Process Mining Adoption

A Technology Continuity Versus Discontinuity Perspective

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Abstract. Process mining is proffered to bring substantial benefits to adopting organisations. Nevertheless, the uptake of process mining in organisations has not been as extensive as predicted. In-depth analysis of how organisations can successfully adopt process mining is seldom explored, yet much needed. We report our findings on an exploratory case study of the early stages of the adoption of process mining at a large pension fund in the Netherlands. Through inductive analysis of interview data, we identified that successful adoption of process mining requires overcoming tensions arising from discontinuing old practices while putting actions into place to promote continuity of new practices. Without targeted strategies implemented to transition users away from old practices, data quality is jeopardised, decision-making is impeded, and the adoption of process mining is ultimately hampered.

1 Introduction

Using Business Process Management (BPM) principles, organisations can improve and optimise their business processes [15]. A key contributor to BPM initiatives is process mining, which involves the data-driven analysis of the historical behaviour of business processes. Process mining techniques provide organisations with the ability, amongst other things, to monitor performance indicators, automatically discover process models, identify resource constraints and bottlenecks, and determine the extent of regulatory performance [1]. Through applying these techniques, process mining is proffered to improve organisation's decision making practices [2]. Recently, process mining has seen a large uptake by organisations across many fields, including healthcare processes [12,32], shared services [31], financial services [4,10], software development [11], and insurance [38]. Further evidence of the surge of process mining is the recent entry of many vendors into the market [24].

Despite the recent uptake of process mining, several issues have been experienced. Moreover, to the best of our knowledge, there has been limited research attention into how process mining has been used *within* organisations and how organisations adapt (or not) to the new technology is uncharted territory.

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In this paper, we examine the ongoing adoption of process mining within an organisation using the theory of technology discontinuity [34], which states that technology is a central force affecting environmental conditions, and that populations within organisational communities may appear or disappear based on the rise and fall of technology. That is, technology is an important source of variances in the environment and thus is a critical factor in population dynamics. New technologies aim to 'discontinue' legacy technologies, whereas users' familiarity with the legacy systems pushes for the 'continuity', which creates tension paradigms (for more detail, see Sect. 2). As such, our **Research Question** is *What are the factors that influence process mining continuity in organisations?*

To provide insights into this question, we conducted an exploratory, inductive case study of the early stages of the adoption of a process mining tool at a large pension fund in the Netherlands. We followed an inductive approach; thus, we did not set out to study process mining adoption through the theory of technology discontinuity [34]. Rather, its importance emerged throughout our data analysis, which involved constantly iterating between data and literature. Nevertheless, for simplicity, we structure the paper sequentially. Next, we provide the theoretical background. Subsequently, we detail our methodology and the background of our case organisation. Following, we present the key challenges and enablers to consider in the adoption of process mining. Then, we discuss the implications of our findings through the theory of technology discontinuity and conclude by outlining our theoretical and practical contributions.

2 Theoretical Background

In the past, a common misconception was held that implementing new technologies in organisations would directly and automatically result in benefits. Following the widely reported IT productivity paradox, where technologies had been implemented yet benefits not obtained for long periods of time [7–9], this technology deterministic attitude has been largely rebuked [30]. Many argued that technologies must be accepted [14,35] and used [30] if benefits would be obtained. Although not a necessary and sufficient condition, technology acceptance is considered to be a precursor to use and benefits. This spurred cumulative research into the technology acceptance [36], which focused on factors related to performance and effort expectations, social norms, facilitators, as well as demographic variables that predicts an individuals intention to use a technology. However, in the context of our case study rather than these individual factors being critical to the acceptance and ongoing use of process mining, it was the tensions between legacy practices and new practices, as discussed later, which was salient. As such, below we focus on literature related to discontinuing the use of existing practices and technologies.

