Explaining and Understanding Organizational Dynamics Using Digital Trace Data

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Abstract

The pervasive use of digital trace data in information systems research presents significant opportunities for exploring processes, changes, and temporal dynamics. Past research has leveraged the vast amount of available data, characterized by its fine-grained nature and temporal characteristics, to investigate process-related phenomena such as organizational change and broader organizational dynamics. However, a comprehensive understanding of how organizational dynamics intersect with and rely on digital trace data remains elusive. This dissertation project addresses this gap by employing digital trace data and computational techniques to analyze them, such as process mining, to elucidate the impact of organizational dynamics on processes. The analysis involves examining how organizational change influences both process dynamics and the organization itself. The research utilizes primarily computational methods, particularly process mining, applied to data sets from financial institutions in Central Europe. To complement the quantitative data, qualitative data is incorporated, acknowledging the often limited nature of digital trace data which typically lacks context.

Keywords
Digital trace data, organizational dynamics, change, process mining

1. Introduction

Recently, digital trace data-based research is gaining increasing attention in social sciences [1] but especially also in information systems (IS) research [2], providing novel means for investigating socio-technical phenomena [2, 3], not least because of their characteristics, such as the inherent inclusion of temporal information [4]. Digital trace data are the residuals or traces which arise from the interaction of a user with a digital tool, an information system [5]. As the communication and collaboration with digital technologies is arising, the amount of available digital trace data is more and more increasing [6].

Not least due to these features, there is a burgeoning number of studies elucidating different facets of research on digital trace data. For instance, various researchers developed guidance on how to use digital trace data [e.g., 7, 8], or conducted methodological analyses of the topic [e.g., 9]. With the increasing interest in researching digital trace data, there is also a growing demand to utilize this data in order to gain a better understanding of the changes and dynamics within companies, whether they are related to processes, organization, or social factors. The research project examines how organizational dynamics occurring in different processes and routines unfold and develop over time by using digital trace data analyses. Besides that, it makes use of the capabilities of digital trace data to capture the actual organizational dynamics. Digital trace data are especially useful in analyzing the dynamics occurring around organizational phenomena [10, 11, 12, 1]. Building on the emerging interest in digital trace data research, the dissertation project aims to answer the following question: How can organizational dynamics be explained and understood using digital trace data? In order to find an answer to this research question, different methodological approaches are taken. To this end, with this research project it is aimed to extend the existing literature on process research and digital trace data research in two ways. First, to study dynamic changes in process behaviour in the organizational context, it leverages the capability of digital trace data to capture actual process behaviour. Second, by using digital traces and related computational methods to analyze them, it sheds light on how organizational processes dynamically unfold over time.

However, as digital trace data typically lacks context, it is difficult to explain how and why these organizational changes occur. Despite the increasing interest in digital trace data research and the growing number of empirical as well as conceptual studies [e.g., 3, 7, 8], there is a need for gathering deeper and broader insights into how digital traces can be leveraged to study how processes are enacted and how they change over time.

Besides contributing to research in process mining and computationally intensive theorizing, this research also contributes to business process management (BPM) research. Following the recent research arguing that BPM initiatives should consider the dynamics of the digital age [e.g., 29, 30] many research projects within this dissertation project include a digital trace data analysis in order to emphasize the importance of taking a dynamic perspective on process changes.

2. Research Methodology and Techniques

Recently, computationally intensive theorizing is getting more and more attention as a new research paradigm which is based on analyzing or theorizing digital trace data with computational methods helping to understand organizational phenomena in the contemporary digital environment [2, 3]. Due to the novelty of the method, guidance on conducting computationally intensive theorizing is only emerging in the last years [e.g., 3,9]. Digital trace data research is characterized by utilizing data from users' digital interactions. This approach provides multiple benefits. Digital trace data, typically unstructured and fine-grained on a large scale, allow researchers to theorize (processual) phenomena by applying computational methods, as highlighted by Recker (2021), giving

them unprecedented capabilities to investigate phenomena at an unprecedented scale and level of detail [28]. Furthermore, digital trace data contains temporal information and therefore allows tracing changes in the process over time [28].

As the dissertation project focusses on process changes over time in the organizational context, as well as the induced dynamics, computationally intensive theorizing with digital trace data was used in different research projects, such as in the research on temporal bracketing (see table 1), where digital trace data was used to explain changes in a digital onboarding process.

3. Research Background

3.1. Digital Trace Data Research and Process Mining

Digital trace data can be described as the digital records of activities carried out through information systems [3, 5, 13. As we increasingly use digital technologies for organizational processes, but also in our communication and collaboration, the amount of such data available is constantly increasing [6, 14]. Besides the large volume and fine-granular nature, the data is typically characterized by the long time span for which this data is commonly collected and hence available [1], providing profound insights into socio-technical phenomena [e.g., 4, 15]. Digital trace data often takes the form of an event log [16] which is structured as timestamp, activity and a corresponding case ID [16]. As it contains temporal information, it is suitable for analyzing the dynamics unfolding around organizational phenomena and changes of the process in different contexts [11, 17]. With the increasing available data, the computational possibilities to analyze them are constantly rising and getting more sophisticated. Especially in the area of information systems, there is growing interest in discussing methodological guidance for digital trace data studies [2, 3] and ensuring the quality of the datasets [13].

