the company's needs. Although the findings coming out of the contextual study show that ERPs consultants and ERPs selection consultants recommend choosing key-users based on various criteria, in practice they often get chosen by circumstances. This becomes even more problematic because, despite the fact that the introduction of ERPs is not a trivial task for key-users, demanding engagement and a high workload, key-users receive seldom support or dedicated time to deal with their implementation tasks.

Key-users not only have the role to shape the ERPs to the needs of their company but are also expected to teach the ERPs to their colleagues in preparation of the usage phase. Because of that, they usually receive special training. Nevertheless, the empirical findings gathered so far suggest that these training sessions are often unsatisfactory in regard to how they are conducted and how they are timed. Through the contextual study, it became clear that, both the consultancy companies as well as the application companies often put too less effort and value on training. Professional training usually only takes place during the implementation phase.

Furthermore, although ERPs are often used for long periods in which things like fluctuation happen, additional training for old or new employees is seldom conducted during the usage phase. Additionally, the findings of this research suggests that, when users receive training, they only have the time to engage with the learning content in the payed training which happen mostly in on-site full day events. Therefore, in these events trainers put as much content as possible. This, the findings suggest, leads to a lower level of ERP knowledge among the key-users than what is required. This low knowledge level is perpetuated in chain, as the key-users are the ones supposed to share the acquired knowledge with the end-users also through training.

To counteract the key-users have to rely on the documentation provided by ERP vendors. The findings indicate that this documentation is often useless because it often is highly technical and kept very generic although a customised and process-oriented documentation would be required. Therefore, when facing a problem with ERPs, users try to turn to direct colleagues for help instead of the documentation. If they can't help the users often try to find solutions on their own through trial and error or use workaround outside of the ERPs.

The findings presented above demonstrate how the implementation of ERPs is a knowledge intensive process. Knowledge has to pass through these different actors which bears a risk of it being altered or reduced which then can lead to a lower ERP system knowledge. To mitigate these effects, a KES oriented ERPs implementation model have been designed, taking account of these issues. The KES can arguably lead to a more sustainable ERPs implementation.

3.2 Complications from Work Practices

Because users usually do not have the time to learn this content after the training takes place most of the learning content gets lost in this process and users have to rely on flawed documentation. The research conducted suggest that to solve this conundrum, not only the initial training should be taken into consideration, but also the KES happening place in everyday work. The findings of this research indicate that knowledge owners often face high amount of articulation work since they have to teach their knowledge to new employees and help colleagues with their issues with the ERP system. The study showed that they therefore started to implement systems on their own like group-chats with self-produced how-to videos to reduce the articulation work.

4 Ongoing Work

Based on the findings of the contextual study carried out in the context of the pre-study, a prototype for a practice-centred e-learning tool has been designed: CoursERP. The prototype features a tree-like structure to visualise distinct learning units similar to skill trees in video games. These learning trees should give users the possibility to learn ERPs in a didactically organised manner if they do not receive proper training but also should support classical training by organising the phases before and after the training. Lastly it should also be a tool for experienced workers to freshen their knowledge and close potential knowledge gaps.

To assess the extent to what this demonstrator can be appropriated by SME workers, different use cases have been outlined for the appropriation studies. Currently the prototype is implemented in the two application companies to examine how the demonstrator is used in practice. Since it is not possible to

implement all ERP knowledge directly, it has been decided that CoursERP would for specific use cases which will be explained in the following.

4.1 Training of Market Employees: The Beverage Industry Case

The participating company from the beverage industry, a beverage wholesaler, has the issue of high fluctuation in their market staff which leads to high amount of articulation work for the market managers due to on-the-job training. Therefore, a learning tree has been developed together with market managers for new employees to give them the possibility to learn on their own and, therefore, reduce the workload for market managers. Since in the markets itself there are not enough computers to learn, CoursERP has been made available to them via tablets so that they can learn as close to their practice as possible.

4.2 Distribution of Post training Materials and Exercises: The Case of the Metal-Working Industry

The project partner from the metal industry is currently in the implementation phase of a new ERPs and close to its go live. Therefore, many training are being conducted. To support these training and give the users to enable learning the ERPs after they received training at an event in a guided way, CoursERP should be used as a platform to distribute the learning materials and give the users tasks to help them memorise the learned content.

4.3 E-Learning Platform for ERP Seminars

In addition to the two industry use cases the demonstrator was implemented as a teaching platform for a practice oriented ERP seminar. Based on the findings of the studies carried out as part of this research, a practice-oriented ERP seminar was designed and CoursERP was used as a platform for students to receive the learning materials and to help them learn the content using the didactic path.

5 Future Work

Based on the proposed use cases, a series of additional appropriation studies will be conducted with the goal to observe to what extend the system supports the users in their goal to appropriate ERPs and to further develop the tool based on the findings stemming from the analysis of the appropriation study.

Acknowledgments

I would like to thank my supervisors Fabiano Pinatti and Claudia Müller for their support and guidance during these first parts of my academic journey. The research project 'ExpertERP' is funded by the German Federal Ministry for Education and Research (No. 02L20C021).

References

Ackerman, M. S., J. Dachtera, V. Pipek, and V. Wulf (2013): 'Sharing knowledge and expertise: The CSCW view of knowledge management'. *Computer Supported Cooperative Work (CSCW)*, vol. 22, pp. 531–573.

Ben Laadar, H., I. Cherti, and M. Bahaj (2019): 'ERP Systems in SMEs between a Choice & An Obligation'. In: *Proceedings of the 2019 8th International Conference on Educational and Information Technology*. pp. 222–229.

Candello, H., C. Pinhanez, M. Muller, and M. Wessel (2022): 'Unveiling Practices of Customer Service Content Curators of Conversational Agents'. *Proc. ACM Hum.-Comput. Interact.*, vol. 6, no. CSCW2.

Clarke, V. and V. Braun (2017): 'Thematic analysis'. *The journal of positive psychology*, vol. 12, no. 3, pp. 297–298.

De Carvalho, A. F. P., S. Hoffmann, D. Abele, M. Schweitzer, P. Tolmie, D. Randall, and V. Wulf (2018): 'Of embodied action and sensors: Knowledge and expertise sharing in industrial set-up'. *Computer Supported Cooperative Work (CSCW)*, vol. 27, pp. 875–916.

Iskanius, P. (2009): 'Risk Management in ERP Project in the Context of SMEs.'. *Engineering Letters*, vol. 17, no. 4.

Karasti, H., K. S. Baker, and F. Millerand (2010): 'Infrastructure time: Long-term matters in collaborative development'. *Computer Supported Cooperative Work (CSCW)*, vol. 19, pp. 377– 415.

Leyh, C. (2014): 'Critical success factors for ERP projects in small and medium-sized enterprisesThe perspective of selected German SMEs'. In: *2014 Federated Conference on Computer Science and Information Systems*. pp. 1181–1190.

Maas, J.-B., P. C. van Fenema, and J. Soeters (2014): 'ERP system usage: The role of control and empowerment'. *New Technology, Work and Employment*, vol. 29, no. 1, pp. 88–103.

Rutz, P., C. Kotthaus, A. F. Pinatti de Carvalho, D. Randall, and V. Pipek (2023): 'The Relevance of KES-Oriented Processes for the Implementation of ERP Systems: Findings From an Empirical Study in German SMEs'. *Proceedings of the ACM on Human-Computer Interaction*, vol. 7, no. CSCW2, pp. 1–34.

Schmidt, K. (1994): 'Cooperative Work and Its Articulation: Requirements For Computer Support'. *Le Travail Humain*, vol. 57, no. 4, pp. 345–366.

Valdebenito, J. and A. Quelopana (2018): 'Understanding the landscape of research in Enterprise Resource Planning (ERP) systems adoption'. In: *Proceedings of the 2018 International Conference on Computers in Management and Business*. pp. 35–39.

Wulf, V., M. Rohde, V. Pipek, and G. Stevens (2011): 'Engaging with practices: design case studies as a research framework in CSCW'. In: *Proceedings of the ACM 2011 conference on Computer supported cooperative work*. pp. 505–512.

Xu, Y., N. Rahmati, and V. C. S. Lee (2008): ‘A review of literature on enterprise resource planning systems’. *5th International Conference Service Systems and Service Management - Exploring Service Dynamics with Science and Innovative Technology, ICSSSM’08*.

Gerbl, Jennifer (2024): Analysing and Visualising the Rhythms and Flows of Hybrid Work. In: Proceedings of the 22nd European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centered Computing on the Design of Cooperation Technologies – Doctoral Colloquium Contributions, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.48340/ecscw2024_dc02

Analysing and Visualising the Rhythms and Flows of Hybrid Work

Jennifer Gerbl
Center for Enterprise Information Research, University of Koblenz, Germany
jgerbl@uni-koblenz.de

Abstract. Following the COVID-19 pandemic, there has been a growth in hybrid work arrangements in organisations. With this greater flexibility, hybrid workgroups face the challenge of increasingly complex levels of coordination, communication, and articulation work to organise the flow of work. To understand how these recent transformations shape the ways in which collaborative joint work takes place, the aim of this research is to provide more contextual analyses and rich visualisations of the rhythms and flows of joint work for hybrid workgroups. The exploratory study investigates the flow of synchronous work, the work locations and how the composition of workgroup members influences the daily work organisation. It explores the complex assemblages of people, technologies, and work contexts with a focus on the transitions between physical and digital workspaces. This requires novel methods capable of providing contextual richness over a long period. Hence, one aspect of this work is to address the methodological challenge of combining rich ethnographic data and methods with the scale of digital trace data analytics and computational methods. A longitudinal diary study will be conducted, designed to act as a bridge between both approaches, which will be enriched with digital trace data from selected collaboration systems.

1. Motivation and Background

The constant evolution in information and communication technologies in organisations has led to transformations and changes to the working lives of employees. During the COVID-19 pandemic, many employees were forced to work remotely, which accelerated these transformations and influenced how employees communicate, collaborate, coordinate and manage information (Lund et al. 2021; Mancl and Fraser 2020; Scharf et al. 2023; Sporsem et al. 2023). Following this, many companies stated that they will continue to support work from home to a certain extent (Allianz 2020; Siemens 2020; Šmite et al. 2023), resulting in a growth of diverse hybrid work arrangements and models (fixed vs. flexible, remote-centric vs. office-centric) (Gratton 2021; Hopkins and Bardoel 2023; Smite et al. 2023). With this greater flexibility in choosing when and where to work and which systems, application and tools to use, more complex assemblages of people, artefacts, technologies, work contexts and practices arise that are driven by regular switches and transitions between the physical and digital space. Consequently, this poses the challenges of increasingly complex levels of coordination, communication, and articulation work between workgroup members that are required to organise the flow of work within hybrid joint work (cf. Babapour Chafi et al. 2022; Bullinger-Hoffmann et al. 2021; Haas 2022).

Against this background, there is a need to provide more contextual analyses and rich visualisations to understand these recent transformations to work practices. With comprehensive insights into the rhythms and flows of hybrid work researchers can further explore, for example, the impact of work interruptions, identify empirical evidence for activity-based working or investigate emerging sequences of coordination work and the complexity of work practices that are driven by these seamless transitions and handoffs in software-supported collaborative work.

These insights provide a deeper understanding of hybrid collaborative work, which are needed "to sufficiently understand collaborative technology […] and to develop models that are in line with the variety and complexity of the systems that we are designing and using today" (Lee and Paine 2015, p. 183). Hence, this investigation will further explore this intersection between technology and work practices and sociotechnical change, drawing on insights from CSCW research (Ackerman 2000; Bullinger-Hoffmann et al. 2021; Schmidt and Bannon 2013) to identify and explore these new challenges, emerging work practices and new requirements that today's hybrid workgroups face.

However, to achieve this requires novel research methods that are capable of providing contextual richness over extended timeframes and allow for the identification of patterns and trends. Several studies have utilised diary methods to collect rich and contextual data about different aspects of work, such as task switching, interruptions or collaboration (Czerwinski et al. 2004; Shah and Leeder 2016), but these studies have a narrow temporal focus. The captured data could also

be enriched with further data to increase the scale of the investigation, as for example shown by Cao et al. (2021). Hence, one aspect of this work is to address the methodological challenge of bridging rich ethnographic and diary study data with digital trace data.

2. Research Aim and Questions

This work seeks to understand how these recent transformations shape the ways that collaborative joint work takes place. Workgroups in which members regularly switch between different work locations, different work tasks, and synchronous and asynchronous collaborative work activities experience new challenges and require higher levels of transitions and handoffs. As a result of adaptations to different compositions of workgroup members and their work location, new or adapted work practices and patterns might emerge. Hence, the aim of this research is to provide rich contextual analyses of the rhythms and flows of joint work for hybrid workgroups.

This involves the identification, analysis, and visualisation of the flow of synchronous and asynchronous work ("When are people working together synchronously?") and work locations ("When do individuals work in the office, when at home, and where do transitions occur?"). It explores activity-based working as well as other patterns and trends at an individual and workgroup level ("Are there work activities that typically preferred to take place in the office or at home?"). A key element of this research is to reveal the complexities and influencing factors of hybrid work by exploring and visualising the complex assemblages of people, artefacts, technologies, work contexts, practices, and processes. Special attention is paid to regular switches and transitions between physical and digital work locations, workspaces, and collaboration tools and how the composition of workgroup members influences the daily work organisation.

While this work investigates the rhythms and flows of hybrid work in general on a high-level, it continues with a specific focus on the flow and nature of (planned and spontaneous) collaborative or joint activities/meetings that take place within hybrid workgroups to inform synchronous work support.

3. Methodological Approach

With digital trace analytics researchers can follow users through traces they leave in collaboration systems and gain insights into how these systems are used, which actions they take and which artefacts people work with (cf. Lampe 2013; Mosen et al. 2020; Østerlund et al. 2020). One of the key benefits is the capability to handle the high volumes of data required to examine hybrid working holistically over a

long period of time. However, these non-reactive system data are descriptively thin (Janetzko 2017) and capture only what happens in the systems.

In contrast, workplace studies and ethnographic methods offer nuanced insights into the lived experience of hybrid workgroups and the situated improvisational and contextual factors these workgroups are operating in (Heath and Luff 2000; Suchman 2006; Szymanski and Whalen 2011). However, these methods face the challenge of handling high volumes of data, making them less scalable.

Thus, researchers face the challenge of having methods suitable for capturing and analysing large volumes of descriptively thin data as well as methods for capturing and analysing narrowly focused, low volumes of descriptively rich data and no methods for bridging between those two.

Hence, this study aims to combine the strengths of both approaches going beyond the traditional methods of ethnography and digital trace analytics by developing alternative methods that are capable of tracing work-based activity across multiple spatial and temporal frames on a larger scale.

To achieve this, a longitudinal diary study will be conducted, designed to act as a bridge between both approaches. This diary study is designed to capture in-depth contextual data across multiple spatial and temporal frames, meaning to follow different workgroup members who themselves transition between locations and work tasks over an extended timeframe. In a subsequent step the diary data will be enriched with digital trace data from selected collaboration systems and tools.

The idea is to increase the scale of research by leveraging the analytical possibilities provided by trace analytics and computational methods as well as to increase the scope and richness of the workplace study by extending and enriching trace data with more contextual and descriptively rich data gathered by the diary study and further ethnographic methods, such as interviews, that can be linked to the data captured in the diary.

The enriched and aggregated data set of sociotechnical sequences of collaborative hybrid work will then be further explored and suitable (computational) methods for analysing and visualising the rhythms and flows will be identified and developed. These visualisations and rich pictures will be the foundation for investigating the phenomenon of interest as outlined above.

In essence this work is exploratory and sociotechnical in nature and follows a pluralistic and pragmatic approach utilising a multitude of methods. For interpretation and analysis this work draws on theoretical and analytical lenses from the disciplines of Social Informatics/Science and Technology Studies, Computer-supported Cooperative Work and Workplace Studies. Furthermore, this research will draw from the emerging fields of computational ethnography and trace ethnography (Abramson et al. 2018; Beaulieu 2019; Geiger and Ribes 2011) for the development and design of the proposed novel approach that combines trace and ethnographic data and methods in the data collection, analysis and visualisation.

4. Expected Contribution

The contribution is two-fold: Firstly, it introduces a methodological advancement as it is extending ethnographic data in scale and scope by extending and enriching it effectively with digital trace data and computational methods. This includes the identification, design, and development of suitable methods and a thoughtful composition of the captured data and methods. This poses a significant methodological and data integration challenge, but when successfully solved will provide the foundations for comprehensive analyses, interpretations, and theorisations on the rhythm and flow of everyday work that can be adapted for similar research endeavours.

Secondly, the analysis and findings of this work contributes to the understanding of hybrid workgroups, the transforming and emerging work practices around coordination and collaboration within hybrid workgroups and the orchestrations and flow of hybrid work and collaborative synchronous sessions. In more detail, this work sheds lights on the lived experience of hybrid workgroups, provides empirical evidence into the sequences of (emerging) work practices involved in the conduction of hybrid work. Furthermore, it presents a comprehensive view of the complex assemblages of people, artefacts, technologies, and work contexts, shedding more light into the influencing factors of collaborative hybrid work and the transitions employees face in everyday work.

With these insights, researchers and organisations can identify and develop ways to better support hybrid and distributed workgroups and inform the design of collaborative systems and software that specifically address the challenges faced in the context of hybrid work.

5. Work/Findings to Date

The first phase of research is a longitudinal diary study in which a workgroup consisting of nine members is participating. The data collection started April 2023 and is ongoing in order to achieve a comprehensive dataset containing the data from at least one year. It contains daily data about the work times and work location on each day of work, as well as details about synchronous work activities such as meetings, e.g. start and end time, location, participants, or type of meeting (spontaneous vs. scheduled).

An app for the data collection of the diary data is currently in development. Current findings already revealed that the current method of data collection via an Excel spreadsheet is tedious and is more error-prone over the duration of the study. With the help of this data collection app, we aim to overcome some limitations and challenges diary studies face, such as participation fatigue or recall bias (Hyers 2018; Jarrahi et al. 2021), and improve the data quality and ease of use.

Besides the ongoing data collection, first ideas for rich visualisation of the rhythms and flows of hybrid work were developed. One example visualisation of the flow of meetings is shown in Figure 1. In addition to that, a first prototype of an interactive analysis and visualisation tool was developed to act as proof of concept of exploring the data and bringing the visualisation ideas to life.

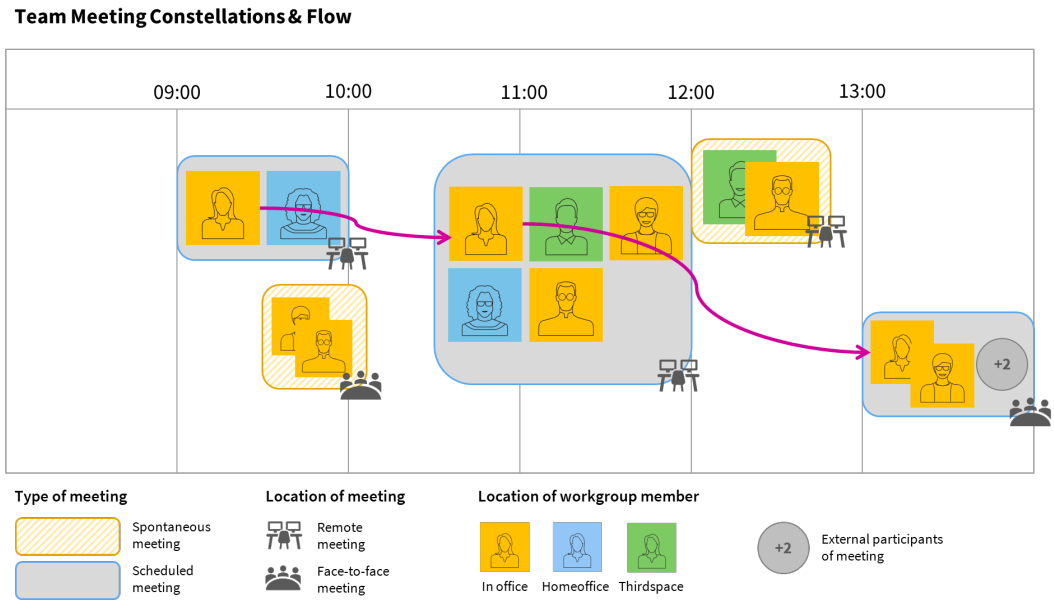

Figure 1: Example of one idea for visualising the flow of meetings.