The notion of the discontinuity of technology emerged in the Management discipline, with the development of the theory of technology discontinuity [3,34]. This theory sort to explain, at a macro level, how technology change influences the organisational landscape. The authors [34] explained that process discontinuities occur in the form of process substitution, or in process innovation that

results in major breakthroughs in any given industry. These process discontinuities can be categorised as competence-destroying or competence-enhancing, as described below:

- Competence-destroying: refers to new ways of making a product or completing tasks that require new skills and abilities. It also requires new technologies as the resultant practice is fundamentally different to the existing practice.
- Competence-enhancing: refers to improvements in existing ways of making products or completing tasks which do not make existing skills and abilities obsolete, rather it is an incremental improvement to the technology [34].

Competence-destroying and competence enhancing discontinuities typically occur due to changes in the competitive environment, which requires organisations to shift and for management to put new initiatives and technologies in place. Yet, The introduction of a new technology in an organisation often leads to organisational change and adoption issues [13]. For technological change to seed, organisational members are required to discontinue their legacy practices and technologies in favour of new technologies and practices, which can be marked by resistance. The aim of the discontinuation of old technologies is to give way to the new concepts, processes, and systems. The legacy technologies that initially bring the innovation and build the foundation of new business models themselves become a blockade for new technologies due to their familiarity and institutionalisation [25]. Our analysis, as later described demonstrated that with competence-enhancing practices, tensions arose as individuals have the potential to revert back to legacy practices. As [3] notes, "older technological orders seldom vanish quietly; competition between old and new technologies is fierce".

3 Methodology

We performed a qualitative, inductive, case study [16] to explore the early stages of the adoption of process mining. In this section, we first describe the case organisation, followed by the data collection and analysis techniques used.

3.1 Case Organisation

The case organisation, APG (Algemene Pensioen Groep), is a large provider of services to pension funds in the Netherlands. APG's direct customers are pension fund providers who outsource some of their end-user focused processes to APG. As these customers have many different processes, rules and regulations, and cater to the needs of 4.6 million pension-fund participants[1], there is a vast potential for process improvement of more than 2,230 pension-related processes in APG.

To optimise its processes, APG has been collecting data from several process-related systems for over 8 years. Recently, APG commenced collecting this data

[1] See https://www.apg.nl/en.

in a single centralised data warehouse ("data core") bringing data under central management using the DAMA-DMBOK data management approach [23]. However, several analyses are still performed on data directly from separate source systems. To leverage the data and to assist with process optimisation efforts, APG had been using business intelligence tools. Two years ago, APG switched its focus to process mining and implemented and commenced using Celonis Process Mining[2]. The process mining initiative was largely driven in a bottom-up manner, whereby Celonis was piloted in a dozen cases, of which a few led to bigger projects: for instance, a large centralised customer journey analysis [10].

In the early phases, governance was less strict, as a 'launch and learn' approach was adopted. This lead to some departments within APG to use Celonis on their own. At the same time, they were missing specific expert guidance, data delivery and governance support. Recently, more governance, expertise, and business user guidance has been set-up in the organisation.

At the time of data collection, APG was on the verge of rolling out the use of Celonis to a large number of users through a generic process analysis dashboard, covering all 2,230 pension related processes. Dashboards were being built, training was being performed and the first users were starting to use Celonis on a daily basis.

3.2 Data Collection and Analysis

Data was primarily collected from APG through performing semi-structured interviews (see Table 1 for interview protocol summary) with participants during the early stages of adoption (December 2019).

Nine interviews were performed, which lasted between 30 and 45 min on average. Purposeful sampling [18] was used to identify interview participants to ensure different perspectives were garnered to facilitate constant comparison. Interviews were, therefore, conducted with data/process intelligence experts, and the Celonis dashboard end-users. All interviews were recorded and transcribed. nVivo (v12) was used as a data repository to collate our interview coding.

To analyse the interviews, we first performed open coding [17] to inductively identify the key themes related to the adoption of Celonis at APG. As such, we did not have a framework to deductively analyse the interviews; rather, we let the themes emerge [17]. As a result, 500 reference nodes inductively emerged from the interview data. The tensions experienced between discontinuing old practice in favour of continuing new practices emerged as a central theme.