Digital trace data can be analyzed through different methods, such as machine learning [9] or process mining [10], yielding insights into processes and their dynamics that would not be discernible through traditional manual analysis techniques. Process mining is the most common used computational method to analyze digital trace data in process research and has gained in popularity and adoption in recent years [19]. It uses digital trace data in the form of event logs that are captured in IS in order to analyze, evaluate and ultimately improve business processes [20, 16]. The event log is used in process mining to apply one of the three process mining techniques: process discovery, conformance checking, and process enhancement [16]. Allowing to analyze the as-is process rather than relying on a modeled process, comparing it with a to-be process model or even take actions from the gathered process insights [16].

The research projects within the dissertation (see table 1) are also based on digital trace data analysis, in particular with the help of process mining. For example, process discovery techniques are used to calculate throughput times and identify loops or bottlenecks. Furthermore, conformance checking techniques are often used in order to check the compliance of processes with the predefined process model and rules.

3.2. Organizational Dynamics and Process Research

Organizational dynamics entail the continuously developing and interrelated aspects of an organization, forming its structure, culture, and decision-making procedures [21]. Organizational change is a complex phenomenon unfolding over time and can occur as intended but also unintended change [10]. Within the dissertation project, the term of organizational dynamics covers any kind of organizational change leading to dynamics within a process, routine or generally the organization. Both, BPM and routine dynamics are research streams exploring processes using digital trace [22].

Rather than organizational dynamics, the term of process dynamics is more discussed in research. With process dynamics the changes in a process structure over time are described [7] and it can be measured using some kind of diachronic analysis [3]. This relates to changes in patterns of (process) behaviour over time which can be captured e.g., with digital trace data. Pentland et al. (2021) for instance, mentioned mechanisms used for theorizing process dynamics, which are patterning [23], endogenous change [24], imbrication [25], and phase change [4]. Organizational Dynamics, or specifically process dynamics can be investigated with digital trace data due to its temporal information included [1, 17], as for instance also shown by Pentland et al. (2021) who studied process dynamics based on digital trace data. With routine dynamics it is often referred to the complexity of a routine, meaning the number of possible paths through which the routine can be performed [7, 26] and thus also uses digital trace data. Computational techniques such as process mining can help theorizing about change in organizations and therefore also organizational dynamics [10]. Organizational dynamics and process research are two sometimes intertwined concepts. Process research is proving to be useful for delving into the intricacies of organizational dynamics and unravelling the mechanisms, patterns and dynamics that drive organizational processes [12].

The research project as a whole is based on the conceptual and theoretical foundation grounded in process research. Process research is an essential element and systematic to examine how change and organizational phenomena unfold over time [12, 27]. Its purpose is to reveal the mechanisms, patterns, and dynamics of processes and provide insights into how and why things happen [12]. Digital trace data, which was previously described can serve as the base for process research [8].

4. Current Research Status

During the first five semesters, there were several research projects started and partially also finalized. In the following semester there are two projects that should be finished while also writing up the dissertation. It is aimed to submit the dissertation in March 2025 and finish the doctoral studies by summer 2025.

The papers published or accepted so far (see table 1) all included a digital trace data analysis of an onboarding process of a financial institution. For instance, a framework has been developed to apply temporal bracketing to digital trace data, following the growing interest in temporal analysis [e.g., 7, 10, 18] in digital trace data and the increasing interest in frameworks to guide such research [2, 9]. The following two research papers that were accepted mainly dealt with the topic of complexity of an organizational routine, whereby

the digital trace data analysis from the onboarding process also formed the basis in each case. And lastly, there was just previously a research paper accepted proposing a context framework for sense-making of the process mining results. The aforementioned research projects have collectively facilitated the formulation of an answer to the research question on *explaining* the organizational dynamics with digital trace data. This was achieved through an analysis and interpretation of digital trace data. The second part, the *understanding* of organizational dynamics, is now to be covered with the help of a generic framework for the implementation of such process science projects. In the table below the current status of research projects related to the dissertation project is outlined.

Table 1
Overview of Ongoing and Finalized Research Projects

Title	Authors	Type & Outlet
Published or Accepted		
Explaining Change with Digital Trace Data: A Framework for Temporal Bracketing	Hartl, S., Franzoi, S., Grisold, T., vom Brocke, J.	Full Paper Hawaii International Conference on System Sciences (HICSS 2023)
Drivers of Complexity in Organizational Routines	Hartl, S., Franzoi, S., Grisold, T., vom Brocke, J.	Full Paper European Group for Organization Studies (EGOS 2023)
Effects of IT-based Changes on the Complexity of an Organizational Routine	Franzoi, S., Hartl, S., Grisold, T., vom Brocke, J.	Full Paper Annual Meeting of the Academy of Management 2024
A Context Framework for Sense-making of Process Mining Results	Grisold, T., van der Aa, H., Franzoi, S., Hartl, S., Mendling, J., vom Brocke, J.	Full Paper International Conference on Process Mining (ICPM 2024)
In Conceptualization		
Framework for Conducting Process Science Studies in an Organization		Tbd – Finalization by 10/24
Further Development of the Research on Complexity of Organizational Routines		Tbd – Finalization by 09/24

    With this doctoral consortium it is aimed to gather feedback on the remaining open research projects and on the current dissertation structure. More precisely, with the doctoral consortium it is intended to gather feedback on the ongoing research about a framework for conducting process science studies as this is currently still in conceptualization. Ultimately, this exchange should facilitate the development of a more coherent structure for the dissertation, as well as provide guidance on how to integrate the disparate research findings into a unified topic. Since the research presented here also touches on the field of organizational research, an exchange with scholars working in this field would also be very helpful.

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