Since the majority of the diary data is captured, next steps involve running deeper analyses of the data to explore the flow of work, initially on a high level. There are many interesting aspects to investigate further, such as identifying patterns, transitions, or frequent handoff situations (e.g. of actors, systems, documents, places). While the captured data already proved itself help- and insightful on its own, the idea behind the diary is to act as a bridge between ethnographic data and digital trace data to achieve a context-rich dataset. Hence, one major step is the enrichment of the current data with captured digital trace data from relevant systems and tools.

Acknowledgments

This Ph.D. project is part of a wider research programme of “2C-NOW: Collaboration and Coordination in Networks of Work - Phase 2: Hybrid Workgroups and Workspaces” (2C-NOW^2, project number: 442171294), which is funded by the Deutsche Forschungsgemeinschaft (DFG).

References

Abramson, C. M., Joslyn, J., Rendle, K. A., Garrett, S. B., & Dohan, D. (2018): 'The promises of computational ethnography: Improving transparency, replicability, and validity for realist approaches to ethnographic analysis', *Ethnography*, vol. 19, no. 2, pp. 254–284.

Ackerman, M. S. (2000): 'The Intellectual Challenge of CSCW: The Gap Between Social Requirements and Technical Feasibility', *Human–Computer Interaction*, vol. 15, no. 2-3, pp. 179–203.

Allianz (2020): 'Leben nach Covid: Die Neue Normalität', Retrieved January 19, 2024 from https://www.allianz.com/de/presse/news/geschaeftsfelder/it/201008_Allianz-Leben-nach-Covid-die-neue-Normalitaet.html.

Babapour Chafi, M., Hultberg, A., & Bozic Yams, N. (2022): 'Post-Pandemic Office Work: Perceived Challenges and Opportunities for a Sustainable Work Environment', *Sustainability*, vol. 14, no. 1, pp. 294.

Beaulieu, J. (2019): 'Vectors for fieldwork: Computational thinking and new modes of ethnography', in L. Hjorth, H. Horst, A. Galloway, & G. Bell (eds.): *The Routledge companion to digital ethnography,* Routledge companions, pp. 30–39. New York: Routledge.

Bullinger-Hoffmann, A., Koch, M., Möslein, K., & Richter, A. (2021): 'Computer-Supported Cooperative Work – Revisited', *i-com*, vol. 20, no. 3, pp. 215–228.

Cao, H., Lee, C.-J., Iqbal, S., Czerwinski, M., Wong, P. N. Y., Rintel, S., et al. (2021): 'Large Scale Analysis of Multitasking Behavior During Remote Meetings', in Y. Kitamura, A. Quigley, K. Isbister, T. Igarashi, P. Bjørn, & S. Drucker (eds.): *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (pp. 1–13). New York, NY, USA: ACM.

Czerwinski, M., Horvitz, E., & Wilhite, S. (2004): 'A diary study of task switching and interruptions', in E. Dykstra-Erickson, & M. Tscheligi (eds.): *Proceedings of the 2004 conference on Human factors in computing systems - CHI '04* (pp. 175–182). New York, New York, USA: ACM Press.

Geiger, R. S., & Ribes, D. (2011): 'Trace Ethnography: Following Coordination through Documentary Practices', in : *44th Hawaii International Conference on System Sciences* (pp. 1–10). IEEE.

Gratton, L. (2021): 'How to Do Hybrid Right', Harvard Business Review: 99 (May-June), https://hbr.org/2021/05/how-to-do-hybrid-right.

Haas, M. (2022): '5 Challenges of Hybrid Work — and How to Overcome Them', Retrieved January 18, 2024 from https://hbr.org/2022/02/5-challenges-of-hybrid-work-and-how-to-overcome-them.

Heath, C., & Luff, P. (2000): *Technology in Action:* Cambridge University Press.

Hopkins, J., & Bardoel, A. (2023): 'The Future Is Hybrid: How Organisations Are Designing and Supporting Sustainable Hybrid Work Models in Post-Pandemic Australia', *Sustainability*, vol. 15, no. 4, pp. 3086.

Hyers, L. L. (2018): *Diary methods. Understanding Qualitative Research* (Understanding qualitative research), Oxford: Oxford University Press.

Janetzko, D. (2017): 'Nonreactive Data Collection Online (Chapter 5)', in N. Fielding, R. M. Lee, & G. Blank (eds.): *The SAGE handbook of online research methods,* pp. 76–91. SAGE Reference.

Jarrahi, M. H., Goray, C., Zirker, S., & Zhang, Y. (2021): 'Digital Diaries as a Research Method for Capturing Practices in Situ', in G. Symon, K. Pritchard, & C. Hine (eds.): *Research Methods for Digital Work and Organization,* pp. 107–129. Oxford University Press.

Lampe, C. (2013): 'Behavioral Trace Data for Analyzing Online Communities', in S. Price, C. Jewitt, & B. Brown (eds.): *The Sage handbook of digital technology research,* pp. 236–249. SAGE.

Lee, C. P., & Paine, D. (2015): 'From The Matrix to a Model of Coordinated Action (MoCA)', in D. Cosley, A. Forte, L. Ciolfi, & D. McDonald (eds.): *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing* (pp. 179–194). ACM.

Lund, S., Madgavkar, A., Manyika, J., Smit, S., Ellingrud, K., & Robinson, O. (2021): 'The future of work after COVID-19, McKinsey Global Institute', Retrieved December 18, 2023 from https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-after-covid-19.

Mancl, D., & Fraser, S. D. (2020): 'COVID-19's Influence on the Future of Agile', in M. Paasivaara, & P. Kruchten (eds.): *Agile Processes in Software Engineering and Extreme Programming – Workshops,* Lecture Notes in Business Information Processing, vol. 396, pp. 309–316. Cham: Springer International Publishing.

Mosen, J., Williams, S. P., & Schubert, P. (2020): 'Visualizing Social Documents as Traces of Collaborative Activity in Enterprise Collaboration Platforms', in : *Proceedings of the 53rd Annual Hawaii International Conference on System Sciences HICSS 2020* .

Østerlund, C., Crowston, K., & Jackson, C. (2020): 'Building an Apparatus: Refractive, Reflective, and Diffractive Readings of Trace Data', *Journal of the Association for Information Systems,* pp. 1–22.

Scharf, N., Lükemann, L., Schubert, P., Williams, S., Abendroth, A., & Schwarz, A. (2023): 'Is the Structure of "Regular Working Days" about to Dissolve? Changes in Employees' Time-Use Patterns Working in Enterprise Collaboration Systems During the COVID-19 Pandemic', *Procedia Computer Science*, vol. 219, pp. 431–438.

Schmidt, K., & Bannon, L. (2013): 'Constructing CSCW: The First Quarter Century', *Computer Supported Cooperative Work (CSCW)*, vol. 22, no. 4-6, pp. 345–372.

Shah, C., & Leeder, C. (2016): 'Exploring collaborative work among graduate students through the C5 model of collaboration: A diary study', *Journal of Information Science*, vol. 42, no. 5, pp. 609–629.

Siemens (2020): *Siemens etabliert mobiles Arbeiten als Kernelement der 'neuen Normalität'*https://press.siemens.com/global/de/pressemitteilung/siemens-etabliert-mobiles-arbeiten-als-kernelement-der-neuen-normalitaet.

Smite, D., Christensen, E. L., Tell, P., & Russo, D. (2023): 'The Future Workplace: Characterizing the Spectrum of Hybrid Work Arrangements for Software Teams', *IEEE Software*, vol. 40, no. 2, pp. 34–41.

Šmite, D., Moe, N. B., Klotins, E., & Gonzalez-Huerta, J. (2023): 'From forced Working-From-Home to voluntary working-from-anywhere: Two revolutions in telework', *The Journal of systems and software*, vol. 195, pp. 111509.

Sporsem, T., Strand, A. F., & Hanssen, G. K. (2023): 'Unscheduled Meetings in Hybrid Work', *IEEE Software*, vol. 40, no. 2, pp. 42–49.

Suchman, L. A. (2006): *Human-machine reconfigurations. Plans and situated actions* (2nd ed): Cambridge University Press.

Szymanski, M. H., & Whalen, J. (2011): *Making work visible. Ethnographically grounded case studies of work practice* (Learning in doing: social, cognitive, and computational perspectives), Cambridge: Cambridge University Press.

Formentini, Lisa (2024): What remains of lockdown? Evolution of artifact ecologies in civil security organizations. In: Proceedings of the 22nd European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centered Computing on the Design of Cooperation Technologies - Doctoral Colloquium Contributions, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.48340/ecscw2024_dc03

What remains of lockdown? Evolution of artifact ecologies in civil security organizations

Lisa Formentini
LORIA - Université de Lorraine and LIST3N - UTT de Troyes, France
lisa.formentini@inria.fr

Abstract. Crisis situations often led to profound professional transformations in terms of resources and practices. For example, COVD-19 has had major impacts on work environments with measures such as mandatory mask wearing, social distancing and containment episodes. Civil protection organizations (firefighters, emergency operations, healthcare) have not returned to their pre-confinement set-up since the end of the pandemic: their collaborative tools and professional practices (i.e. regular introduction of teleworking, new inter-departmental communication tools), that is their artifact ecologies, have evolved. My research aims to develop a better characterization of these evolutions by documenting and analyzing the evolutions of the ecologies of hardware and software artifacts of civil protection organizations, while and after the lockdown period. To achieve this, my study uses a qualitative research strategy based on semi-directive interviews and practical observations of inter-service training sessions. The lessons learnt from this aim at providing guidance for dealing with changes during crisis situations in the context of long-term cooperating organizations and their associated ecologies of artifacts.

1 Positioning and research questions

The end of the COVID-19 pandemic marked the abolition of exceptional practices, such as the wearing of compulsory health masks and social distancing. To adapt to these special conditions, civil security populations (i.e. firefighters, emergency operations, healthcare), who always worked in close cooperation in the front line of a crisis situation (Linot, 2017), saw their collaborative processes, tools and work practices evolve in a very short time (Thirion, 2013; Chaluleau *et al.*, 2022). These radical changes in the practice of the profession have left their mark in current times, such as widespread practice of telecommuting or the insertion of new means of communication. However, few studies have documented these changes, and none have focused specifically on the civil protection profession.

Civil security organizations had to cope with lockdown while having to keep on their activities, combining presence on multiple changing fields, in remote work as well as hybrid configurations (Cormi, 2023). Therefore, their tools and practices of collaboration (*i.e.* softwares, hardwares, practical devices, remote work, etc.) or "artifact ecologies" had to change too. More than changing one tool for another, it's often the entire ecology of artifacts, taken as the set of hardware and software tools that actors possess and mobilize in a practice (Lyle *et al.*, 2020), that has had to be reshaped to enable activities to continue.

My research question deals with building a comprehensive and relevant overview of the evolution of the ecologies of artifacts of civil security organizations and professionals. Among the research work in CSCW and HCI studying artifact ecologies, this research identify different perspectives going from activity theories (see Bødker and Klokmose, 2011; Bødker, Lyle and Saad-Sulonen, 2017) to distributed cognition (see Vasiliou, 2017; Blandford and Furniss, 2005, 2010). Drawing on related and comparative theoretical work (Halverson, 2002), as well as examples of application to my own artifact ecologies, I identified several categories and visual representations reflecting key dimensions of artifact ecologies and their evolution: spatial, temporal, personal, interpersonal and interactional.

2 Fieldwork and methodological approach

On the basis of these dimensions, my research approach aims at documenting the evolutions of the ecologies of hardware and software artifacts of civil protection organizations, while and after the lockdown period. I am especially interested in which collaborative tools have been abandoned since COVID, which are retained, and why. As a first stage, I have chosen to focus my research on one civil security organization, namely the SDIS 57 firefighters of Moselle. Containing more than

5.000 agents and located in Saint-Julien-lès-Metz, the SDIS 57 is responsible for fire prevention, protection, and control as well as protection and fight against other accidents, disasters and catastrophes to the assessment and prevention of technological or natural risks and to emergency assistance of more than a million residents, distributed over 6.000 km2. On the basis of a qualitative inquiry, my study seeks to disentangle the sociotechnical practices that have been of use, and those that have since been discarded, during the lockdown as well as the motivations behind these evolutions from the perspectives of the involved actors. I draw on multiple qualitative research methods from interviews to observation taking inspiration from Linot (2017), who worked with the same population. I also chose my research methods based on many user cases drew from a particular cooperative tool or practice study (*i.e.* Jung, Stolterman, Ryan, Thompson Siegel, 2008) or a COVID-related phenomenon (*i.e.* Franco *et al.*, 2021). My ambition is to expand the analysis to the other organizations who work in cooperation with SDIS57 in order to complete the interdimensional description with multiple points of view.

3 Work to date and next steps

An initial interview was conducted with the head of research and development of the SDIS 57 of Moselle, which enabled us to officially validate our partnership around this thesis, as well as to negotiate our fieldwork approach based on semi-directive interviews with multiple stakeholders (*i.e.* firefighters from multiple SDIS, regional command centers, interdepartmental zone headquarters, health services, internal security forces, army, approved civil protection associations, air resources group, mine-clearing services, etc.) and a more exploratory observation of an inter-service exercise in anticipation of the 2024 Olympics. In parallel, I am considering the publication of a comparative theoretical article on the study of artifact ecologies for civil security. The next steps are to formalize and precise this methodology enough to create an interview guide and start interviewing the various actors previously mentioned while preparing the observation of inter-service practical training from the Field Command Center, whose capture will be reduced to handwritten notes. I will be able to start the data collection afterwards.

4 Expected contributions

The lessons learnt from this study will provide guidance for dealing with changes during crisis situations in the context of long-term cooperating organizations and their associated ecologies of artifacts. I will use knowledge from the practice of civil security organizations to design better collaborative working tools, and even help independent services to work with and between themselves in the future.

Finally, this work proposes a theoretical perspective for visual representation of the changing artifact ecologies, highlighting that it is necessary to mix approaches to obtain a more complete and accurate vision of a collective phenomenon.

References

Blandford, A., Furniss, D. (2006). DiCoT: A Methodology for Applying Distributed Cognition to the Design of Teamworking Systems. In S. W. Gilroy M. D. Harrison (Éds.), *Interactive Systems. Design, Specification, and Verification* (pp. 26-38). Springer. https://doi.org/10.1007/117527073

Bødker, S., Klokmose, C. (2011). The Human–Artifact Model: An Activity Theoretical Approach to Artifact Ecologies. *Human-Computer Interaction, 26*, pp. 315-371. https://doi.org/10.1080/07370024.2011.626709

Bødker, S., Lyle, P., Saad-Sulonen, J. (2017). *Untangling the Mess of Technological Artifacts: Investigating Community Artifact Ecologies: Full paper.* pp. 246-255. https://doi.org/10.1145/3083671.3083675

Chaluleau, J-L., Coudert, T., Badassari, C., Beyl, C., Corbin, G., Delzant, E., De plinval, B., Leclerc, P., Becq-giraudon, M; Peny, F. (2022). *Retour d'expérience de l'emploi des forces de sécurité intérieure et des personnels de sécurité civile pendant la crise sanitaire.*

Cormi, C. (2020). *Modélisation d'outils informatiques pour des pratiques coopératives, inter-organisationnelles et réglementées: Etude des pratiques de télémédecine dans un groupement hospitalier de territoire* [Thèse, Troyes]. https://www.theses.fr/s338896

Franco, Z., Kalet, A., Davis, C., Horng, M., Horng, J., Hernandez, C., Dotson, K., Yaspan, A., Kumar, A., Lijnse, B. (2021). *Augmenting Google Sheets to Improvise Community COVID-19 Mask Distribution.*

Halverson, C. A. (2002). Activity Theory and Distributed Cognition: Or What Does CSCW Need to DO with Theories? *Computer Supported Cooperative Work (CSCW), 11*(1), pp. 243-267. https://doi.org/10.1023/A:1015298005381

Jung, H., Stolterman, E., Ryan, W., Thompson, T., Siegel, M. (2008). Toward a framework for ecologies of artifacts: How are digital artifacts interconnected within a personal life? *Proceedings of the 5th Nordic Conference on Human-Computer Interaction: Building Bridges*, 201-210. https://doi.org/10.1145/1463160.1463182

Linot, B. (2016). *Confiance dans les situations de travail collaboratifs médiatisés par des environnements numériques.* [Thèse, Université de Lorraine]. https://www.theses.fr/s187689

Lyle, P., Korsgaard, H., Bødker, S. (2020). What's in an Ecology? A Review of Artifact, Communicative, Device and Information Ecologies. *Proceedings of the 11th Nordic Conference on Human-Computer Interaction: Shaping Experiences, Shaping Society*, pp. 1-14. https://doi.org/10.1145/3419249.3420185

Thirion, A. (2023). *Présentation stratégique du projet annuel de performances.*

Vasiliou, C. (2017). *A distributed cognition perspective for collaboration and coordination: artifact ecologies in design studies* [Thèse, Cyprus]. https://hal.science/hal-01599899/

Romero Goldar, Maria Sol (2024): Co-designing a Socio-Technical Solution to Mitigate Workplace Communication Overload: An Interdisciplinary Practice-Based Study. In: 22nd European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centered Computing on the Design of Cooperation Technologies – Doctoral Colloquium Contribution, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.18420/ecscw2024_dc04.

Co-designing a Socio-Technical Solution to Mitigate Workplace Communication Overload: An Interdisciplinary Practice-Based Study

Maria Sol Romero Goldar
CNRS-LISST-LAAS
maria.romero-goldar@univ-tlse2.fr

Abstract. The proliferation of Information and Communication Technologies (ICTs) in professional environments has led to an increase in communication activities, resulting in communication overload. This thesis seeks to address this challenge by proposing a socio-technical solution. Using a co-design methodology that integrates workshops, ethnography and interviews, the study explores workers' communication practices and organizational dynamics. These findings will be used to inform the system design and identify actionable strategies in the organization. The overall aim of this research is to deepen our understanding of effective solutions for improving communication practices and working conditions. It also aims to provide insights into interdisciplinary collaboration and methods for cross-disciplinary data sharing.

1 Introduction

The use of information and communication technologies (ICTs) in professional contexts has become widespread and communication is now distributed across different tools, both digital and non-digital. This blending of communication practices requires employees to engage in articulation work, which can be challenging as it involves cognitive, physical, attentional and coordination efforts (Denis & Licoppe, 2008; Figueiredo & Lopes, 2017; Ughetto, 2018). This has resulted in an increase in the communicative aspect, resulting in employees being exposed to multiple interruptions and simultaneous activities (Ingham, 2003; Datchary, 2011; Bidet, 2017; Arnold et al., 2023).

Consequently, there has been an increase in the use of digital and technological tools designed to enhance communication and collaboration in the workplace. These tools aim to simplify tasks and support employees in various activities. However, the rapid and frequent advancements in technology can present a challenge. When adopting new technological tools, it is necessary to reevaluate methods, processes, and organizational strategies (Bobillier Chaumon, 2020). This can lead to significant disruptions and disorganization in the workplace, which are often borne by individuals or groups.

Regulating workplace communication overload is a significant challenge for companies, both in terms of efficiency and occupational health. However, the solutions implemented thus far have been ineffective. Both awareness-based recommendations and purely technical solutions are not perceived as effective means of improving practices (Prost & Zouinar, 2015; Salembier & Zouinar, 2017).

2 Research questions and methodological approach

The objective of this thesis1 is to co-design a socio-technical solution that regulates communication in order to reduce communication overload among employees. The methodology used combines co-design workshops with ethnography and employee interviews. Its purpose is to serve both the development of new practices and the advancement of scientific knowledge through a dialectical reflection/action process (Sendra et al., 2022). To achieve this, the project adopts a participatory design approach that involves stakeholders in the early stages (Koskinen et al., 2011). This approach is guided by principles of participation, democracy, inclusion, equality, and sharing (van der Velden & Mörtberg, 2021). It recognizes individuals as genuine experts on their own

[1] This thesis is part of the interdisciplinary research project titled "VERTUOSE: Towards an infrastructure for communication supporting sustainable mediated communication practices." It brings together sociologists, computer scientists, and a psychologist. The project involves three research laboratories (LAAS, LISST, LIST3N) and is supported by the French National Centre for Scientific Research.

situations and the issues that concern them, rather than being referred to as mere 'users' (Sanders, 2008).

This practice-based study examines workers' practical experiences and the socio-organizational conditions that shape communication activity. The analysis aims to contribute to the design process by providing information on practices, work activity, representations, and organizational issues (Anderson, 1997). It also provides recommendations for system redesign and identifies constraints that individuals encounter in their activities (Baxter & Sommerville, 2011).