Subsequently, as per [19] we performed on-coding, which involved constantly comparing the different themes together, resulting in a refined list of challenges and enablers related to the tensions associated with the adoption of process mining. As discussed in Sect. 4, seven challenges and four enablers of process mining have been identified.

We then performed theoretical coding [37] to identify the key relationships between the challenges and enablers (see: Sect. 5.1). Throughout this process, we

[2] See https://www.celonis.com/.

Table 1. Interview protocol.

Question type	Purpose	Example interview questions
Introductory Questions	To understand the processes the participants are involved with and how they interact with Celonis (e.g., process mining expert, end user)	1. How do you use Celonis to perform your work? 2. Why do you use Celonis to perform your work?
Overview of using the system	To understand how the system is used to attain the user goal and the factors that alter how the system used	3. How do you use Celonis in a way that helps you attain your goals? 4. How does your use of Celonis vary depending on different factors?
Dashboard building process	To understand the process and factors behind the design and build of the dashboard	5. When you build dashboards how do you select the elements (e.g., features) to use? 6. What is the most difficult question you have attempted to answer using the dashboard elements?
Validation of dashboard output	To understand how the users assess the validity of the information provided by the dashboard	7. Has Celonis ever provided inaccurate information? How did you discover this? 8. How do you validate your conclusions from Celonis?
Factors influencing use	To understand the facilitators and constraints for users to effectively adopt these dashboards	9. What facilitates the effective use of Celonis? 10. What constrains the effective use of Celonis?
Outcomes	To understand the impact of using Celonis	11. What are the impacts of using Celonis? 12. Do you have any stories that highlight the effect of Celonis?

constantly compared our findings to literature and recognised the importance of technology continuity theory and other relevant literature (see Sect. 5). This iterative process of open coding, on-coding, and theoretical coding continued until theoretical saturation was reached [21]. We determined that theoretical saturation was attained when the challenges, enablers, and relationships between challenges and enablers were stable (i.e., no new themes related to these themes or relationships emerged from the analysis).

Throughout this iterative inductive analysis process, to maintain reliability of the coding coder-corroboration was used [33]. Following this approach three researchers coded the interview data and then discussed any differences until consensus was reached. While our coding was manually performed [20], we also supplemented our findings with additional analyses performed in nVivo, including cross-tab and matrix-coding queries to discover interrelationships between different factors [5]. Near and AND operators were used to analyse relevant concepts discussed in the interview data.

4 Findings

In this section, we provide an account of the challenges (Table 2) and enablers (Table 3) experienced by the APG in the early stage of process mining adoption.

4.1 Challenges of Process Mining

Overall, we identified seven process mining adoption challenges which are summarised in Table 2 and detailed below

Table 2. Identified process mining challenges.

Challenge	Definition	Reference interview quotes
Governance	Organisational level challenges concerning the policies, regulations, roles and responsibilities, and accountability	*You have a question who do you go to, do you go to me, do you go to the owner of the dashboard? . . . We are still arguing about that and it is still not clear; . . . So the first issue we have, which is not a Celonis issue, it is . . . the way we govern our data and structure our data (A8)*
Collaborative tensions	The inter-dependency, information collaboration, and communication tensions between teams in a process mining initiative	*The pension dept. and the change dept. don't have a role in the community . . . using the dashboard. Report comes from the communication department. . . . They are serving other departments, which is what we have to overcome (A1)*
Data & information quality	Users' misunderstanding of process mining outcomes due to inaccurate information, inconsistent interpretation of data	*. . . It's quite difficult sometimes to get the right data from all the systems. [It's] the biggest limitation inside APG, to get the data and build the view, on which you can build the dashboard that shows what you want to see or analyse (A2)*
Technical	Users' resistance towards dashboard and process mining systems due to their perceptions of the technical aptitude of the system to provide accurate information	*systems are currently limited, because of history, because the systems have been built on for ten years or something, and you have this like little sub-process, I guess you can call them (A9)*
Process complexities	The unclear process boundaries, interfaces and emergent complexities due to several interrelated processes	*[In] pension administration, most processes are handled in one system, and that was quite hard already, and here they have 7 different teams systems, and one process can span across . . . all 7 systems. . . . You need to connect and extract the data from all the systems, model views on that data, so that's quite an extensive process (A1)*