The study seeks to answer the following research questions: How can interventions in communication practices improve employees' quality of life and working conditions? How are communication conventions collectively developed? How can these discussions be facilitated? The study explores the strategies used by individuals to regulate communication and the collective conventions of use, which may be more or less negotiated and explicit (Datchary, 2011). The aim of this intervention is multi-layered, as it not only defines tool functionalities but also elaborates on the collective and organizational dimensions of the tool's implementation. The technical aspect involves software deployed on the organization's IT infrastructure and various terminals. This is supported by an organizational intervention aimed at assisting employees in establishing collective conventions that will direct the system's actions to reduce repetitive, exhausting, or problematic communication. Additionally, involving employees from the beginning of the project ensures transparency, comprehension, and ownership of the solution, which are prerequisites for its long-term sustainability.

Considering the interdisciplinary nature of the project, the study also examines the issues and contributions of sociology when working with other disciplines. It explores the interaction between Sociology and Computer Science within the research group, including the complementarity between disciplines and the circulation of theories, concepts, and methods.

3 Work and findings to date

The work completed thus far can be classified into three main areas: a literature review, fieldwork, and the start of data analysis. Initially, a systematic literature review and synthesis were conducted based on various approaches in the areas of workplace communication, participatory design, interdisciplinary work, and computer network architecture.

Fieldwork with the project's partner organization began in February 2022. The process involved several techniques, including 110 hours of ethnographic observation, 5 hours of interviews, 19 hours of co-piloting meetings, and two co-design workshops with all employees, each lasting two days for a total of 14 hours. The purpose of the interviews and ethnographic observation was to gain a comprehensive understanding of the workers' practices and the role of

communication in their work. This information was used to plan workshops and design activities based on participants' actual experiences, even during the ideation phase. In addition, this method proved to be an efficient way to avoid costly self-observation by employees in a context of time pressure (Gaudart & Volkoff, 2022). The constant presence in the field also strengthened the participants' confidence, allowing them to fully engage in the exchange.

Co-piloting meetings were used to jointly monitor the project's progress with two employee volunteers, co-conceive research hypotheses, and plan and debrief co-design workshops. These individuals play a crucial role as privileged informants, monitoring organizational changes resulting from our discussions in terms of both organizational and communication conventions.

The co-design workshops aim to define the research problem and co-design solutions that are adapted to the employees' reality. These discussion forums bring together employees, sociologists, and computer scientists to share, learn, and confront their points of view, with the goal of co-constructing a solution that is acceptable and accepted by all. Each day has been planned carefully to establish a framework of listening and mutual trust, where individuals express diverse viewpoints and engage in a process of 'reflection-in-action' (Grosjean et al., 2019).

The analysis of the data has already started. Different methods for storing and integrating data from various sources are being tested. This task is challenging as it requires significant effort, particularly in formatting the data. Additionally, analyses are difficult to carry out since each piece of data reflects different aspects of reality. There is also the challenge of interdisciplinary work since the data analyses must lead to useful recommendations for the computer system's design (Ackerman, 2000). The research team is currently analyzing the data collected during these workshops, taking a truly interdisciplinary approach to designing a system that considers the diversity of viewpoints within the partner organization.

The preliminary findings suggest that employees' work is characterized by the succession and interweaving of different projects, resulting in intrinsic fragmentation. This type of work necessitates individual and collective organization of activities and working time. However, engaging in multiple activities does not necessarily result in constant interruptions on a daily basis (Datchary, 2011). According to Datchary & Licoppe (2007), even if a person appears to be engaged in just one activity, the others remain in play.

Overload can become an issue when communication becomes burdensome and lacks meaning for workers. The workshops revealed concrete problems related to work overload, difficulties in coordinating hybrid work, and dissatisfaction with certain forms of collective organization. These discussions allowed for a review of current practices and the exploration of collective solutions, which are currently undergoing testing. Furthermore, the employees proposed an inventory

of potential forms for a regulatory body focused on communication and provided a list of ten data points to share with the research team.

4 Next steps

Future challenges include analyzing workshop data, continuing ethnographic work, and testing the functionalities offered by the new system developed by the computer scientists in collaboration with the participants.

To avoid perpetuating power imbalances between disciplines within the research team, it is essential to involve the Humanities and Social Sciences in the design process led by computer scientists. This task requires a clear articulation of terminologies, techniques, and ways of knowing, since ethnographic totalization procedures involve immersion in the uniqueness of circumstances, whereas computational modeling involves generalization at a universal level. Additionally, this work involves a strong connection between the analyses derived from qualitative research and the practical demands of system design (Karasti, 2001).

Relating professional practices to system design can be a complex process that may not align with typical research timelines. Questions often arise regarding the duration of sociological analyses and the need to make progress in system design. However, I strongly believe that this complex approach is worthwhile as it ensures a deep understanding of social realities while also facilitating the development of a technological solution that is tailored to and embraced by all stakeholders involved.

5 Expected contributions

The contribution of my thesis is threefold. Firstly, it aims to consolidate knowledge of the strategies employed by workers, collectives, and organizations to mitigate communication overload. The analysis of the three-year processes will enhance understanding of effective solutions to improve communication practices and working conditions.

Secondly, the insights gained from this study aim to contribute to bridging the gap between qualitative research findings and the practical requirements of system design. Specifically, I am interested in exploring manners of facilitating the translation of ethnographic and sociological data into actionable contributions in the field of collaborative systems design.

Finally, this research will provide insights into interdisciplinary collaboration and methods for sharing data across disciplines. It will explore ways to foster collaboration among researchers from different backgrounds who use different methodologies, particularly in computer science (such as modeling) and social science (such as inductive analysis).

References

Ackerman, M. S. (2000). The Intellectual Challenge of CSCW: The Gap Between Social Requirements and Technical Feasibility. Human–Computer Interaction, 15(2-3), 179-203. https://doi.org/10.1207/S15327051HCI1523_5

Arnold, M., Goldschmitt, M., & Rigotti, T. (2023). Dealing with information overload: A comprehensive review. Frontiers in Psychology, 14, 1122200. https://doi.org/10.3389/fpsyg.2023.1122200

Baxter, G., & Sommerville, I. (2011). Socio-technical systems: From design methods to systems engineering. Interacting with Computers, 23(1), 4-17. https://doi.org/10.1016/j.intcom.2010.07.003

Bidet, A. (2017). Être « contraint de s'organiser »: La multi-activité, entre situations de travail et formes sociales. In C. Datchary & G. Gaglio, Quand travailler, c'est s'organiser: La multi-activité à l'ère numérique. Presses des Mines.

Bobillier Chaumon, M.-E. (Éd.). (2020). Digital transformations in the challenge of activity and work: Understanding and supporting technological changes. ISTE Ltd / John Wiley and Sons Inc.

Datchary, C. (2011). La disperstion au travail (Octares éd).

Datchary, C., & Licoppe, C. (2007). La multi-activité et ses appuis: L'exemple de la "présence obstinée" des messages dans l'environnement de travail. Activités, 4(1),

de Bailliencourt, T., Beauvisage, T., & Smoreda, Z. (2007). La communication interpersonnelle face à la multiplication des technologies de contact. Réseaux, 145-146(6-7), 81-115.

Denis, J., & Licoppe, C. (2008). La coprésence équipée. Usages de la messagerie instantanée en entreprise.

Figueiredo, M., Rui Pedro, & Lopes, B., Joao Carlos. (2017). Information and Communication Overload in the Digital Age. IGI Global.

Gaudart, C., & Volkoff, S. (2022). Le travail pressé: Pour une écologie des temps du travail. Petits matins.

Grosjean, S., Bonneville, L., & Redpath, C. (2019). Le patient comme acteur du design en e-santé: Design participatif d'une application mobile pour patients cardiaques. Sciences du Design, 9(1), 65-83. https://doi.org/10.3917/sdd.009.0065

Ingham, J. (2003). E-mail overload in the UK workplace. Aslib Proceedings, 55(3), 166-180. https://doi.org/10.1108/00012530310472651

Karasti, H. (2001). Bridging Work Practice and System Design: Integrating Systemic Analysis, Appreciative Intervention and Practitioner Participation. Computer Supported Cooperative Work (CSCW), 10(2), 211-246. https://doi.org/10.1023/A:1011239126617

Koskinen, I. K., Zimmerman, J., Binder, T., Redström, J., & Wensveen, S. (2011). Design research through practice: From the lab, field, and showroom. Morgan Kaufmann/Elsevier.

Prost, M., & Zouinar, M. (2015). De l'hyper-connexion à la déconnexion: Quand les entreprises tentent de réguler l'usage professionnel des e-mails. Perspectives interdisciplinaires sur le travail et la santé, 17-1, Art. 17-1. https://doi.org/10.4000/pistes.4454

Salembier, P., & Zouinar, M. (2017). Interruptions et TIC: De l'analyse des usages à la conception. In A. Bidet, C. Datchary, & G. Gaglio, Quand travailler, c'est s'organiser: La multi-activité à l'ère numérique. Presses des Mines.

Sanders, E. (2008). An Evolving Map of Design Practice and Design Research. Interactions, 15(6), 13-17. https://doi.org/10.1145/1409040.1409043

Ughetto, P. (2018). Les nouvelles sociologies du travail : Introduction à la sociologie de l'activité. De Boeck supérieur.

Coeuret, Margaux (2024): Exploring collaborative practices in qualitative analysis: the case of GTM. In: Proceedings of the 22nd European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centered Computing on the Design of Cooperation Technologies - Doctoral Colloquium Contributions, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.48340/ecscw2024_dc05

Exploring collaborative practices in qualitative analysis: the case of GTM

Margaux Coeuret
LIST3N/Tech-CICO, Université de Technologie de Troyes, France
margaux.coeuret@utt.fr

Abstract. This doctoral research project aims to study the collaborative practices of social scientists who use Grounded Theory Methodology (GTM). The main objective is to analyze how these researchers organize their collaboration within the analysis process of GTM. The study will first review the literature to understand the evolution of cooperation within GTM, which includes cooperative data collection, joint theorizing, and peer validation. A field study will then focus on social scientists at the University of Liège, including observations, interviews, and scenarios. This fieldwork will be enriched by including design sciences researchers from the Université de Technologie de Troyes. In the final phase of this research, the potential of artificial intelligence and data visualization in survey assistance, case clustering, and theorizing will be explored. To overcome the current limitations of CAQDAS software, a proposal for a collaboration tool aligned with GTM practices will be put forward. This research will contribute to a deeper understanding of researchers' GTM collaboration practices and tools.

1 Research Questions

The notion of collaborative research refers to the relations that researchers have with each other in their practices and data analysis. This doctoral research is interested in understanding collaborative practices of social science researchers using grounded theory methods for qualitative analysis. Grounded Theory Methodology (GTM), formalized by Glaser and Strauss (1967), aims to build scientific theories from the analysis of field data rather than from pre-existing theoretical frameworks. Researchers using this method place a premium on data, recording their reflections in memos and applying an iterative process governed by the theoretical saturation of data. This analytical work is used as a central organizing principle for a large-scale research project as a whole (Bryant and Charmaz, 2007). GTM thus encourages collaboration between researchers, enabling a constant exchange of ideas and perspectives. However, little is known in the literature about how researchers using GTM cooperate. Our question in this context is: How is a collaboration between researchers organized within qualitative analysis using grounded theory, and what are the services and tools supporting this cooperation?

2 Methodological approach

Our methodology for understanding and supporting collaborative practices in grounded theory methods involves three key steps: first a theoretical analysis of recommended practices that we will then compare with field studies of actual practices. These two stages will then be used to study the existing tools that support GTM in order to design and integrate new features that can assist in better qualitative analysis for collaborative research. To initiate our approach, we conducted an in-depth analysis of the state of the art on researchers' collaboration in the context of GTM (Muller & Kogan, 2010). This investigative step, currently ongoing, can often be overlooked by researchers who rely primarily on field data. Whereas a state of the art is rarely conducted when focusing on field data, we chose to start with an analysis of handbooks and methodology books in order to better observe and understand methodological divergences among practitioners (Schmidt & Bannon, 1992; Malone & Crowston, 1990). The guidelines mentioned in the literature will then be compared with the actual practices of researchers in a collaborative environment. Observation techniques will be used to collect experimental data from grounded theory users and analyze their experience with the current software and tools that aid in their qualitative analysis. This will enable a comparison of recommended practices in grounded theory methodology literature with actual practices of different user groups. As a third step and based on our analysis of researchers' current collaborative

practices, we will design and integrate new functionalities into IT tools that could support this collective work. This step comes after identifying user needs and practices. The aim is to examine how to offer practical support to researchers while exploring the potential of artificial intelligence (AI) and data visualization as a tool to assist cooperative qualitative analysis during the grounded theory method. Our contributions to current tools will involve assistance in three GTM tasks: conducting the survey, analyzing "coding" interview transcripts, and articulating/theorizing cases. Our methodology will adopt an iterative and exploratory approach. We revisit our inquiries, fieldwork, and interview methods at each data analysis phase to uncover researchers' collaborative practices. This entails reviewing the theoretical analysis stage, conducting fresh field studies, and adapting tools as needed with each discovery.

3 Current findings

In the literature on Grounded Theory Methodology, the researcher often presents the work of analysis as an individual process. Glaser and Strauss (1967) stressed the need for researchers to remain open and attentive to the data, to avoid preconceived judgments, and to let theories emerge from the analysis of observations. This approach advocates maintaining an analytical distance to prevent any undue influence from existing literature or pre-established theories and to preserve, in their view, the originality and authenticity of the theories emerging from the study. Similarly, a parallel perspective is emerging, highlighting the collaborative nature of analytic work and its potential to foster the researcher's personal reflexivity and theoretical emergence. The co-construction of analyses and theoretical concepts can enrich the results and push the researcher to deepen their research (Corbin and Strauss, 2008; Charmaz, 2006; Morse et al., 2021). This cooperation among researchers on the same project is encouraged from the beginning of the research process, involving the selection of participants and data collection. Strauss and Corbin (1990) in "Basics of Qualitative Research: Grounded Theory Procedures and Techniques", highlight case studies on the Vietnam War, where the initial collaboration and historical knowledge of both researchers helped better target the actors to be interviewed (combatants and non-combatants) and the data collection method (interviews, reading war narratives, etc.). Cooperation within the GTM is also built through interaction between researchers and the subject. This constructivist approach considers that concepts and theories emerge from the interaction between researchers and participants, underlining the importance of constant reflection. Through their interviews, the two actors co-construct the participants' experiences through their narratives (Charmaz, 2008)). Collaboration between researchers takes shape during the reflection phase on the analysis of collected data, enabling the initial meanings of observed phenomena to be extracted. This reflective phase

can be facilitated by keeping a journal where impressions, decisions, and personal reflections on the researcher's analytical journey are recorded (Charmaz, 2006). Based on the researchers' personal diaries, these team exchanges encourage reflection and communication between them, ensuring transparency and consistency in data analysis. This collaborative stage helps develop a rich data vision by examining personal and interpersonal responses. It allows the development of the researcher's "sensitivity", which is the ability to present oneself from the participant's point of view and play the role of the other through collaborative immersion in the data (Corbin and Strauss, 2008).

The contribution of team discussions about data also becomes apparent during the material coding process. As Corbin and Strauss (2008) emphasizes, it is essential to regularly share and discuss individual interpretations during coding and data analysis. Team coding also allows novice researchers to transition from specific to abstract concepts more quickly (Wiener, 2007). This group practice facilitates the confrontation of different interpretative perspectives and refines the understanding of categories as the research progresses. Ongoing discussions among researchers maintain openness to various analysis paths, fostering the emergence of additional perspectives during subsequent theoretical samplings. Collaboration among researchers extends to theoretical construction. Codes derived from teamwork, memos analyzed and constructed during meetings, and discussions contribute to refining the term, becoming the main category of the theory (Wiener, 2007). This analytical approach subsequently facilitates peer validation by encouraging the presentation and discussion of ideas as a team, helping to validate and refine theoretical concepts. According to this literature analysis of GTM, collaboration evolves progressively, encompassing cooperation in data collection, the joint development of theories, and peer validation. Building on the literature, our approach will involve conducting field studies to explore the collaborative practices employed by GTM researchers (Muller & Kogan, 2010).

4 Next steps

To explore researchers' actual collaborative practices in qualitative analysis through grounded theorizing, our field work will focus primarily on the University of Liège. This choice is explained by the diversity of students and researchers in the social sciences (sociology, education sciences, psychology, etc.) in Liège, who are training in qualitative analysis and GTM under the supervision of Christophe Lejeune. We plan to extend our study to researchers in design sciences at the Université de Technologie de Troyes. This extension is intended to enrich our understanding of collaboration between researchers within the framework of GTM. Compared to Liège, these informants are distinguished by their active engagement in a dynamic of systems design and transformation fostering in the humanities and social sciences, an approach generally absent,

with the notable exception of management sciences and ergonomics. By combining these two fields, we hope to obtain a diverse sample of researchers and collaborative practices in grounded theory analysis.

From March 2024, our research study in Liège will focus on two groups. The first group will comprise six undergraduate PhD students in the social sciences, who will engage in weekly hands-on collective analysis work. The second group will be made up of doctoral students and teacher-researchers in psychology and education, who will take part in discussion seminars on their individual and collaborative practices of the grounded theorizing method. To begin with, we will conduct a preliminary observation phase using the shadowing method. This approach involves closely following the subjects in their analytical practice while observing their natural behavior when using tools. This methodology will enable us to capture the dynamics and nuances of analytical processes within these specific groups in great detail. After the group classes, we plan to conduct two types of interviews to understand collaborative practices better. The first type is the semi-structured, free-form, life-focused individual interviews, where we will explore the researchers' personal experiences with GTM collaboration. The second type is group interviews, mainly using the focus group method, which will focus on observed interactions by having participants verbalize them and explore shared representations between users of qualitative analysis tools (Schmidt & Bannon, 1992). Finally, we'll use scenarios to support conversations about collaborative methodological practices and tools to help them express their needs. This method will enable us to reflect on collaborative applications and practices. It will allow us to collect a variety of data, which will be compared as we go along. We will use this data collection method with researchers at the Université de Technologie de Troyes who use GTM. At the end of the fieldwork, we will have identified the theoretical orientations and effective collaborative practices of GTM researchers. In this final stage of research, we will explore the potential of data visualization and artificial intelligence (AI) as an analytical lens through which human researchers can see new data elements or representations through which they can compare codes and other interpretations (Muller et al., 2016). We are interested in providing assistance in three different tasks:

- **Survey assistance:** The main aim is to facilitate the identification of relevant elements when coding the corpus, while guiding users in making decisions about closing the survey. For instance, clustering, obtained whether visually or through machine learning algorithms, allows researchers to grasp potential data patterns.
- **Assistance with reading and analyzing interviews:** This exploration will involve detecting emerging trends and weak signals, as well as facilitating text comparison. Lexicometric algorithms can be used to revisit the text, see it differently, or highlight specific elements. It will be possible to

display text "specificities" with visual elements such as rare words (Spärk, 1972).

- **Assistance with the articulating of cases and theorizing:** The final contribution will be to support researchers in developing their theoretical analysis through augmented visualizations, such as graphs or matrices. These visualization methods aim to showcase the benefits of data visualization in qualitative analysis and theoretical emergence (Kuckartz, 2010).

5 Towards implications for design

Semi-automatic software, commonly called "CAQDAS" such as NVivo, AtlasTI, or MaxQDA, have mainly marked the qualitative research landscape, particularly in GTM. These tools have undeniably facilitated the analysis process by offering functionalities such as labeling, editing, and schematization, thus contributing to the structuring and understanding of collected data (Muller & Kogan, 2010). However, despite their usefulness, these software packages have significant shortcomings in fully meeting the needs of GTM researchers, whose practice goes beyond simple coding. The focus on coding, highlighted in the specialized literature, sometimes diverts these tools from the strict application of GTM. Certain functionalities, often integrated for marketing purposes, can lead to a reductive vision of the methodology, neglecting other crucial aspects of the collaborative work of GTM researchers. With this in mind, our research proposes to overcome the current limitations of CAQDAS by designing a collaborative tool specifically aligned with the practice of GTM researchers. We draw on cooperative theory, put forward by researchers such as Christophe Lejeune (2017) and Charmaz (2006), to emphasize overlooked but essential features such as logs, diagrams, and bottom-up labeling. By involving researchers directly in the creative process through cooperative workshops, their needs and practices are thoroughly considered. This approach goes beyond just improving existing functionalities and integrating user testing stages based on the UX method. These tests help to clarify users' fundamental objectives, ensuring that the tool designed meets the specific needs of GTM researchers (Schmidt & Bannon, 1992; Malone & Crowston, 1990).

References

Bryant, A. and K. Charmaz (2007): *The Sage handbook of grounded theory*. Sage publications.

Charmaz, K. (2006): *Constructing grounded theory: A practical guide through qualitative analysis*. Sage.

Charmaz, K. (2008): ‘Grounded theory as an emergent method’. *Handbook of emergent methods*, vol. 155, pp. 172.

Corbin, J. and A. Strauss (2008): ‘Qualitative research’. *Techniques and procedures for developing grounded theory*, vol. 3.

Glaser, B. and A. Strauss (1967): ‘Grounded theory: The discovery of grounded theory’. *Sociology the journal of the British sociological association*, vol. 12, no. 1, pp. 27–49.

Kuckartz, U. (2010): ‘Innovations dans un logiciel d’analyse qualitative de données: l’intégration d’outils de visualisation’. *Recherches Qualitatives*, vol. 9, pp. 109–119.

Malone, T. W., & Crowston, K. (1990). What is coordination theory and how can it help design cooperative work systems? *Proceedings of the 1990 ACM Conference on Computer-Supported Cooperative Work, CSCW 1990*, (October), 357–370.

Morse, J. M., B. J. Bowers, K. Charmaz, A. E. Clarke, J. Corbin, C. J. Porr, and P. N. Stern (2021): *Developing grounded theory: The second generation revisited*. Routledge.

Muller, M., S. Guha, E. P. Baumer, D. Mimno, and N. S. Shami (2016): ‘Machine learning and grounded theory method: convergence, divergence, and combination’. In: *Proceedings of the 2016 ACM International Conference on Supporting Group Work*. pp. 3–8.

Muller, M. J., and Kogan, S. (2010). Grounded theory method in HCI and CSCW. *Cambridge: IBM Center for Social Software*, *28*(2), 1–46.

Schmidt, K., and Bannon, L. J. (1992). Taking CSCW Seriously: Supporting Articulation Work. *Computer Supported Cooperative Work*, *1*(1–2), 7–40.

Strauss, A. and J. Corbin (1990): *Basics of qualitative research*. Sage publications.

Wiener, C. (2007): ‘Making teams work in conducting grounded theory’. *The Sage handbook of grounded theory*, vol. 4, pp. 293–310.

Lauferon, Alexis (2024): Understanding the changes in railway maintenance work: a sociotechnical perspective. In: Proceedings of the 22nd European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centered Computing on the Design of Cooperation Technologies - Doctoral Colloquium Contribution, Reports of the European Society for Socially Embedded Technologies (2510-2591), DOI: 10.48340/ecscw2024_dc06.

Understanding the Changes in Railway Maintenance Work: A Sociotechnical Perspective

Alexis Lauferon
Troyes University of Technology (UTT), LIST3N/Tech-CICO, France
alexis.lauferon@utt.fr;

Abstract. Railway maintenance work is relatively unknown to the general public, and sociologists have shown little interest in it. It is an outdoor job, punctuated by interventions, equipped with a lot of artifacts and distributed on the rails. This paper presents my PhD work, at the intersection between the concerns of the sociology of work, concerned with studying and characterizing this professional activity, and the CSCW, particularly around the method of technology probes and discussions between ethnography and design.

1. Context and research questions

This work is part of a large project funded by the French Public Bank for Innovation, piloted by Vossloh, a leading global rail technology company that sells integrated offers for rail transportation including for instance track fastening

systems, concrete ties, switch systems, crossings, so as services associated with the lifecycle of rail tracks. The aim of this major 4-year project is to bring together players in the rail and safety industries and researchers to develop a new-generation, secure remote monitoring system dedicated to rail infrastructures, using a range of devices: Innovative sensors, new-generation concentrators dedicated to local data collection and transmission, a centralized data acquisition system with real-time data processing and analysis, modular user interfaces with key indicators based on usage, maintenance prediction and alarms, and an operator support system for the maintenance on the field.

Transformations in the socio-professional practices of railway maintenance workers are therefore the focus of this study. This study belongs to a sociological research tradition that examines how new technologies are appropriated and used in the work situation and how they redefine the organizational contours. It articulates several levels of analysis. Firstly, it focuses on the work activity by analyzing the forms of learning and use (individual and collective) and the incorporation of new tools in the workplace. This is done by mobilizing the notion of "artifact ecology". "ecology of artifacts" concept (Bødker and Klokmose, 2012; Lyle et al., 2020), sometimes referred to as a constellation of technologies (Rossito and al., 2014) or digital assemblages (Sawyer et al. 2014). These concepts are particularly useful for understanding work activity as it happens and for grasping the situated nature of the use of artefacts at work, describing in precise terms the places, temporalities and resources of action. In addition, these concepts offer a dynamic vision of digital tools and their appropriation by workers that can evolve.

With this in mind, we can ask ourselves, how is maintaining re-composed? How are individual and collective choices, capacities for action, but also the relationship with production standards or safety, transformed by remote monitoring and the use of data from sensors or computerized maintenance management systems? Should we fear a risk of de-skilling, a loss of meaning and knowledge, or (and under what conditions) can artefacts be a resource or an affordance for the (re)construction of one's own activity individually and collectively, and engage in articulation work (Strauss, 1992)?

At the meso and macro levels, the aim is to examine how these technologies enable (or fail to enable) new, more flexible, articulated work, based in part on automated actions. What are the implications of these changes for work organization and job definitions, but also for management, support and employment, qualifications and subcontracting relationships? From this perspective, this research can be seen as feeding into the broader questions about changes in the world of work and production models around the so-called "industries of the future" or "future of work".

2. Methodological approach

This PhD work is based on a variety of data collected in a single site study. This study takes place in a small (around fifty employees) French private railway maintenance company, which was created less than ten years ago. This organization is considered as “innovative” in the railway domain because both the railway infrastructure is recent and the organization is equipped with relatively new maintenance machines (with several inspection wagons) and surveillance technologies (notably in remote monitoring systems and sensors).

First, several ethnographic observations were carried out in situ from January 2022 to the present, for about eighty hours. These observations took place both on the maintenance sites and in the maintenance control center of an infrastructure management company. This ethnographic approach allowed the collection of a set of heterogeneous documents related to the maintenance activity on this site (job descriptions, documentation of the integrated management system, operating procedures, photographs of the maintenance sites, etc.)

In addition, 8 semi-structured interviews were conducted in 2023 and 14 are in march 2024: 17 with maintenance technicians, 8 with workers in maintenance a coordination center and 5 with middle management. These semi-structured interviews were then used to carry out a thematic analysis, supported by NVivo software.

As part of the wider research project, I am taking part in an industrial working group involving researchers and industrial actors. The aim of this working group is to develop solutions to make the work of maintenance technicians easier, and therefore to 'equip' them with maintenance aid solutions. In this respect, it resonates with questions raised by CSCW researchers about the links between ethnography and design (Blomberg and Karasti, 2013). We have introduced in the project the idea of working with technology probes (Hutchinson et al., 2003 ; Hemmings et al., 2002), as this research and design method "combines the social science goal of gathering information about the use and users of technology in a real-world setting, the engineering goal of field-testing the technology, and the design goal of inspiring users and designers to think about new kinds of technology to support their needs and desires" (Hutchinson et al., 2003, p. 18).

3. Findings and next steps

Thanks to my initial observations and interviews, I was able to make a number of empirical observations about the characteristics of maintenance work. Firstly, site work is outdoor work, most of it at night, and physically demanding. It is also distributed work, where technicians can work synchronously (or not) on different objects in the same area, which is quite surprising when you're not familiar with

the environment. People spread out around the objects without necessarily having to talk to each other and start working, their tasks in mind following a briefing given earlier in the night.

The second observation is that this work is already very well equipped, with tools of various kinds. These include both purely technical tools (such as spanners, hammers, rulers, etc.) and digital artefacts, particularly smartphones. In fact, in addition to the various software applications used, for example, to fill in maintenance forms, technicians use their smartphones to coordinate their work simultaneously, by making calls to each other or writing to each other in an internal group via a social network. A night's work ends when the intervention is finished, the idea always being to get feedback from colleagues quickly so as not to lose time (or gain time). I would like to take a closer look at these issues of time (saving time, losing time, hurrying, shortening a job, rescheduling it, etc.) and space (dividing up, moving between two locations, communicating remotely, etc.) to get a better grasp of how smartphones are used during interventions.

These preliminary results will be completed thanks to new observations and interviews and the introduction of two technology probes, one aiming at identifying how to offer an easy access to documentation while being involved in a maintenance task on site, and the second one focusing on facilitating the escalation of critical problems on the infrastructure

4. Contributions

My doctoral work in sociology will firstly make a scientific contribution to knowledge of a professional activity that is relatively unknown in the sociology of work. In particular, by documenting work on maintenance sites, I would like to gain a better understanding of the real constraints under which this work takes place and all the coordination required to carry out an intervention successfully.

More on the design side, between sociological and CSCW concerns, I would like to focus my analysis on the technical and digital tools used by these technicians, and in this way help to reintegrate the discourse around digitalization and the development of technologies designed to 'facilitate' the work of operators into the actual uses of the artefacts by the operators. The use of the technology probe method is aimed precisely at reconciling the objectives of research and those of technology design.

Acknowledgments

This work is part of the RailMon project that has been supported by the French government under the "Future Investment Programme". We also thank the participants for their precious time.

References

Bødker, Susanne; and Clemens Nylandsted Klokmose (2011). The Human–Artifact Model: An Activity Theoretical Approach to Artifact Ecologies. *Human–Computer Interaction*, vol. 26, no. 4, December 2011, pp. 315–71.

Blomberg, Jeanette; and Helena Karasti (2013). Reflections on 25 Years of Ethnography in CSCW. *Computer Supported Cooperative Work (CSCW)*, vol. 22, no. 4, August 2013, pp. 373–423.

Hemmings, Terry; Karen Clarke; Mark Rouncefield; Andy Crabtree; and Tom Rodden (2002). Probing the Probes. *Proceedings of the 7th Biennial Participatory Design Conference 2002*. Malmø, Sweden, pp. 42–50.

Hutchinson, Hilary; Wendy Mackay; Bo Westerlund; Benjamin B. Bederson; Allison Druin; Catherine Plaisant; Michel Beaudouin-Lafon; Stéphane Conversy; Helen Evans; Heiko Hansen; Nicolas Roussel; and Björn Eiderbäck (2003). Technology Probes: Inspiring Design for and with Families In *: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.* CHI '03. New York, NY, USA: Association for Computing Machinery, pp. 17–24.

Lyle, Peter; Henrik Korsgaard; and Susanne Bødker (2020). What's in an Ecology? A Review of Artifact, Communicative, Device and Information Ecologies In : *Proceedings of the 11th Nordic Conference on Human-Computer Interaction: Shaping Experiences, Shaping Society*. NordiCHI '20. New York, NY, USA: Association for Computing Machinery, pp. 1–14.

MacKay, Wendy E. (1999). Is Paper Safer? The Role of Paper Flight Strips in Air Traffic Control. *ACM Transactions on Computer-Human Interaction*, vol. 6, no. 4, December 1999, pp. 311–40.

Rossitto, Chiara; Cristian Bogdan; and Kerstin Severinson-Eklundh (2014). Understanding Constellations of Technologies in Use in a Collaborative Nomadic Setting. *Computer Supported Cooperative Work (CSCW)*, vol. 23, no. 2, April 2014, pp. 137–61.

Sawyer, Steve; Kevin Crowston; and Rolf T. Wigand (2014). Digital Assemblages: Evidence and Theorising from the Computerisation of the US Residential Real Estate Industry: Digital Assemblages. *New Technology, Work and Employment*, vol. 29, no. 1, March 2014, pp. 40–56.

Strauss, Anselm (1992). *La trame de la négociation. Sociologie qualitative et interactionniste*. Éditions L'Harmattan, Paris, p. 319.

Natali, Chiara (2024): Frictional AI. Designing Desirable Inefficiencies in Decision Support Systems for Knowledge Work. In: Proceedings of the 22nd European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centered Computing on the Design of Cooperation Technologies - Doctoral Colloquium Contributions, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.48340/ecscw2024_dc07

Frictional AI. Designing Desirable Inefficiencies in Decision Support Systems for Knowledge Work

Chiara Natali
University of Milano Bicocca, Italy
chiara.natali@unimib.it

Abstract. My research involves the conceptualization of 'Frictional AI' as a novel approach for enhancing cognitive engagement in Decision Support Systems (DSS) through intentional design inefficiencies. Through empirical studies and theoretical analysis, I explore the balance between human intuition and automation-induced enhancements to decision-making in medical diagnostics. With the introduction and assessment of four distinct frictional protocols (cautious, comparative, judicial, and adjunct), this design framework prioritizes the efficacy and integrity of human knowledge work, ensuring that professionals are engaged, critical thinkers, capable of counteracting automation bias and deskilling–even at a slight cost in efficiency and comfort.

1 Introduction

The CSCW community is wary of "underrating the skills and competencies that are required in even the most routine of tasks," (Hartswood et al., 2003) instead acknowledging the skills and expertise demanded by tasks often perceived as mundane. This ethos stems from an appreciation of the complexities inherent in collaborative efforts and the view of technology as a means to empower, not replace, human participation.

In this light, my doctoral research is driven by the goal of informing the debate around "what to automate and what to leave to human skill and ingenuity" (Hartswood et al., 2003) by proposing design strategies that promote AI-supported decision-making processes.

I propose a series of design solutions informed by the concept of Frictional AI: an AI design principle that leverages programmed inefficiencies (Cabitza et al., 2019) to stimulate human cognitive activation and mitigate overreliance on automated systems (Cabitza et al., 2024a).

The development of Decision Support Systems (DSS) brings to light the critical issues of dependency and the erosion of skills, highlighting the necessity of considering the multitude of design options available in AI deployments. These options manifest in how a system's outputs are displayed, ranging from oracular advice, clear-cut classifications, probabilities or ranked alternatives, among other possibilities. Equally important, yet less frequently addressed, are design choices regarding the sequence and level of automation (Parasuraman et al., 2000), the benchmarks for optimization (such as precision or practicality), and the customization for specific user groups (like beginners or specialists).

Together, these elements constitute a Human-AI Collaboration Protocol (HAI-CP), outlining a structured approach for the application of AI instruments by skilled professionals in executing particular tasks or roles, as described by Cabitza et al. (2023b). Each protocol offers a unique scope for affecting and shaping user reliance, thereby determining the extent of 'dominance' - the level of impact an AI entity may have on human decision-making (Cabitza et al., 2023a).

Although reducing friction is often sought to improve user experience and system usability, I question the wisdom of favoring ease and efficiency at the expense of the quality and integrity of knowledge work (Kelloway and Barling, 2000; Bossen and Pine, 2023). Echoing the thoughts of Frischmann and Selinger (2018), who argue that embracing a degree of inefficiency and friction might be vital for maintaining an environment that fosters human flourishing, my research aims to investigate the potential advantages of 'frictional protocols'.

These protocols are designed to make the interpretation of AI output less immediate, thereby stimulating user cognitive engagement, with the goal of enhancing decision-making accuracy, sense of agency and the preservation of professional skills. Such an approach is particularly pertinent for professionals,

like those in the medical field, who are involved in high-stakes processes, ensuring they remain actively involved, critically minded participants rather than mere operators. My work focuses on designing a conceptual framework for AI systems that accurately mirror the nuances of diagnostic tasks and are implemented in a manner that honors the irreplaceable contribution of human expertise.

My research encompasses the development and empirical assessment of four distinct protocols devised to protect human autonomy: cautious protocols, which encourage prudence; comparative protocols, which facilitate the evaluation of multiple outcomes; judicial protocols, which involve agonistic decision-making processes; and adjunct protocols, which move the AI support to an ancillary role to human judgment.

2 Frictional protocols

- **Cautious protocol.** This approach offers a range of possible answers, each with its own confidence level, and includes a probability that the correct answer is among them, similar to conformal prediction (Shafer and Vovk, 2008). It allows the system to choose not to give an answer if uncertainty is too high (Campagner et al., 2020), making users aware of the AI's limitations in a clear way, similar to the concept of 'seamful design' (Chalmers et al., 2003).
- **Comparative protocol.** Here, the AI system presents users with cases similar to the one being examined, along with their outcomes. This method is akin to a Transactive Memory System (Lewis and Herndon, 2011), utilizing a database of previous cases and their outcomes to aid decision-making.
- **Judicial protocol.** This protocol offers multiple, sometimes conflicting, viewpoints or decisions, supported by explanations. It can involve using AI to generate arguments for different sides (Miller, 2023), similar to having a debate between opposing conversational AI agents, or using antagonistic machine learning models optimized according to different parameters (Hildebrandt, 2018). Kliegr et al. (2021) has similarly proposed using "conflicting rules/knowledge" as a way to reduce biases like overconfidence or underconfidence
- **Adjunct protocol.** Differently from the other protocols, which focus on output presentation, this one focuses on the decision-making process itself through specialized HAI-CP. Introduced in previous work as a method where AI serves more as a consultant providing a second opinion (Cabitza and Natali, 2022; Cabitza et al., 2023b), it involves designing the decision-making process to encourage critical thinking. Cognitive forcing functions (Buçinca et al., 2021) such as checklists, delaying AI recommendations, or

longer wait times are used to counteract common biases like anchoring bias (Rastogi and et al., 2022) or confirmation bias (Kliegr et al., 2021).

3 Research questions

Main question. How can the principles of Frictional AI inform the design of AI systems in a way that aligns with CSCW tenets, fostering environments where professionals are engaged, critical thinkers and decision-makers?

Investigating this wide-reaching research question requires addressing four sub-questions:

- **Q1.** Are frictional design principles conducive to more effective, or at least equally effective, decision-making compared to traditional AI-supported protocols?
- **Q2a.** Can frictional DSS mitigate the risks of automation bias, as operationalized by Cabitza et al. (2023a)? Similarly, **Q2b.** Do frictional DSS mitigate the risk of deskilling as well as upskilling inhibition?
- **Q3.** How does the usability of frictional design patterns change according to user expertise and task complexity?
- **Q4.** What is the ethical and conceptual basis for the development and acceptance of Frictional AI systems in (work) practice?

4 Methodological approach

To address these research questions, I participated to a series of empirical user studies involving medical professionals (Natali et al., 2023; Cabitza et al., 2023a,b,d,c, 2024b), with additional studies planned to further explore and evaluate other frictional HAI-CP.

For the first and second research questions, which tackle the effectiveness of frictional AI and its potential to reduce automation bias, I will leverage the strategies for evaluating technology benefit and reliance patterns developed by Cabitza et al. (2023a), specifically aimed at examining the influence of DSS on decision-making effectiveness and susceptibility to cognitive biases.

The most challenging investigation delves into the possible deskilling effects and upskilling prevention stemming from prolonged engagement with non-frictional HAI-CPs. Given the time-intensive nature of such an experiment, as well as its ethical implications, I will address this research question by consulting the relevant literature as it develops and designing feasible qualitative investigations.

As for the third research question, on the usability of Frictional AI according to user experience and task complexity, I will tackle it via user studies as well state-of-the-art usability questionnaires. The findings could be strengthened via

ethnomethodological observations and qualitative interviews analyzed following the grounded theory approach (Muller and Kogan, 2010).

I will tackle the fourth research question by employing a robust theoretical examination to situate the concept of Frictional AI within CSCW literature, inspired by Bossen and Pine's (2023) observations on factors for successful human-AI collaboration, such as AI supporting "what motivates many knowledge workers: reflecting and learning through experimentation". This will be followed by principle elicitation initiatives through workshops and conference special tracks (see Section *Future Work*).

5 Preliminary findings

As a first step, I introduced the concept of Frictional AI within the CSCW context through a study on AI system perceptions by oncological radiologists in two French hospitals, detailed in "Invisible to machines: Designing AI that supports vision work in radiology" (Anichini et al., 2024).

As for user studies, I explored the impact of pro-hoc explanations in AI systems as an example of comparative, human-first protocols in fracture detection tasks (Cabitza et al., 2024b). This approach involved comparing similar past cases to assist in diagnosis, akin to a Transactive Memory System (Lewis and Herndon, 2011) leading to a decrease in diagnostic errors by 10%. The study highlighted differences in how specialists and residents adjusted their diagnoses when using the system, particularly in complex cases. Notably, decision changes were generally beneficial, though some instances of automation bias were observed, more so among residents than specialists. My contribution included a section exploring in depth the topic of Frictional AI.

My latest research, currently in peer review, examines the use of AI in group decision-making, finding that groups show less reliance on AI compared to users in individual Human-AI decision-making settings. The study suggests that group discussions before AI consultation can lead to less dependence on the AI's advice, although potentially leading to the phenomenon of groupthink. However, when AI advice is considered first, after a first private decision (Bahrami et al., 2012), it appears to foster more critical discussion and analysis initiated by reflections on AI's contributions (Chiang et al., 2023), reducing groupthink and automation bias.

This work proposes a model where AI serves as a catalyst for group deliberation, playing an ancillary or adjunct role, ensuring collective decisions are driven by human intelligence.

6 Future work

Building upon these preliminary results, future studies will focus on cautious and judicial protocols. Additionally, an ethnomethodological investigation would shed light on the receptiveness of medical professionals towards the principles of Frictional AI, providing valuable context and understanding of its practical implications in real-world settings.

Empirical evidence and literature analysis will provide the basis of a comprehensive framework dedicated frictional design principles for AI systems.

The goal is to curate a collection of frictional design patterns for the development of HAI-CP suitable for a broad spectrum of scenarios. This would include the development of guidelines and recommendations to ensure responsible deployment, which will be conducted via principle elicitation activities.

A first example is my organization of the workshop “Stimulating Cognitive Engagement in Hybrid Decision-Making: Friction, Reliance and Biases” to be held at HHAI24 on June 11th 2024, intended to be the first of its kind in its discussion of Frictional AI.

As for further investigation of strategies to decrease overreliance, I will be chair of the Special Track “Calibrating Trust in XAI” at the 2nd World Conference on eXplainable AI in July 2024 (date TBA).

7 Expected contributions

The expected contributions of my research to the CSCW research community includes introducing and elaborating on the concept of Frictional AI as a novel approach to designing AI systems that enhance, rather than replace, human decision-making capabilities.

I will explore both the potential benefits and the inherent challenges of incorporating frictional design into AI systems. This exploration will involve both empirical studies and theoretical analysis to understand whether, and how, frictional design can foster greater cognitive engagement and effectively reduce overreliance on automation, thus guiding the creation of AI systems that prioritize human-centered design principles.

8 Conclusion

My doctoral research introduces design principles rooted in the concept of Frictional AI, presenting a paradigm that may seem to deviate from the dominant market trajectory focused on enhancing specificity and certainty in AI technologies.

The industry's current trajectory gravitates towards AI solutions that are marketed on the promise of increased efficiency, unambiguous outcomes, and, purportedly, superior returns on investment. Yet, it is within this juxtaposition that Frictional AI finds its most significant justification and potential for impact.

This strategy advocates for a more sustainable model of technology adoption, where the value of AI is measured not just in terms of efficiency gains but also in its ability to maintain and enhance the professional skills of its users.

By steering AI development to better reflect the uncertain, intuitive, and cooperative aspects of professional work environments, this research aims to pave the way for a more nuanced and impactful integration of technology in the realm of diagnostic work.

Acknowledgments

The author gratefully acknowledges the PhD grant awarded by the Fondazione Fratelli Confalonieri, which has been instrumental in facilitating her research pursuits.

References

Anichini, G., C. Natali, and F. Cabitza (2024): 'Invisible to machines: Designing AI that supports vision work in radiology'. Computer supported cooperative work (CSCW), vol. In press, no. tbd, pp. tbd.

Bahrami, B., K. Olsen, D. Bang, A. Roepstorff, G. Rees, and C. Frith (2012): 'What failure in collective decision-making tells us about metacognition'. Philosophical Transactions of the Royal Society B: Biological Sciences, vol. 367, no. 1594, pp. 1350–1365.

Bossen, C. and K. H. Pine (2023): 'Batman and Robin in Healthcare Knowledge Work: Human-AI Collaboration by Clinical Documentation Integrity Specialists'. ACM Transactions onComputer-Human Interaction, vol. 30, no. 2, pp. 1–29.

Buçinca, Z., M. B. Malaya, and K. Z. Gajos (2021): 'To trust or to think: cognitive forcing functions can reduce overreliance on AI in AI-assisted decision-making'. Proceedings of the ACM on Human-Computer Interaction, vol. 5, no. CSCW1, pp. 1–21.

Cabitza, F., A. Campagner, R. Angius, C. Natali, and C. Reverberi (2023a): 'AI Shall Have NoDominion: on How to Measure Technology Dominance in AI-supported Human decision-making'. In: Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems.

Cabitza, F., A. Campagner, D. Ciucci, and A. Seveso (2019): 'Programmed inefficiencies in DSS-supported human decision making'. In: Modeling Decisions for Artificial Intelligence: 16th International Conference, Milan, Italy, September 4–6, 2019. pp. 201–212.

Cabitza, F., A. Campagner, and et al. (2023b): 'Rams, hounds and white boxes: Investigating human-AI collaboration protocols in medical diagnosis'. Artificial Intelligence in Medicine.

Cabitza, F., A. Campagner, L. Famiglini, C. Natali, V. Caccavella, and E. Gallazzi (2023c): 'Let Me Think! Investigating the Effect of Explanations Feeding Doubts About the AI Advice'. In: International Cross-Domain Conference for Machine Learning and Knowledge xtraction. pp. 155–169.

Cabitza, F., A. Campagner, C. Natali, E. Parimbelli, L. Ronzio, and M. Cameli (2023d): ‘Painting the black box white: experimental findings from applying XAI to an ECG reading setting’. Machine Learning and Knowledge Extraction, vol. 5, no. 1, pp. 269–286.

Cabitza, F. and C. Natali (2022): ‘Open, multiple, adjunct. Decision support at the time of relational AI’. In: HHAI2022: Augmenting Human Intellect. IOS Press, pp. 243–245.

Cabitza, F., C. Natali, L. Famiglini, A. Campagner, V. Caccavella, and E. Gallazzi (2024a): ‘Never tell me the odds. Investigating pro-hoc explanations, as instances of frictional AI, in medical decision making’. Artificial Intelligence in Medicine.

Cabitza, F., C. Natali, L. Famiglini, A. Campagner, V. Caccavella, and E. Gallazzi (2024b): ‘Never tell me the odds: Investigating pro-hoc explanations in medical decision making’. Artificial Intelligence in Medicine, pp. 102819.

Campagner, A., F. Cabitza, and D. Ciucci (2020): ‘Three-way decision for handling uncertainty in machine learning: A narrative review’. In: IJCRS 2020, Havana, Cuba, June 29–July 3, 2020, Proceedings. pp. 137–152.ù

Chalmers, M., I. MacColl, and M. Bell (2003): ‘Seamful design: Showing the seams in wearable computing’. In: 2003 IEE Eurowearable. pp. 11–16.

Chiang, C.-W., Z. Lu, Z. Li, and M. Yin (2023): ‘Are Two Heads Better Than One in AI-Assisted Decision Making? Comparing the Behavior and Performance of Groups and Individuals in Human-AI Collaborative Recidivism Risk Assessment’. In: Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems. pp. 1–18.

Frischmann, B. and E. Selinger (2018): Re-engineering humanity. Cambridge University Press.

Hartswood, M., R. Procter, M. Rouncefield, and R. Slack (2003): ‘Making a case in medical work: implications for the electronic medical record’. Computer Supported Cooperative Work (CSCW), vol. 12, pp. 241–266

Brito, Luciana Sá; França, Juliana Baptista dos Santos, Vivacqua, Adriana Santarosa (2024): Design of Data Literacy Assets-based Learning Strategies with Marginalized Communities Inspired by Paulo Freire's Pedagogy. In: Proceedings of the 22nd European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centered Computing on the Design of Cooperation Technologies - Doctoral Colloquium Contribution, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.48340/ecscw2024_dc08

Design of Data Literacy Assets-based Learning Strategies with Marginalized Communities Inspired by Paulo Freire's Pedagogy

Luciana Sá Brito, Juliana Baptista dos Santos França, Adriana Santarosa Vivacqua
Universidade Federal do Rio de Janeiro
lbrito@cecierj.edu.br, julianabsf@ic.ufrj.br, avivacqua@ic.ufrj.br

Abstract. This article presents the design of an ethnographic investigation through action research to propose a participatory educational design for teaching and learning data literacy (DL). We were inspired by the Paulo Freire method, which is collaborative in its philosophy and design. The proposal unites universities, social movements, public authorities, and territories through stages of culture circles. Asset-based design will be the epistemological approach for building and evaluating a learning method. The culture circles will occur in Complexo do Alemão Favelas, Rio de Janeiro, and may be extended to other communities.

1 Introduction

We all create data daily, which is collected, counted, and computed on a massive scale by institutions (Lupi and Posavec, 2016). The volume of data in the world is increasing because information detection devices have become cheap and numerous and because the world's capacity to store information has practically doubled every 40 months since the 1980s (NATIONS, 2023). However, even with evidence of the need to talk about data and its impact on our lives, we still need an education aligned with the social needs of the data-driven world. Meanwhile, 4 out of 10 Brazilians receive fake news daily (Brasil, 2022), technologies that claim to be scientific reinforce racism and other forms of injustice (Benjamin, 2023), surveillance systems are implemented without us having control over our privacy (Snowden, 2019), and social media algorithms possibly impact the population's mental health (Faelens et al., 2021).

Society's difficulty in dealing with data can undermine democracy, facilitating the rise of fascism around the world, in addition to increasing the social contradictions generated by capitalism (Chomsky, 2005; País, 2018; Guardian, 2018; Post, 2023; Braziliense, 2023; Notícias, 2019; Brito et al., 2023; Castro-Gómez and Grosfoguel, 2007; Mignolo, 2007). In this reality, in which marginalization imposes everyday microaggressions and the development of systems that subjugate entire groups of people (Liang et al., 2021), an argument in favor of mass Data Literacy (DL) teaching is to enable citizens to interpret, understand, and use data effectively to maintain transparent and accountable governments (Bhargava et al., 2015). DL can help civil society catalog rights and violations, feed data-based journalism, and encourage citizen engagement in anti-corruption efforts. Furthermore, increasing DL can help overcome the digital divide problem (Bhargava et al., 2015).

Educational Design carries out educational projects (Shackelford and Weekes-Shackelford, 2021). The principles of Educational Design derive from knowledge about human cognition and are related to secondary knowledge (Geary and Berch, 2016), which organizes knowledge into biological or evolutionary and primary knowledge. Humans evolved to acquire primary knowledge of listening to and speaking a native language, for example, which tends to be acquired automatically (Shackelford and Weekes-Shackelford, 2021). We can acquire secondary knowledge, but we have not specifically evolved this, so we need conscious effort to acquire it. An example of secondary knowledge is solving a simple equation, for which we must possess the primary-generic problem-solving strategy. However, we need to go further and learn domain-specific solving tactics offered explicitly.

The main objective of this research is to build strategies to support DL learning with actors from historically marginalized territories. Other objectives are: 1) expand the voice of the territories so they can show their demands to the

government and society; 2) encourage the strengthening of social networks and collaboration between favela and university data collectives; 3) design educational resources for teaching and learning DL; 4) provide means for implementing public policies related to DL in Brazil.

The question of this research is: How can we create DL teaching-learning methodologies and strategies, based on the Paulo Freire method and community assets in the favelas, to expand voices in the search for their rights?.

2 Related Work

As works related to this research design, we present some references relevant to the use of Asset-based Design Approach in the context of CSCW research (subsection "CSCW and Asset-based Design") and DL education through the Popular Education philosophy (subsection "Data Literacy and Popular Education").

2.1 CSCW and Asset-based Design

HCI and CSCW researchers have explored teaching DL to citizens for engagement and civic interaction (D'Ignazio and Bhargava, 2016; D'Ignazio and Bhargava, 2020; Johnson et al., 2021), emphasizing ethical paths (Shapiro et al., 2020), equity, decolonization, sustainability (Bentley et al., 2023), feminism (D'ignazio and Klein, 2023), and well-being (Oman, 2021) in data teaching. In other contexts, they have provided methodological paths for community-based projects (Taylor et al., 2013; Balestrini et al., 2014, 2015). Sharing this perspective, asset-based design is a design approach that seeks to meet the communities' needs by discovering their potential towards the participatory development of sustainable solutions (Wong-Villacres et al., 2021; Cho et al., 2019).

The Asset-based Design Approach centers on individuals' and communities' existing potential (Wong-Villacres et al., 2021). In HCI and CSCW, assets-based design aids immigrants (Cho et al., 2019; Wong-Villacres et al., 2021) and human trafficking victims (Wong-Villacres et al., 2021). Asset-based Design key steps include knowing when to use it; identifying assets; amplifying voices; aligning assets with goals; and envisioning new futures (Wong-Villacres et al., 2020b). Intersectionality is crucial, addressing gender, race, ethnicity, language, and economic factors like low income (Cho et al., 2019).

Assets-based design utilizes various resources, from institutional to intangible like knowledge, care, solidarity, cultural values, social networks, and local knowledge (Hui et al., 2020; Wong-Villacres et al., 2020b; Mills et al., 2019; Roldan et al., 2019; Karusala et al., 2017; Ismail and Kumar, 2018; Wong-Villacres et al., 2020a; Cho et al., 2019; Dickinson et al., 2019; Karusala et al.,

2019; Pei and Nardi, 2019). This approach aligns with a CSCW perspective, offering support first in the social, then technical areas.

3 Data Literacy and Popular Education

Popular education is politically significant and driven by a liberating pedagogy. It empowers individuals to question existing ideologies and fosters continuous learning and unlearning (Jara, 2010). We mapped literature on DL learning experiences through the Popular Education lens. DL learning based on the concept of Popular Education encompasses skills for data use and critical production, including reading, processing, communicating, and producing data (Tygel and Kirsch, 2016).

Developing DL research alongside Popular Education is crucial given societal structures that perpetuate social disparities through exploitation and marginalization based on factors like race, gender, sexual orientation, and colonial history (Mignolo, 2007; Castro-Gómez and Grosfoguel, 2007). DL rooted in Popular Education (Tygel and Kirsch, 2016) stems from Paulo Freire's Pedagogy (Freire, 1971, 2014; Lyra, 1996), which integrates the political and pedagogical dimensions (Machado, 2022), viewing literacy not just as technical skill acquisition but as a path to emancipation (D'Ignazio, 2017).

Employing the PICOC protocol (Petticrew and Roberts, 2008) and defining search parameters, we explored Google Scholar, Scopus, IEEE Xplorer, and SciElo databases, yielding 102 publications, including articles, book chapters, and theses from 2015 to 2022.

The study revealed four strategies for DL education. The most hegemonic, through the dialogue between science and art (D'Ignazio, 2017; D'Ignazio and Bhargava, 2020; Markham and Pereira, 2019; Stornaiuolo, 2020; Bhargava et al., 2016; Xie, 2018; Bhargava and D'Ignazio, 2015; Raffaghelli, 2022; Vacca et al., 2022b; Matuk et al., 2022; Vacca et al., 2022a). The second most used approach was based on real-world scenarios without the aid of art (Peer, 2019; Fotopoulou, 2021; Verständig, 2021). Other research (Verständig, 2021; D'Ignazio, 2017; D'Ignazio and Bhargava, 2016; Johnson et al., 2021; Bay and Atherton, 2021; Tygel, 2016; Hadzigeorgiou and Hadzigeorgiou, 2016) were inspired by practices based on epistemologies/ideologies/philosophies. Moreover, Tygel and Kirsch (2016) took a theoretical approach.

In the science and art approach, the types of art for student engagement were muralism (D'Ignazio and Bhargava, 2020; Bhargava et al., 2016), theatrical performance (D'Ignazio and Bhargava, 2020; Markham and Pereira, 2019), printmaking (Stornaiuolo, 2020), photography (D'Ignazio, 2017; Matuk et al., 2022), jewelry (D'Ignazio, 2017), audiovisual (Xie, 2018), music (Bhargava and D'Ignazio, 2015), sculpture (Raffaghelli, 2022), comics (Vacca et al., 2022b; Matuk et al., 2022), dance (Matuk et al., 2022), collages (Matuk et al., 2022), and

memes (Vacca et al., 2022a). Integrating science and art fosters holistic learning experiences, aligning with popular education's ethos. Both fields value creative imagination, which can transform reality perception and inspire attitudes toward life and its complexities (Hadzigeorgiou and Hadzigeorgiou, 2016).

The proposal of this research differs from the works presented in the mapping because it is inspired by Paulo Freire's culture circles for the collaborative construction of learning strategies with universities, territories, and public authorities, taking advantage of the positive features and potential found in territories and peer collaboration through Assets-based Design Approach.

4 Methods

We will conduct an ethnographic study through action research using asset-based participatory design. The analysis method will be qualitative and quantitative, as recommended in the literature for discovering knowledge in Human-Computer Interaction (HCI) (Sharp et al., 2019; Lazar et al., 2017). The research methodology comprises steps defined by the research team and community interaction.

The steps pre-defined by the research team are: 1) Identification of the problem within its context; 2) Systematic mapping about DL learning experiences based on the concept of Popular Education; 3) Holding and participating in Human-Data Interaction workshops to foster the emerging Brazilian community in the area; 4) Submission of the project to the research ethics committee; 5) Participating in a service learning project involving UFRJ's community, public authorities, and local territories to conduct ethnographic research, action-oriented projects, and workshops with community actors; 6) Participatory design of the DL learning strategies; 7) Design of artifacts and educational resources; 8) Evaluation of results together with the community and experts; 9) Systematization of results. Step 4 has already been completed, and step 5 has begun.

4.1 Workshops Evaluation

The evaluation of the workshops will consist of assessments carried out before and after each activity through written tests, interviews, direct observation of participants' behavior, and notes of situations experienced during ethnography and action research. In addition, there will also be conversation circles with participants to evaluate the results and plan new steps. At the end of the collaborative work with the community, the methodology created, the derived artifacts, and other results will be submitted to experts in the areas of knowledge that make up DL in the complexity achieved during ethnography.

5 Design of the data literacy learning strategies

The design of the learning methodology will be participatory with the Nave do Conhecimento of Nova Brasília - Complexo do Alemão, Universidade do Rio de Janeiro, and Rio de Janeiro City Hall in at least two cycles of Design Science Research (DSR) (Fig.1). The first cycle is inspired by the Paulo Freire method and his culture circles, conducted through the action research method, in which the researcher and the community negotiate the activities carried out in the workshops.

The second cycle will involve workshop activities with Nave partner communities to improve the strategies. We expect that there will be a third cycle of improvement with social movement collectives. After the cycles end, the method will be evaluated with experts and groups collaborating in the design process.

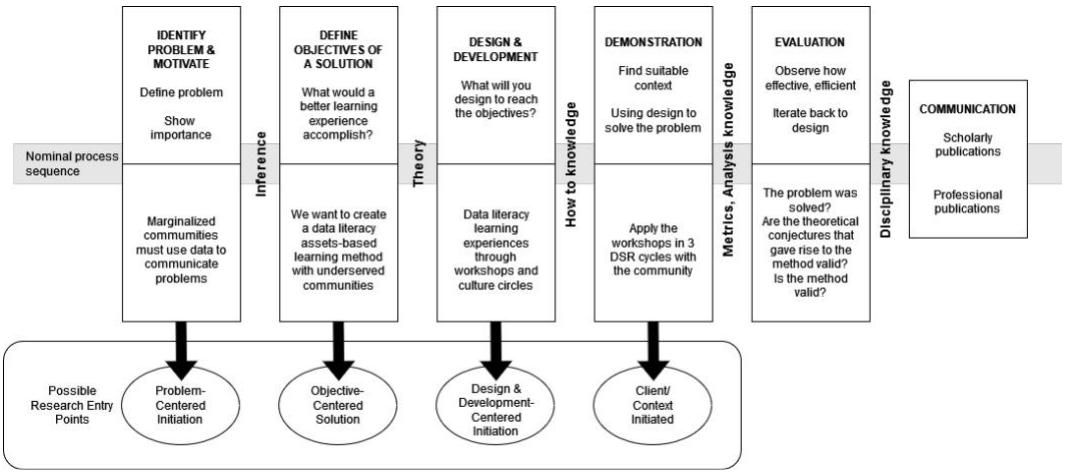

Figure 1. Design science research methodology Process Map by Ken Peffers and Chatterjee (2007).

5.1 Culture circles for data literacy

The preliminary design of the method described in steps 5 and 6 (Methods), and the first DSR cycle mentioned in section 4, follows the inspiration of the Paulo Freire method in its stages. It takes place in 4 joint efforts: 1) Community outreach: to initiate contact with participants to establish bonds of trust and achieve partnerships; 2) Coding phase: to explore the generating themes that will give impetus to discovering the subjects that the community wants to address in the workshops; 3) Culture circles: to make the thematic delimitation; 4) The data literacy campaign: to express participants' thoughts about the reality in which they live while the educator problematizes the issues raised by the group.

When writing this article, we are finishing the first joint effort. In the second, a photovoice workshop (Lu et al., 2023; O'Leary et al., 2021) will be held, in which culture circles will find topics of interest to the community for discussion about data.

5.2 Expected results and contributions

The expected contribution of this research is a learning environment with activities and educational resources aimed at learning DL. This environment will mainly focus on helping vulnerable communities obtain the knowledge necessary to claim their rights as citizens through collection, management, analysis, and argumentation through data.

6 Conclusion

Based on the Paulo Freire method, we propose creating DL learning strategies in collaboration with favela actors. The research design is proposed by a team of educators, headed by me as the first author of this paper. I have been an Instructional Designer at the Secretariat of Science, Technology, and Innovation of the State of Rio de Janeiro for over ten years, and a science educator with at least 17 years of experience in the classroom. The inspiration for this project comes from my trajectory of activism in social movements and my interest in activism through data. The dream of another world possible through education, solidarity, affection, and cooperative relationships that go beyond market logic led me to choose to work in territories, as well as the unfavorable context in which the population of the global South finds itself in the face of the data deluge and the absence of DL programs designed by and for the Brazilian population. I invite the public and other researchers to join this proposal due to its intrinsically collaborative nature.

Acknowledgments

A special thanks to the educators and community at Nave do Conhecimento, the Instituto de Desenvolvimento e Ação Comunitária, the service learning staff at the Universidade Federal do Rio de Janeiro, and the Secretariat of Science and Technology of Rio de Janeiro, for making this partnership possible. Other special thanks to all ECSCW and SIGCHI researchers who supported this research and welcomed us into the community

References

Balestrini, M., J. Bird, P. Marshall, A. Zaro, and Y. Rogers (2014): 'Understanding sustained community engagement: a case study in heritage preservation in rural Argentina'. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. New York, NY, USA, p. 2675–2684, Association for Computing Machinery.

Balestrini, M., T. Diez, P. Marshall, A. Gluhak, and Y. Rogers (2015): 'IoT Community Technologies: Leaving Users to Their Own Devices or Orchestration of Engagement?'. *EAI Endorsed Transactions on Internet of Things*, vol. 1, no. 1.

Bay, J. and R. Atherton (2021): 'Rhetorics of data in nonprofit settings: How community engagement pedagogies can enact social justice'. *Computers and Composition*, vol. 61, pp. 102656. Rhetorics of Data: Collection, Consent, '&' Critical Digital Literacies.

Benjamin, R. (2023): 'Race after technology'. In: *Social Theory Re-Wired*. 65 Bridge Street. Cambridge CB2 1UR, UK: Routledge, pp. 405–415.

Bentley, C., C. Muyoya, S. Vannini, S. Oman, and A. Jimenez (2023): 'Intersectional approaches to data: The importance of an articulation mindset for intersectional data science'. *Big Data & Society*, vol. 10, no. 2, pp. 20539517231203667.

Bhargava, R., E. Deahl, E. Letouzé, A. Noonan, D. Sangokoya, and N. Shoup (2015): 'Beyond data literacy: Reinventing community engagement and empowerment in the age of data'. *MIT Libraries*, vol. 1, no. 1, pp. 37.

Bhargava, R. and C. D'Ignazio (2015): 'Designing tools and activities for data literacy learners'. In: *Workshop on data literacy, Webscience*. Oxford, UK, MIT Media Lab.

Bhargava, R., R. Kadouaki, E. Bhargava, G. Castro, and C. D'Ignazio (2016): 'Data murals: Using the arts to build data literacy'. *The Journal of Community Informatics*, vol. 12, no. 3.

Brasil, C. (2022): '4 em cada 10 brasileiros afirmam receber fake news diariamente'. Retrieved 23 January 2024 from https://www.cnnbrasil.com.br/nacional/4-em-cada-10-brasileiros-afirmam-receber-fake-news-diariamente/.

Braziliense, C. (2023): 'Bolsonaro confirma envio de fake news a empresário: "Qual o problema?"'. Retrieved 24 January 2024 from https://www.correiobraziliense.com.br/politica/2023/08/5119274-bolsonaro-confirma-envio-de-fake-news-a-empresario-qual-o-problema.html.

Brito, L., J. França, A. Dias, and A. Vivacqua (2023): 'Diálogos, coincidências e complementaridades epistemológicas em Interação Humano-Dados'. In: *Anais do II Workshop Investigações em Interação Humano-Dados*. Porto Alegre, RS, Brasil, pp. 11–18, SBC.

Castro-Gómez, S. and R. Grosfoguel (2007): 'Colonialidad del poder y clasificación social'. In: S. Castro-Gómez and R. Grosfoguel (eds.): *El giro decolonial. Reflexiones para una diversidad epistémica más allá dela capitalismo global*. Bogotá D.C.: Siglo del Hombre Editores, Chapt. 5, p. 33.

Cho, A., R. G. Herrera, L. Chaidez, and A. Uriostegui (2019): 'The "Comadre" Project: An Asset-Based Design Approach to Connecting Low-Income Latinx Families to Out-of-School Learning Opportunities'. In: *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. New York, NY, USA, p. 1–14, Association for Computing Machinery.

Chomsky, N. (2005): 'On Fake News and Other Societal Woes'. Retrieved 24 January 2024 from https://chomsky.info/20051207/.

Dickinson, J., M. Díaz, C. A. Le Dantec, and S. Erete (2019): '"The cavalry ain't coming in to save us": Supporting Capacities and Relationships through Civic Tech'. *Proc. ACM Hum.-Comput. Interact.*, vol. 3, no. CSCW.

D'Ignazio, C. (2017): 'Creative data literacy: Bridging the gap between the data-haves and data-have nots'. *Information Design Journal*, vol. 23, no. 1, pp. 6–18.

D'Ignazio, C. and R. Bhargava (2016): 'DataBasic: Design principles, tools and activities for data literacy learners'. *The Journal of Community Informatics*, vol. 3, no. 12.

D'ignazio, C. and L. F. Klein (2023): *Data feminism*. MIT press.

D'Ignazio, C. and R. Bhargava (2020): '13. Data visualization literacy: A feminist starting point'. *Data visualization in society*, vol. 1, no. 1, pp. 207.

Faelens, L., K. Hoorelbeke, R. Cambier, J. van Put, E. Van de Putte, R. De Raedt, and E. H. Koster (2021): 'The relationship between Instagram use and indicators of mental health: A systematic review'. *Computers in Human Behavior Reports*, vol. 4, pp. 100121.

Fotopoulou, A. (2021): 'Conceptualising critical data literacies for civil society organisations: agency, care, and social responsibility'. *Information, Communication & Society*, vol. 24, no. 11, pp. 1640–1657.

Freire, P. (1971): *Pedagogia do oprimido*. Rua do Triunfo, 177. Santa Efigênia, São Paulo, SP: Paz e Terra.

Freire, P. (2014): *Educação como prática da liberdade*. Rua Argentina, 177, 3º andar, São Cristóvão. Rio de Janeiro, RJ.: Editora Paz e Terra.

Geary, D. C. and D. B. Berch (2016): 'Evolution and children's cognitive and academic development'. *Evolutionary perspectives on child development and education*, vol. 1, no. 1, pp. 217–249.

Guardian, T. (2018): 'Revealed: 50 million Facebook profiles harvested for Cambridge Analytica in major data breach'. Retrieved January 2024 from https://www.theguardian.com/news/2018/mar/17/cambridge-analytica-facebook-influence-us-election.

Hadzigeorgiou, Y. and Y. Hadzigeorgiou (2016): *'Artistic'Science Education*. University of the Aegean. Rhodes, Greece: Springer.

Hui, J., N. R. Barber, W. Casey, S. Cleage, D. C. Dolley, F. Worthy, K. Toyama, and T. R. Dillahunt (2020): 'Community Collectives: Low-tech Social Support for Digitally-Engaged Entrepreneurship'. In: *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. New York, NY, USA, p. 1–15, Association for Computing Machinery.

Ismail, A. and N. Kumar (2018): 'Engaging Solidarity in Data Collection Practices for Community Health'. *Proc. ACM Hum.-Comput. Interact.*, vol. 2, no. CSCW.

Jara, O. H. (2010): 'Popular education and social change in Latin America'. *Community Development Journal*, vol. 45, no. 3, pp. 287–296.

Johnson, B., B. Rydal Shapiro, B. DiSalvo, A. Rothschild, and C. DiSalvo (2021): 'Exploring Approaches to Data Literacy Through a Critical Race Theory Perspective'. In: *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. New York, NY, USA, Association for Computing Machinery.

Karusala, N., I. Holeman, and R. Anderson (2019): 'Engaging Identity, Assets, and Constraints in Designing for Resilience'. *Proc. ACM Hum.-Comput. Interact.*, vol. 3, no. CSCW.

Karusala, N., A. Vishwanath, A. Kumar, A. Mangal, and N. Kumar (2017): 'Care as a Resource in Underserved Learning Environments'. *Proc. ACM Hum.-Comput. Interact.*, vol. 1, no. CSCW.

Ken Peffers, Tuure Tuunanen, M. A. R. and S. Chatterjee (2007): 'A Design Science Research Methodology for Information Systems Research'. *Journal of Management Information Systems*, vol. 24, no. 3, pp. 45–77.

Lazar, J., J. H. Feng, and H. Hochheiser (2017): *Research methods in human-computer interaction*. 50 Hampshire Street, 5th Floor, Cambridge, MA 02139, United States: Morgan Kaufmann.

Liang, C. A., S. A. Munson, and J. A. Kientz (2021): 'Embracing Four Tensions in Human-Computer Interaction Research with Marginalized People'. *ACM Trans. Comput.-Hum. Interact.*, vol. 28, no. 2.

Lu, A. J., S. Sannon, S. Brewer, K. N. Jackson, J. Green, D. Reeder, C. Wafer, and T. R. Dillahunt (2023): 'Organizing Community-based Events in Participatory Action Research: Lessons Learned from a Photovoice Exhibition'. In: *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems*. New York, NY, USA, Association for Computing Machinery.

Lupi, G. and S. Posavec (2016): *Dear data*. 202 Warren Street. Hudson. New York 12534: Chronicle books.

Lyra, C. (1996): *As quarenta horas de Angicos: uma experiência pioneira de educação*. Rua Bartira, 387. São Paulo, SP: Cortez Editora.

Machado, L. A. (2022): hooks, bell. *Ensinando pensamento crítico: sabedoria prática*. Tradução: Bhuvi Libanio. São Paulo: Elefante, 2020. São Paulo: Elefante.

Markham, A. N. and G. Pereira (2019): 'Analyzing public interventions through the lens of experimentalism: the case of the Museum of Random Memory'. *Digital Creativity*, vol. 30, no. 4, pp. 235–256.

Matuk, C., K. DesPortes, A. Amato, R. Vacca, M. Silander, P. Woods, and M. Tes (2022): 'Tensions and synergies in arts-integrated data literacy instruction: Reflections on four classroom implementations'. *British Journal of Educational Technology*, vol. 53, no. 5, pp. 1159– 1178. Funding Information: We thank Veena Vasudevan who supported the curriculum design and implementations described in this study. We also acknowledge support from the National Science Foundation through a collaborative Discovery Research K-12 award (1908557, 1908142, 1908030). Publisher Copyright: © 2022 British Educational Research Association.

Mignolo, W. D. (2007): 'Delinking: The rhetoric of modernity, the logic of coloniality and the grammar of de-coloniality'. *Cultural studies*, vol. 21, no. 2-3, pp. 449–514.

Mills, K., E. Bonsignore, T. Clegg, J. Ahn, J. Yip, D. Pauw, L. Cabrera, K. Hernly, and C. Pitt (2019): 'Connecting children's scientific funds of knowledge shared on social media to science concepts'. *International Journal of Child-Computer Interaction*, vol. 21, pp. 54–64.

NATIONS, U. (2023): 'Big Data for Sustainable Development'. Retrieved 16 February 2023 from https://www.un.org/en/global-issues/big-data-for-sustainable-development.

Notícias, S. (2019): 'CPMI das Fake News é instalada no Congresso'. Retrieved 24 January 2024 from https://www12.senado.leg.br/noticias/materias/2019/09/04/cpmi-das-fake-news-e-instalada-no-congresso.

O'Leary, T. K., E. Stowell, J. A. Hoffman, M. Paasche-Orlow, T. Bickmore, and A. G. Parker (2021): 'Examining the Intersections of Race, Religion & Community Technologies: A Photovoice Study'. In: *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. New York, NY, USA, Association for Computing Machinery.

Oman, S. (2021): *Understanding well-being data: Improving social and cultural policy, practice and research*. Springer Nature.

País, E. (2018): ‘Noam Chomsky: “As pessoas já não acreditam nos fatos”. Retrieved 24 January 2024 from https://brasil.elpais.com/brasil/2018/03/06/cultura/1520352987_936609.html.

Peer, F. (2019): ‘Community Indicator Data Dashboards as Infrastructures for Data Literacy’. In: *Companion Publication of the 2019 on Designing Interactive Systems Conference 2019 Companion*. New York, NY, USA, p. 109–112, Association for Computing Machinery.

Pei, L. and B. Nardi (2019): ‘We did it right, but it was still wrong: Toward assets-based design’. In: *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*. Glasgow, Scotland UK, pp. 1–11, Proceedings of CHI Conference on Human Factors in Computing Systems Extended Abstracts, Glasgow, Scotland UK.

Petticrew, M. and H. Roberts (2008): *Systematic reviews in the social sciences: A practical guide*. 350 Main Street, Malden, MA 02148-5020, USA: John Wiley & Sons.

Post, T. W. (2023): ‘How Donald Trump uses dishonesty’. Retrieved 24 January 2024 from https://www.washingtonpost.com/politics/2023/12/04/trump-misinformation-republicans/.

Raffaghelli, J. E. (2022): *Educators’ data literacy: Understanding the bigger picture*. Park Square, Milton Park, Abingdon, Oxon OX14 4RN: Routledge.

Roldan, W., P. Vanegas, L. Pina, C. Gonzalez, and J. Yip (2019): ‘The role of funds of knowledge in online search and brokering’. *International Society of the Learning Sciences*, vol. 1, no. 1.

Shackelford, T. K. and V. A. Weekes-Shackelford (2021): *Encyclopedia of evolutionary psychological science*. Gewerbestrasse 11, 6330 Cham, Switzerland: Springer.

Shapiro, B. R., A. Meng, C. O’Donnell, C. Lou, E. Zhao, B. Dankwa, and A. Hostetler (2020): ‘Re-Shape: A Method to Teach Data Ethics for Data Science Education’. In: *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. New York, NY, USA, p. 1–13, Association for Computing Machinery.

Sharp, H., J. Preece, and Y. Rogers (2019): ‘Interaction design: beyond human-computer interaction’.

Snowden, E. (2019): *Permanent Record: A Memoir of a Reluctant Whistleblower*. The Smithson, 6 Briset Street, London EC1M 5NR: Pan Macmillan.

Stornaiuolo, A. (2020): ‘Authoring Data Stories in a Media Makerspace: Adolescents Developing Critical Data Literacies’. *Journal of the Learning Sciences*, vol. 29, no. 1, pp. 81–103.

Taylor, N., K. Cheverst, P. Wright, and P. Olivier (2013): ‘Leaving the wild: lessons from community technology handovers’. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. New York, NY, USA, p. 1549–1558, Association for Computing Machinery.

Tygel, A. F. (2016): ‘Semantic tags for open data portals: metadata enhancements for searchable open data’. *Federal University of Rio de Janeiro*, vol. 1, no. 1.

Tygel, A. F. and R. Kirsch (2016): ‘Contributions of Paulo Freire for a Critical Data Literacy: a Popular Education Approach’. *J. Community Informatics*, vol. 12, no. 3.

Vacca, R., K. DesPortes, M. Tes, M. Silander, A. Amato, C. Matuk, and P. J. Woods (2022a): ‘What Do You Meme? Students Communicating their Experiences, Intuitions, and Biases Surrounding Data Through Memes’. In: *Proceedings of the 21st Annual ACM Interaction Design and Children Conference*. New York, NY, USA, p. 212–224, Association for Computing Machinery.

Vacca, R., K. DesPortes, M. Tes, M. Silander, C. Matuk, A. Amato, and P. J. Woods (2022b): ‘”I happen to be one of 47.8%”: Social-Emotional and Data Reasoning in Middle School Students’ Comics about Friendship’. In: *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*. New York, NY, USA, Association for Computing Machinery.

Verständig, D. (2021): ‘Critical Data Studies and Data Science in Higher Education: An interdisciplinary and explorative approach towards a critical data literacy’. *Seminar.net*, vol. 17, no. 2.

Wong-Villacres, M., C. DiSalvo, N. Kumar, and B. DiSalvo (2020a): ‘Culture in Action: Unpacking Capacities to Inform Assets-Based Design’. In: *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. New York, NY, USA, p. 1–14, Association for Computing Machinery.

Wong-Villacres, M., A. Gautam, W. Roldan, L. Pei, J. Dickinson, A. Ismail, B. DiSalvo, N. Kumar, T. Clegg, S. Erete, E. Roden, N. Sambasivan, and J. Yip (2020b): ‘From Needs to Strengths: Operationalizing an Assets-Based Design of Technology’. In: *Companion Publication of the 2020 Conference on Computer Supported Cooperative Work and Social Computing*. New York, NY, USA, p. 527–535, Association for Computing Machinery.

Wong-Villacres, M., A. Gautam, D. Tatar, and B. DiSalvo (2021): ‘Reflections on Assets-Based Design: A Journey Towards A Collective of Assets-Based Thinkers’. *Proc. ACM Hum.-Comput. Interact.*, vol. 5, no. CSCW2.

Xie, A. (2018): ‘Democratic Design: Creating diagrams to draw young citizens together’. Ph.D. thesis, OCAD University.

Leach, Jason (2024): The Agency of Artificial Intelligence in Microsocial Decision Making in the Ministry of Works and Transport: An Analysis of the User-AI Interaction in U-Turn System In: Proceedings of the 22nd European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centered Computing on the Design of Cooperation Technologies – Doctoral Colloquium Contributions, Reports of the European Society for Socially Embedded Technologies (ISSN 1573-7551), DOI: 10.18420/ecscw2024_dc09

The Agency of Artificial Intelligence in Microsocial Decision Making in the Licensing Division of the Ministry of Works and Transport: An Analysis of User-AI Interaction in the U-Turn System

Jason Leach
Department of Communication, University of Ottawa, Canada
jleac030@uottawa.ca

Abstract. As developing nations seek to increase the use of technology in their governance, the integration of artificial intelligence (AI) in public sector organizations is gaining momentum. While existing research has predominantly explored AI's macro implications, this study investigates its microsocial effects on daily professional practices within public organizations. Focusing on the case of Trinidad and Tobago's Licensing Authority and its implementation of the U-Turn system, this research employs an organizational ethnography approach. By analyzing interviews, observations, and documents, the study aims to understand how employees interact with AI-based technology at the microsocial level. Initial findings highlight the significance of the law in

shaping technological usage, with AI often serving as a manifestation of legal mandates. Furthermore, the introduction of AI prompts organizational transformations, necessitating new administrative practices to bridge technological gaps. Ultimately, this study contributes to a deeper understanding of the nuanced interactions between employees and AI systems in public sector decision-making processes, shedding light on the evolving dynamics of organizational practices and knowledge construction.

1 Context and Research Question

Public organizations are increasingly engaging the use of Artificial Intelligence (AI) as it seeks to maximize productivity and efficiency (Ahn & Chen, 2020). The use of AI-based technologies is currently advancing public sector operations in policy creation, patent review and customer service (Susar & Aquaro, 2019). However, the engagement with technology as a means of ensuring governments' efficiency in the allocation of scare resources, reduction of corruption and increased efficiency both in internal processes and with interactions with the public, have contributed to what Ahn & Chen (2020) refer to as frontier technology, that is, technology that brings about social transformation.

The literature suggests that research has focused primarily on the use of AI in public organizations as a vehicle for implementing policy and as tool for ensuring efficiency, as such there is little existing research on how the use of AI-based technologies affects the daily professional practices in public organizations (Wirtz et al., 2019). As AI becomes more intuitive and its use increases in public organizations, it has become urgent to better understand the ways in which this increased use shapes how people work and, more broadly, how these technologies reshape how people collaborate and make decisions. The synergies and forms of collaboration that can take place between human workers and AI in the workplace need to be explored in greater detail (Seeber et al., 2020). *"A key challenge to the implementation and adoption of intelligent machines in the workplace is their integration with situated work practices and organizational processes"* (Wolf and Blomberg 2019, p. 546).

The increased role of AI and its ability to contribute significantly to organizational processes may mean that researchers must actively consider that the agency of AI in decision-making is increasing (Wimmer et al., 2020). Also of significant consideration is that much of AI can operate either autonomously or semi-autonomously and may serve a standalone role in public organizations.

The problem to be examined under this study is: What are the implications for microsocial decision-making when AI, as a non-sentient entity, is an equal contributor to the practices involved in decision making?

To examine and explore these issues, a case study is being conducted of the implementation of AI technology within a public organization. The Government

of the Republic of Trinidad & Tobago (GORTT) embarked on significant legislative change as a means of reducing road fatalities, reducing inefficiency in the internal processes of the Licensing Authority, and improving the quality of interactions with the public. The U-Turn system, which the Ministry of Works and Transport describes as "software that provides real time connectivity between the Judiciary, the Trinidad and Tobago Police Service, the Licensing Authority, TTPost and the new Traffic Management Center" was the technological vehicle used to implement the broader goals of policy change, improved efficiency, and enhanced public engagement. van Noordt & Misuraca, (2020) advance the concept that AI in the public sector is typically placed under ICT platforms as part of a broader eGovernance approach.

This increasing adoption of AI-based technology in public organizations has generated a lot of research on the macro implications of the technology but less on the day-to-day interactions between workers and AI systems. This leads to the following research question: How do employees of public organizations interact with AI-based technologies in the workplace to assist them in their decision-making process? More specifically, the objective is to understand:

a) How do employees collaborate with AI-based technology in their daily tasks?
b) How is this AI-based technology shaping the way they work and make decisions?

2 Theoretical Framework

A practice-based framework (Barrett & Orlikowski, 2021; Corradi et al., 2008) is the lens through which the data is being analyzed. The study takes the position as established by Orlikowski (2000, 2007) that a practice lens is appropriate for examining the way in which technology helps construct and define organizational reality. Thomas et al., (2014) presents a three-part rationale for understanding practice lens as a social construct in organization which helps researchers better interpret organizational phenomena. In the first instance, they argue that knowledge is a socially constructed, individual process that participants actively engage in as they make sense of their environment.

The production and construction of knowledge is a combination of what is being learned, the content of the information, the persons involved in the process and the goals of individuals as they make sense of their specific context. The second argument is that learning is a function of dissonance, and individuals generate new knowledge as they seek to make sense of uncertainty in the workplace. The resolution of this dissonance is once again a function of sense-making that is specific to the environment and premised on the content of the knowledge. Finally, a socio constructivist approach explains the development of knowledge via *"the acquisition of cognitive processing strategies, self-regulation,*

and problem solving through socially constructed learning opportunities." (Thomas et al., 2014).

3 Methodology

In this research project, an organizational ethnography will be conducted within the Licensing Authority of Trinidad and Tobago, focusing on the operations of the Traffic Enforcement Center Unit, the department with direct oversight of the U-Turn software.

Organizational ethnography is described as being best suited for grasping the essence of organizational action (Czarniawska, 1997) and in the case of the U-System, the actions being considered are the changes to microsocial decision making that comes with the introduction of a complex technology. Organizational ethnography is concerned with implications of rules, strategies, and meanings and how these impact the social relations in the organization (Rosen, 1991). The introduction of the U-Turn system impacts the ways that things are done and ergo the 'rules' by which stakeholders engage with each other in the organization. Because of the pervasive effect of the technology being used, there are resulting organizational, cultural and sensemaking changes taking place in the organization. Therefore, ethnography will be the best way to see how the practices have changed, while engaging users to fill gaps and allowing them to be reflexive and reflective in their thinking about their own decision-making and the ways in which that has changed their engagement.

The table below identifies the various methods that have been used thus far in the gathering of the data for this thesis. During the months of September and October 2023 and February 2024, trips were made to Trinidad and Tobago to engage in an ethnographic inquiry around the implementation of the U-Turn system.

Table I. Data Gathered during organizational ethnography.

Interviews	Observation	Document collection	Ethnographic interviews	Photo elicitation	Picture & video
No: 4 (Senior Management)	No:30 (Staff Members: Office & Field) 90 Hours of observation	Legislative, Communication and System Generated	No: 5 (Office and Field staff)	No:4 (Office staff)	75 pictures & 37 minutes of video

4 Current State of the Study

Data was analyzed in two phases. In the first phase, an inductive process analysis was conducted (Mezmir, 2020; Azungah, 2018). Due to the interest in understanding work practices and the dynamic nature of collaboration with an AI-based system (such as the U-Turn system), the inductive analysis contributes to identifying and describing works practices. NVivo was used for coding the transcribed interviews, observation notes and reflection notes containing interpretations, and document analysis on fieldwork were uploaded. A thematic analysis was conducted to identify core themes and sub-themes that focused on work practices, group interactions, modalities of collaboration between services, and tensions that arise during the use of the AI system. This process of analysis is an iterative one, meaning that while engaged in developing themes, there is also a search (looking) for congruence with the literature review and determining what other areas may need to be engaged to help explain some of the findings from the data collected. While the analysis is ongoing, there are several emergent themes that have become apparent. These are:

1) The materialization of the law in the AI as a "figure" of authority.
2) AI-based technology as a new partner, reconfiguring the situated decision-making (the case of field officers).

4.1 The materialization of the law in the AI as a "figure" of authority

The translation and incarnation of laws and regulations into AI-based technology shape work practices and transform the way employees interact with the public and other departments within the organization. The law limits the ways in which technology can be used, which is a separate discussion from the capacity and scope of the technology. In public organizations, the law drives technology and not the other way around. In essence what seems to be occurring is a materialization of the law through the technology. Materialization in this context is understood as the passing of matter from one stage to another as defined by Cooren (2020). Ergo, the U-Turn is the law materialized, that is, having been conceived legally, it has now materialized as technology.

4.2 AI-based technology as a new partner, reconfiguring the situated decision-making (the case of the field officers)

A first analysis of interviews and observations with officers in the field shows how they integrate − or try to integrate − the U-Turn system into their daily practice. This study will focus on two aspects. The first is the way officers integrate the U-Turn system into their interactions with the public; and the second is the way officers in the field coordinate with the new Traffic Management Center that was created specifically after the system was implemented within the

Ministry of Works & Transport. This new organizational unit plays a unique role by ‘controlling” activities and decisions made by the officers in the field. It appears that the implementation of the U-Turn system has fragmented the decision-making process by limiting the access of officers to specific information about driver’s licenses or previous traffic offences.

5 Contributions to the Discipline

The growing presence of AI in public organizations is of interest to organizational communication and CSCW researchers who are interested in understanding the complex relationship between AI-based technologies and organizations, as well as how the technology might shape work practices and how the use of AI might create new forms of collaboration in organizations (Makarius et al., 2020; Mateescu & Elish, 2019; Wolf & Blomberg, 2019; Lampinen et al., 2022; Flügge et al., 2020). The U-Turn system is pervasive in the way in which it transformed the Licensing Authority. However introducing comprehensive technology reform into an organization that has not been a culturally technologically inclined institution, means that there are bridging practices that must happen to ensure continuity of operations.

Liao et al., (2020) in their discussion argue that a lot of the research on AI usage has been focused on the data scientists and have taken a top-down approach. Conversely, the study of the U-Turn system in positioned from the perspective of the user and how that interaction in turn reframes the organizational practices. Ergo, while the technology affects the user, this study contributes to the discourse on how the user impacts on the way the technology is used and the way in which organizational practices are restructured to facilitate effective collaboration using the technology. The present study offers a real time observation of the evolution of organizational practice around AI usage from the perspective of the persons who are the primary users.

References

Ahn, M. J., & Chen, Y.-C. (2020). Artificial Intelligence in Government: Potentials, Challenges, and the Future. *ACM International Conference Proceeding Series*, 243–252. https://doi.org/10.1145/3396956.3398260

Azungah, T. (2018). Qualitative research: deductive and inductive approaches to data analysis. *Qualitative research journal*, 18(4), 383-400.

Barrett, M., & Orlikowski, W. (2021). *Scale matters: Doing practice-based studies of contemporary digital phenomena*.

Cooren, F. (2020). Beyond entanglement:(Socio-) materiality and organization studies. *Organization Theory*, *1*(3), 2631787720954444.

Corradi, G., Gherardi, S., & Verzelloni, L. (2008). Ten good reasons for assuming a 'practice lens' in organization studies. *3rd OLKC Conference*, 1–37.

Czarniawska, B. (1997). *Narrating the organization: Dramas of institutional identity*. University of Chicago Press.

Flügge, A. W. A., Hildebrandt, T., & Møller, N. H. (2020, January). Algorithmic decision making in public services: A CSCW-perspective. In *Companion Proceedings of the 2020 ACM International Conference on Supporting Group Wor*k (pp. 111-114).

Lampinen, A., Holten Møller, N. L., Shaikh, R. I., Ammitzbøll Flügge, A., Kaltenhäuser, K., & Cakici, B. (2022). *CSCW and Algorithmic Systems. In ECSCW 2022*, 27 June-1 July, 2022, Coimbra, Portugal. European Society for Socially Embedded Technologies (EUSSET).

Liao, Q. V., Gruen, D., & Miller, S. (2020). Questioning the AI: informing design practices for explainable AI user experiences. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–15.

Mateescu, A., & Elish, M.C. (2019). *AI in Context: The Labor of Integrating New Technologies* (New York: Data & Society Research Institute, 2019), https://datasociety.net/wp-content/uploads/2019/01/DataandSociety_AIinContext.pdf

Makarius, E. E., Mukherjee, D., Fox, J. D., & Fox, A. K. (2020). Rising with the machines: A sociotechnical framework for bringing artificial intelligence into the organization. *Journal of business research*, 120, 262-273.

Mezmir, E. A. (2020). Qualitative data analysis: An overview of data reduction, data display, and interpretation. *Research on humanities and social science*s, 10(21), 15-27.

Orlikowski, W. J. (2000). Using technology and constituting structures: A practice lens for studying technology in organizations. *Organization Science*, *11*(4), 404–428.

Orlikowski, W. J. (2007). Sociomaterial Practices: Exploring Technology at Work. *Organization Studies*, *28*(9), 1435–1448. https://doi.org/10.1177/0170840607081138

Rosen, M. (1991). Coming to terms with the field: Understanding and doing organizational ethnography. *Journal of Management Studies*, *28*(1), 1–24.

Seeber, I., Bittner, E., Briggs, R. O., De Vreede, T., De Vreede, G. J., Elkins, A., ... & Söllner, M. (2020). Machines as teammates: A research agenda on AI in team collaboration. *Information & management, 57*(2), 103174.

Thomas, A., Menon, A., Boruff, J., Rodriguez, A. M., & Ahmed, S. (2014). Applications of social constructivist learning theories in knowledge translation for healthcare professionals: A scoping review. *Implementation Science*, *9*(1). Gale Academic OneFile. https://link.gale.com/apps/doc/A540645481/AONE?u=otta77973&sid=bookmark-AONE&xid=f7ad5b10

van Noordt, C., & Misuraca, G. (2020). Evaluating the Impact of Artificial Intelligence Technologies in Public Services: Towards an Assessment Framework. *Proceedings of the 13th International Conference on Theory and Practice of Electronic Governance*, 8–16. https://doi.org/10.1145/3428502.3428504

Wimmer, M. A., Viale Pereira, G., Ronzhyn, A., & Spitzer, V. (2020). Transforming Government by Leveraging Disruptive Technologies: Identification of Research and Training Needs. *EJournal of eDemocracy and Open Government*, *12*(1), 87–113. https://doi.org/10.29379/jedem.v12i1.594

Wirtz, B. W., Weyerer, J. C., & Geyer, C. (2019). Artificial Intelligence and the Public Sector-Applications and Challenges. *International Journal of Public Administration*, *42*(7), 596–615. https://doi.org/10.1080/01900692.2018.1498103

Wolf, C. T., & Blomberg, J. L. (2019). Intelligent systems in everyday work practices: integrations and sociotechnical calibrations. In *Intelligent Human Systems Integration 2019: Proceedings of the 2nd International Conference on Intelligent Human Systems Integration (IHSI 2019): Integrating People and Intelligent Systems, February 7-10, 2019,* San Diego, California, USA (pp. 546-550). Springer International Publishing.

Corieri, Isabella L. (2024): Critical Perspective of Infrastructures in the Field of Migrant Reception. In: Proceedings of the 22nd European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centered Computing on the Design of Cooperation Technologies – Doctoral Colloquium Contribution, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.48340/ecscw2024_dc10

Critical Perspectives of Infrastructures in the Field of Migrant Reception

Isabella L. Corieri
Syracuse University School of Information Studies
ilcorier@syr.edu

Abstract. This position paper discusses the convergence of literature on information infrastructures, critical theories of information and work relating to the field of reception in the context of migration. With evidence from existing literature and the preliminary findings of a pilot study based in Italy, the work of individuals and organizations within the field of migration is often filled with multi-faceted points of social support that are deeply embedded within one another. These points of social support pertain to employment, housing, food security, legal aid, language learning and so much more. Furthermore, those that are of migration background and seeking various forms of social support are entitled to the information they need in order to actively participate in their locality. Therefore, how do the systems involved in this work embody equity and inclusion? By specifically studying the information infrastructures involved in this work, one can gain perspective on the dynamic elements and practices of reception work and its reliance on technology and communication across a larger network of social support providers.

1 Infrastructures and Reception in Italy

The act of Infrastructuring is a phenomenon situated in Science and Technology Studies and often associated with digital information and organization research (Bowker et, al, 2010). The utility and understanding of infrastructures alone has been constructed by society over time throughout various periods of intervention (Edwards, 2017). Perhaps one of the first sociotechnical understandings of infrastructures comes from Thomas Hughes (1983) and the idea of the expansion beyond being technical artifacts and emphasis on social relations, power dynamics and institutions. This understanding derived from his work on electrical power systems and the understanding that they serve as a critical infrastructure to society at large (Hughes, 1983).

IT Infrastructures can be seen as physical entities, such as hardware and software. This definition, however, has been expanded to include a more administrative view of infrastructures that includes policies, rules, budgets and training associated with the use of the physical side of the IT infrastructure (Saga & Zmud, 1994 in Evaristo & Munkvold, 2002). Information Infrastructures in particular have been defined in a way centered on nature, development, and impact from a sociotechnical perspective. Hanseth and Monteiro (1998) argue that information infrastructure should not be perceived as a fixed technological entity but rather as a dynamic and evolving sociotechnical system. Rather, emphasis is placed on the need to move beyond a narrow focus of technology and instead consider the intricate interplay between technological components, human actors, and organizational practices. By adopting an expansive view that includes both technical and social aspects, Hanseth and Monteiro shed light on the complexities of managing and evolving information infrastructures within various organizational contexts. Hanseth and Monteiro (1998) assert that information infrastructures are often constructed incrementally, like a patchwork quilt, with various components and technologies being added over time.

Infrastructures within migration studies encompass the physical, social, and institutional frameworks that facilitate or impede the movement of people across borders. Physical infrastructures, such as transportation networks and border control systems, shape the material conditions and pathways of migration (Madianou & Miller, 2013). Social infrastructures, including migrant support networks, community organizations, and transnational social ties, play a crucial role in providing resources, information, and emotional support for migrants during their journeys and settlement processes (Faist, 2009). Understanding these infrastructures is essential for comprehending the lived experiences of migrants. Additionally, institutional infrastructures, such as immigration policies, legal frameworks, and international agreements, significantly impact migration patterns and outcomes. While public administrations implement laws and regulations, international organizations, like the International Organization of Migration (IOM),

and border agencies monitor, control, or try to prevent mobilities for not only crisis situations, but educational and professional opportunities (Lang, Pott & Shinozaki, 2021). Research within migration studies often examines how these formal structures shape the opportunities and constraints for migrants, influencing their decision-making processes and access to rights and resources (Castles, de Haas, & Miller, 2014).

While there are many areas one can study in migration from an infrastructural perspective, my work is particularly focused on reception. Since reception looks different depending on one's local context, I further concentrate on reception in Italy. Regarding the major governmental organizations involved in the Italian reception process, one must understand the roles of SPRAR and CAS. SPRAR is the system for protection of asylum seekers and refugees, but does not host all refugees, asylum seekers and individuals with other forms of protection (Bassoli & Oggioni, 2017). CAS is the emergency solution put in place by the Ministry of the Interior in order to fulfill hosting needs when SPRAR is no longer available. CAS structures are typically large and host dozens of individuals, while the SPRAR arrangements are typically shared flats or smaller centers. Both SPRAR and CAS also occur in the second phases of the hosting system of Italy, given the initial is in government centers (Bassoli & Oggioni, 2017). There are also practices of reception that are more informal and driven in local contexts as a way to alleviate the shortcomings of the previously discussed approaches. For example, domestic hospitality is the initiative of everyday citizens in society to welcome refugees and other individuals with migration background into their homes (Boccagni & Giudici, 2021).

2 Previous Work in Lazio, Italy

A pilot study of the field of reception in Italy was carried out in the summer of 2021 while I interned at an organization focused on domestic hospitality practices. The findings, overall, noted a great deal of grassroots approaches to reception. Oftentimes, those involved in providing various forms of support for individuals of migration background identified with activist movements and other groups centered on equity and inclusion. This inspired curiosity pertaining to the collaboration and communication practices that takes place within and across infrastructures as well information equity practices of these groups. The pilot study findings also presented notions of creative infrastructure action, or the "resourceful, ad hoc and imaginative development of homegrown infrastructures and the work of integrating new tools into older infrastructures and cultural practices" (Jack et al., 2017, p. 6512).

3 Research Questions

My research questions are exploratory in nature, inspired by this 2021 pilot study as well as literature on infrastructures, reception in Italy and information equity: How can creative infrastructural action be seen across the field of reception in Italy? What happens when an infrastructure breaks? How can infrastructures embody equity and inclusion? How are infrastructures manifested through relationships and networks?

4 Methodological Approach

My methods are mainly ethnographic in nature, with particular focus on critical approaches to interviewing and participant observation that focus on strength based perspectives. I also see documents as a key point of departure for understanding infrastructures. A document-focused study compliments a project looking at infrastructures within the field of reception because like migration, documents are not always fixated, but rather fluid and ever-changing. Much like other forms of data gathering, documents can tell the lived experiences of individuals. The working definition of a document that I use in my work is, "Any artifact that includes substantial references to the social processes to which it was produced or reproduced" (Shankar et. al, 2016, p. 59). A document-based perspective will not only offer insight into the social processes of reception, but the political and legal as well. "Documents do more than represent the world; they often also refer to the practices, objects, rules, knowledge, and organizational forms that produced them" (Shankar et. al, 2016, p. 62).

Studying infrastructures is not an easy feat and therefore need diverse methodological approaches that offer holistic perspectives. Studying Infrastructures, or rather visualizing them, becomes possible when researchers account for both the categorical lens that considers both the construction and maintenance of systems as well as the experiences of actors involved in the infrastructure itself (Singh & Jackson, 2021). Previous epistemic approaches have been carried out to study infrastructures in a more holistic way. While previous work that directly applied theories to the study of infrastructures has made valuable contributions, there is still much to gain from inductive approaches in order to generate new theories. Therefore, studying infrastructures with a grounded theoretical approach that has an ecological design methodology allows for more greater understanding of both systems and actors. Ecological Design promotes a design methodology that values sustainability, interdisciplinary collaboration, and stakeholder participation. It aims to create information environments that not only function effectively but also contribute positively to the ecological, social, and cultural contexts in which they exist (Baker, 2004).

5 Expected Outcomes

By focusing on the creative action of infrastructures and how it may (or may not) embody equity and inclusion, I believe this future case study will shed light on the unseen practices of reception work in Italy. I also hope to open conversation for organizations within the field of reception to reflect upon their own infrastructures that are constantly working in the background, invisible, but crucial.

References

Baker, K. S. (2004): 'Ecological Design: An interdisciplinary, interactive participation process in an information environment'. *Proceedings of the Workshop on Requirements Capture for Collaboration in E-Science*, 14-15 January 2004, Edinburgh, 5–7.

Bassoli, M., and L. Oggioni. (2017): 'Domestic Hospitality: An IT Based Approach.' In *ICT and Innovation: A Step Forward to a Global Society*, edited by A. Zardini, F. Virili, and S. Za, 29–42. Roma: LUISS University Press.

Boccagni, P., and Giudici, D. (2021): 'Entering into domestic hospitality for refugees: a critical inquiry through a multi-scalar view of home'. *Identities*, 1-20.

Bowker, G. (1996): 'The History of Information Infrastructures: The Case of the International Classification of Diseases'. *Information Processing and Management*, 32(1), 49-61.

Bowker, G. C., Baker, K., Millerand, F., and Ribes, D. (2010): 'Toward Information Infrastructure Studies: Ways of Knowing in a Networked Environment'. In J. Hunsinger, L. Klastrup, & M. Allen (Eds.), *International Handbook of Internet Research* (pp. 97–117). Springer Netherlands. https://doi.org/10.1007/978-1-4020-9789-8_5

Castles, S., de Haas, H., and Miller, M. J. (2014): *The age of migration: International population movements in the modern world* (5th ed.). Guilford Press.

Edwards, P. N., Bowker, G. C., Jackson, S. J., and Williams, R. (2009): 'Introduction: An Agenda for Infrastructure Studies'. *Journal of the Association for Information Systems*, 10(5), 364–374.

Edwards, P. N., and Harvey, B. R. (2018): Infrastructural inversion: Charting the surprises of network restructuring. In Y. Kim, B. R. Smith, M. Erickson, & A. S. Mattson (Eds.), Proceedings of the *2018 CHI Conference on Human Factors in Computing Systems* (p. 243). ACM. https://doi.org/10.1145/3173574.3173883

Evaristo, J. R., and Munkvold, B. E. (2002): Collaborative Infrastructure Formation in Virtual Projects. *Journal of Global Information Technology Management*, 5(2), 29–47. https://doi.org/10.1080/1097198X.2002.10856324

Faist, T. (2009): 'The Transnational Social Question: Social Rights and Citizenship in a Global Context'. *International Sociology*, 24(1), 7-35. https://doi.org/10.1177/0268580908099153

Hanseth, O., and Monteiro, E. (1998): *Understanding Information Infrastructure*.

Hughes, T. P. (1983). *Networks of power: Electrification in Western society*, 1880-1930. The Johns Hopkins University Press.

Jack, M., Chen, J., and Jackson, S. J. (2017): 'Infrastructure as Creative Action: Online Buying, Selling, and Delivery in Phnom Penh'. in Proceedings of the 2017 *CHI Conference on Human Factors in Computing Systems*, 6511–6522. https://doi.org/10.1145/3025453.3025889

Lang, C., Pott, A., and Shinozaki, K. (2021): 'Organizations and the production of migration and in/exclusion.' *Comparative migration studies*, 9, 1-16.

Madianou, M., and Miller, D. (2013): *Migration and New Media: Transnational Families and Polymedia.* Routledge.

Shankar, K., Hakken, D., and Østerlund, C. (2016): 'Rethinking Documents'. In Ulrike Felt, Rayvon Fouché, Clark A. Miller, Laurel Smith-Doerr (Eds.) *Handbook of Science and Technology Studies*, 4th edition. Cambridge: MIT Press.

Singh, R., & Jackson, S. (2021): 'Seeing Like an Infrastructure: Low-resolution Citizens and the Aadhaar Identification Project.' *Proceedings of the ACM on Human-Computer Interaction*, 5(CSCW2), 1–26. https://doi.org/10.1145/3476056

Alhomaid, Hadeel F. R. (2024): Social Media Influencers and Consumer behaviour: Online Shopping Trends among Saudi Women. In: Proceedings of the 22nd European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centered Computing on the Design of Cooperation Technologies – Doctoral Colloquium Contributions, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.18420/ecscw2024_dc11

Social Media Influencers and Consumer Behaviour: Online Shopping Trends among Saudi Women

Hadeel F. R. Alhomaid
School of Computing and Communication, Lancaster University, UK
h.alhomaid@lancaster.ac.uk

Abstract. Through empirical investigations of collaborative practices, this research seeks to dissect the influence of social media influencers on the online shopping behaviours of Saudi women, a topic that has been relatively understudied in the existing literature. The objective is to advance the domains of CSCW and Human-Computer Interaction (HCI) by investigating the consumer online shopping practices, particularly how they are influenced by social media influencers and cultural contexts. It aims to understand how cultural and technical aspects impact digital shopping experiences in this specific context. Saudi Arabia, known for its unique blend of traditional and contemporary elements, provides an excellent context for studying the impact of the design and influencer marketing on women's online shopping purchase decisions. The study explores the impact of cultural perspectives, especially from Saudi Arabian culture, on HCI design with the goal of improving the inclusivity and worldwide relevance of technological solutions. This research strengthens the field of HCI by highlighting the need of considering cultural sensitivity in design. Moreover, it enriches our understanding of consumer behaviours across different global contexts, emphasizing the insights from non-Western perspectives such as those in Saudi Arabia.

1 Introduction

Social media use has dramatically affected how people communicate and interact with one another and how they receive information and news. Furthermore, it has changed customers' behaviours; for example, customers now often consult reviews and other people's opinions on social media (Alshammari and Almansour, 2020; DePaula et al., 2018; Djafarova and Rushworth, 2017). The affected activities include consumer intention and the actual buying behaviour. This change has made a significant impact on how marketing businesses manage their campaigns and ads and how people decide and make a purchase. A critical phenomenon that has taken place in social media communities is the introduction of Social Media Influencers (SMIs) - "online personalities with large numbers of followers, across one or more social media platforms (e.g., YouTube, Instagram, Snapchat, or personal blogs) [who] influence their followers" (Varghese and Agrawal, 2021). They have a significant impact on people's daily choices, including purchasing habits (Arora et al., 2019). Furthermore, SMIs usually specialise in a particular area to increase the consumers' trust in their opinions about a product or service (Hall, 2016; Lou and Yuan, 2019). This literature review aims to focus on the broad trends in relation to SMIs, consumer buying behaviour and purchase intention, while indicating the contextual gaps that have emerged in non-western cultures and specially in the contexts of Saudi Arabia.

2 Literature Review

Human-Computer Interaction (HCI) is a dynamic and interdisciplinary field that has witnessed considerable evolution over the past 40 years. It integrates a range of disciplines including Sociology, Psychology, Communication, Human Factors Engineering, and Industrial Engineering, reflecting its broad scope and multidisciplinary nature (Gurcan et al., 2021; Jinjuan et al., 2017). The Association for Computing Machinery (ACM) conceptualizes HCI as concerned with the creation, assessment, and application of interactive computing systems designed for human use, as well as the investigation of significant phenomena surrounding them (Hewett et al., 1992). This definition underscores the field's commitment to improving the interface between humans and computers, highlighting its relevance in the digital age.

Research within HCI has transitioned from a machine-centric to a human-centric approach over the last six decades, with Gurcan et al. (2021) emphasizing the shift towards online communicative technologies and social media. This pivot is significant, considering the pervasive impact of social media on contemporary human-computer interactions.

In the rapidly evolving field of HCI, current research keenly explores the interaction between social media interfaces and user experiences, particularly emphasizing the critical role of cultural nuances in designing accessible and user-friendly platforms (Cao and Loiacono, 2019) for diverse global audiences, including those in non-Western contexts like Saudi Arabia.

Emerging research also delves into Social Media Influencers (SMIs) and their profound influence on followers, exploring themes of trust, platform governance, and the professionalization of influencers (Ki et al., 2022; Han et al., 2021; Niu et al., 2021; Establés et al., 2019; Weber and Ludwig, 2021). Studies like those by AlArfaj et al. (2019); Ahmed AlArfaj and Solaiman (2022) extend this inquiry to specific cultural and regional contexts, examining how trust in platforms and HCI design considerations impact consumer buying behaviours in places like Saudi Arabia.

Furthermore, research by Weber and Ludwig (2021), alongside studies focused on the purchasing behaviours of young adults influenced by SMIs (Croes and Bartels, 2021; Djafarova and Rushworth, 2017), contribute to understanding the nuanced effects of social media within HCI. These studies collectively underscore the importance of HCI research in navigating the complex interplay between technology, social media, and different cultures, offering insights into the potential for HCI to shape and enhance the digital interactions.

3 Research Questions

This research seeks to evaluate the impact of social media influencers on the online purchasing behaviours of Saudi women. The Main Research Question: To what extent do social media influencers impact the online shopping behaviours of Saudi women?

- RQ1: How do social media influencers in Saudi Arabia integrate e-commerce elements into their online content to influence the purchasing behaviours of Saudi women?
- RQ2: How do cultural preferences and values of Saudi women mediate the influence of SMIs on their purchasing decisions, particularly within the context of online endorsements and social media interactions?
- RQ3: What design implications can be derived for e-commerce platforms based on their influence on the purchasing decisions of Saudi women?
- RQ4: How do Saudi women perceive and evaluate their purchase decisions influenced by social media posts?

4 Method

The concurrent parallel design introduced by Creswell (2013) was chosen as a basic mixed-methods design for this work. The convergent parallel design is defined as "concurrent quantitative and qualitative data collection, separate quantitative and qualitative analyses, and the merging of the two data sets" (Creswell and Plano Clark, 2017). This design was chosen because it provides a complete understanding of the phenomenon, as it covers qualitative and quantitative data that explain each other in depth and in more detail (Creswell and Plano Clark, 2017). Merging strategies in convergent designs has also been described as a varying form of data triangulation introduced by Denzin (1978), which will help to increase the accuracy and ensure the reliability of the results (Harrison et al., 2020; Turner et al., 2017). The qualitative data would be composed of semi-structured interviews and digital auto-ethnography. The transcripts of the semi-structured interviews, along with the diary entries of the digital auto-ethnography would be subjected to thematic analysis. While for the quantitative components of this research, which would include a survey and a sentiment analysis using Natural Language Processing (NLP), two primary modes of analysis will be used. The survey would run through performing statistical analysis. In the case of the NLP, sentiment analysis would be used on the comments sections of social media posts posted online by influencers to gain key critical insights from an NLP perspective regarding Saudi women and their consumer behaviour online. This study received ethical approval from The FST Research Ethics Committee (FSTREC) in Lancaster University, ensuring adherence to the highest ethical standards.

5 Findings

Through this ongoing study, fascinating patterns and trends have started to uncover that are closely linked to Saudi women online consumer behaviour. While the full conclusions are not final yet, these first findings provide a valuable view into the effect of Social Media Influencers (SMIs) on Saudi women online shopping behaviours. For example, the early data gathered from semi-structured interviews with Saudi women who follow SMIs and practice online shopping have shown indications of the strong impact of social bonds on the consumer online behaviour among Saudi women. This preliminary evidence implies that the study delves into several interesting themes explained in the following. The study indicates the appearance of the theme 'Influence of Friends and Family on online Buying Decisions', revealing the fascinating convergence of traditional family guidance in Saudi Arabia with the impact of digital influences (Mabkhot et al., 2022). Within the context of Human-Computer Interaction (HCI), this discovery

highlights the need of digital interfaces integrating traditional cultural values with the dynamism of current social media (Servidio et al., 2015). Likewise, within the context of the theme 'Parasocial Relationships with SMIs and Building Trust', the important impact of social media influencers is influenced by cultural perspectives on trust and credibility. HCI designers have the task of developing platforms that align with the culturally distinct expectations of users (Kyriakoullis and Zaphiris, 2016). The significance of culturally responsive HCI design is highlighted by the data, emphasising the need for technology to be in integration with the distinct cultural landscape of non-western countries such Saudi Arabia (Jagne and Smith-Atakan, 2006). Regarding the theme of 'Promotion of Online Shopping vs In store Shopping', the research reveals an interesting cultural shift towards online shopping, which may be attributed to the impact of digital marketing tactics (Al Hamli and Sobaih, 2023). This transition necessitates Human-Computer Interaction (HCI) solutions that not only cater to usability but also align with the cultural preferences of Saudi women (Shen et al., 2023). The theme 'Incentivizing Online Shopping via SMIs' highlights the importance of e-commerce platforms including cultural awareness into its design. This ensures that incentives and promotions are both culturally acceptable and successful (Gefen and Heart, 2008). These observations emphasise the important role of Human-Computer Interaction (HCI) in creating digital platforms that are not just technically skilled, but also deeply integrated into the cultural background of their users, especially when it comes to involving the growing market of Saudi women (Kumar and Dell, 2018).

6 Future Work

During the next phases of this study, the main objective will be to successfully finish and incorporate various data gathering techniques. The autoethnographic component seeks to give personal insights into the cultural context of online buying behaviours among Saudi women, presenting a distinctive narrative viewpoint (Rapp, 2018). Simultaneously, the work would continue further out with using Natural Language Processing (NLP) to analyse social media content. This will allow to identify patterns and attitudes pertaining to e-commerce and influencer marketing within the Saudi context. Moreover, the examination of survey data will enhance these qualitative observations by providing numerical evidence, enhancing the comprehension of the wider patterns in consumer behaviour. Expanding upon these results, there will be a notable emphasis on understand the implications of HCI design. The objective of this project is transforming the knowledge acquired via the comprehensive research method into actionable suggestions for e-commerce platforms, particularly those focused on the Saudi market in order to cater to the unique cultural and behavioural requirements of Saudi women (Dourish, 2006). In conclusion, a delve into the

broader impact of the findings on worldwide e-commerce strategies and digital marketing practices. Understanding how global e-commerce platforms can adapt to varied cultural settings will be crucial by integrating cultural subtleties in technology usage and customer behaviour patterns. This study is anticipated to make a substantial contribution to both the academic field and practical implementations, providing vital perspectives for the ever-changing realm of digital commerce and technological development (Broeder and Gkogka, 2020).

References

Aisha Ahmed AlArfaj and Ellis Solaiman. Comparing different qualitative methods to understand user experience in Saudi Arabia. 2022.

Sarah S. Al Hamli and Abu Elnasr E. Sobaih. Factors Influencing Consumer Behavior towards Online Shopping in Saudi Arabia Amid COVID-19: Implications for E-Businesses Post Pandemic. *Journal of Risk and Financial Management*, 16(1), 2023. ISSN 19118074.

Aisha Ahmed AlArfaj, Ellis Solaiman, and Lindsay Marshall. "Why would you buy from a stranger?" Understanding Saudi Citizens' motivations and challenges in social commerce. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, volume 11747 LNCS, 2019.

Norah Fahad Alshammari and Amal Abdullah Almansour. Aspect-based Sentiment Analysis for Arabic Content in Social Media. In *2nd International Conference on Electrical, Communication and Computer Engineering, ICECCE 2020*, 2020.

Anuja Arora, Shivam Bansal, Chandrashekhar Kandpal, Reema Aswani, and Yogesh Dwivedi. Measuring social media influencer index- insights from facebook, Twitter and Instagram. *Journal of Retailing and Consumer Services*, 49, 2019. ISSN 09696989.

Peter; Broeder and Anna Gkogka. The cultural impact of navigation design in global e-commerce. *Journal of Tourism, Heritage & Services Marketing*, 6(3), 2020. ISSN 2529-1947.

Shiya Cao and Eleanor Loiacono. The State of the Awareness of Web Accessibility Guidelines of Student Website and App Developers. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, volume 11578 LNCS, 2019.

John W. Creswell. Steps in Conducting a Scholarly Mixed Methods Study: What I am looking for core characteristics: Do you have a quantitative database? (closed- ended). *University of Nebraska - Lincoln*, 2013.

John W. Creswell and Vicki L. Plano Clark. *Designing and Conducting Mixed Methods Research | SAGE Publications Ltd*. 2017.

Emmelyn Croes and Jos Bartels. Young adults' motivations for following social influencers and their relationship to identification and buying behavior. *Computers in Human Behavior*, 124, 2021. ISSN 07475632.

Norman K Denzin. Triangulation: A case for methodological evaluation and combination. *Sociological methods*, 1978.

Nic DePaula, Ersin Dincelli, and Teresa M. Harrison. Toward a typology of government social media communication: Democratic goals, symbolic acts and self-presentation. *Government Information Quarterly*, 35(1), 2018. ISSN 0740624X.

Elmira Djafarova and Chloe Rushworth. Exploring the credibility of online celebrities' Instagram profiles in influencing the purchase decisions of young female users. *Computers in Human Behavior*, 68, 2017. ISSN 07475632.

Paul Dourish. Implications for design. In *Conference on Human Factors in Computing Systems Proceedings*, volume 1, 2006.

María José Establés, Mar Guerrero-Pico, and Ruuth S. Contreras-Espinosa. Gamers, writers and social media influencers: Professionalisation processes among teenagers. *Revista Latina de Comunicacion Social*, 74, 2019. ISSN 11385820.

David Gefen and Tsipi Heart. On the need to include national culture as a central issue in ecommerce trust beliefs. In *Handbook of Research on Information Management and the Global Landscape*. 2008.

Fatih Gurcan, Nergiz Ercil Cagiltay, and Kursat Cagiltay. Mapping Human–Computer Interaction Research Themes and Trends from Its Existence to Today: A Topic Modeling-Based Review of past 60 Years. *International Journal of Human-Computer Interaction*, 37(3), 2021. ISSN 15327590.

Katie Hall. The importance of authenticity in influencer marketing, 2016. ISSN 08876045.

Jinda Han, Qinglin Chen, Xilun Jin, Weikai Xu, Wanxian Yang, Suhansanu Kumar, Li Zhao, Hari Sundaram, and Ranjitha Kumar. FITNet: Identifying Fashion Influencers on Twitter. *Proceedings of the ACM on Human-Computer Interaction*, 5(CSCW1), 2021. ISSN 25730142.

Robert L. Harrison, Timothy M. Reilly, and John W. Creswell. Methodological Rigor in Mixed Methods: An Application in Management Studies. *Journal of Mixed Methods Research*, 14(4), 2020. ISSN 15586901.

Thomas Hewett, Ronald Baecker, Stuart Card, Tom Carey, Jean Gasen, Marilyn Mantei, Gary Perlman, Gary Strong, and William Verplank. *ACM SIGCHI Curricula for Human-Computer Interaction*. 1992.

Jainaba Jagne and A. Serengul Guven Smith-Atakan. Cross-cultural interface design strategy. *Universal Access in the Information Society*, 5(3), 2006. ISSN 16155289.

Jonathan Lazar Jinjuan, Heidi Feng, and Harry Hochheiser. Research Methods in Human-Computer Interaction Second Edition. *Journal of the American Society for Information Science and Technology*, 61(1), 2017.

Chung-Wha (Chloe) Ki, Tsz Ching Chow, and Chunsheng Li. Bridging the Trust Gap in Influencer Marketing: Ways to Sustain Consumers' Trust and Assuage Their Distrust in the Social Media Influencer Landscape. *International Journal of Human–Computer Interaction*, pages 1–16, 7 2022. ISSN 1044-7318.

Neha Kumar and Nicola Dell. Towards informed practice in HCI for development. *Proceedings of the ACM on Human-Computer Interaction*, 2(CSCW), 2018. ISSN 25730142.

Leantros Kyriakoullis and Panayiotis Zaphiris. Culture and HCI: a review of recent cultural studies in HCI and social networks. *Universal Access in the Information Society*, 15(4), 2016. ISSN 16155297.

Chen Lou and Shupei Yuan. Influencer Marketing: How Message Value and Credibility Affect Consumer Trust of Branded Content on Social Media. *Journal of Interactive Advertising*, 19(1), 2019. ISSN 15252019.

Hashed Mabkhot, Normalisa Md Isa, and Ammar Mabkhot. The Influence of the Credibility of Social Media Influencers SMIs on the Consumers' Purchase Intentions: Evidence from Saudi Arabia. *Sustainability (Switzerland)*, 14(19), 10 2022. ISSN 20711050.

Shuo Niu, Cat Mai, Katherine G. McKim, and Scott McCrickard. #TeamTrees: Investigating How YouTubers Participate in a Social Media Campaign. *Proceedings of the ACM on HumanComputer Interaction*, 5(CSCW2), 2021. ISSN 25730142.

Amon Rapp. Autoethnography in Human-Computer Interaction: Theory and Practice. 2018.

Rocco Servidio, Barry Davies, and Kevin Hapeshi. Human-computer interaction in consumer behaviour. In *Mobile Computing and Wireless Networks: Concepts, Methodologies, Tools, and Applications*, volume 3-4. 2015.

Pengyi Shen, Demin Wan, and Jinxiong Li. How human–computer interaction perception affects consumer well-being in the context of online retail: from the perspective of autonomy. *Nankai Business Review International*, 14(1), 2023. ISSN 20408757.

Scott F. Turner, Laura B. Cardinal, and Richard M. Burton. Research Design for Mixed Methods: A Triangulation-based Framework and Roadmap. *Organizational Research Methods*, 20(2), 2017. ISSN 15527425.

Mr. Sony Varghese and Ms. Mansi Agrawal. Impact of Social Media on Consumer Buying Behavior. *Saudi Journal of Business and Management Studies*, 6(3), 2021. ISSN 2415-6663.

Philip Weber and Thomas Ludwig. It's a kind of art!: Understanding food influencers as influential content creators. In *Conference on Human Factors in Computing Systems - Proceedings*, 2021.