(*continued*)

Table 2. (*continued*)

Challenge	Definition	Reference interview quotes
User tailoredness	User resistance towards standardised features of a process mining system thus limiting the flexibility for user-customisation	*. . . They have all kinds of different tools they are used to. Human habit is to grab what they know. This is new, so, every time we show them more and more, they get more and more interested. But, there is a saying in Dutch "what I don't know I don't eat", they have to get used to it, it's not that they are avoiding it, no, they are not used to it yet (A3)*
User-related	User challenges related to training, confidence in their ability to use the PM tools, and sunk costs	*There are always challenges, if you are using a new tool. You have to learn the buttons: where is what, how does it interact when I do something here, how does it work? The biggest challenge is to start with the first dashboard (A5)*

Governance Issues. The participants mentioned the absence of appropriate governance mechanisms early on as a challenge for process mining initiatives. The need for a well-defined structure, policies and regulations, and clearly defined separation of responsibilities were mentioned as vital needs to enable employees to use process mining. The dependency on receiving the required technical or context expert advice led to delays in determining the quality and accuracy of the process mining outcomes. The support requests from users who were not familiar with process mining tools faced delays due to unwritten and ad-hoc practices in the absence of a sound governance mechanism.

Collaborative Tensions. The initial split between the design team and the end-users did not always work out well. The initial artefacts were designed and implemented by the Celonis experts, but the end-users were contacted too late. Furthermore, the lack of coordination between the technical implementation team and the end-users led to increased confusions on how to use the process mining features effectively. The differences in the definitions between different collaborating departments should be rectified, aligned, and incorporated in technical feature design. Additionally, the absence of clearly defined roles and responsibilities and the final ownership of dashboard has created confusion amongst the staff. The ambiguity related to who would provide the post-implementation support, who should address technical queries, and who should take the final approval and decisions on data access and quality was yet to be addressed.

Data & Information Quality Challenges. The users' confidence on process mining outcomes were significantly influenced by the quality of data and information. The data visualisation is generated by using different data sources; hence, consistency and accuracy mismatches resulted in users lacking confidence in the generated output. Furthermore, the data source itself was mentioned as a

primary criterion to build user confidence in the process mining outcomes. The inconsistent naming conventions and redundancies that existed in the legacy data sources contributed significantly to incorrect insights. The bureaucratic inter-dependencies between different organisational functions slow-downed the ability of the technical team to take corrective actions. Access to the right data sources was considered as the primary reason that hampered the technical staff's ability to provide relevant insights to the users. The respondents also confirmed the significant loss of development time, due to communication issues, that was needed to overcome the stakeholders' differences on naming attributes and process definitions. For example, a process was considered to be a straight-through-process when the automation rate reaches 100% by technical staff, whereas, 90% was considered sufficient by the beneficiary department. The respondents also confirmed the difficulties in data interpretation were not caused by Celonis, but it was a result of incorrect data input or combination of different data-sets. The long-term view of system expansion and future requirements of data quality were not taken into consideration during initial design phases. The efforts to prioritise and improve the input data quality via the data-core to Celonis were negatively affected by the technical limitations of the old system, which did not have the option to update.

Technical Challenges. The nature of technical issues ranges from Celonis design to the legacy nature of existing systems. The respondents have mentioned that a few requirements had not been developed because Celonis process explorer did not support the functionality. The existing confusions on post-implementation maintenance aspects of Celonis were linked with the absence of governance frameworks and policies. The respondents appreciated the modular development approach adopted by the implementation team, since it supported users' familiarity and expectations of Celonis. The real-time data availability was mentioned as a vital element to address stakeholders' demands for on-time information.

Process Complexities. The extensive amount of process exponentially adds to the analytical complexities. There are $2,230$ processes used in the organisation, which complicated the ability to perform deeper analysis of data. The nature of user requirements depends on data from a variety of processes from different departments, and hence, users were not able to explain exactly the type of analytical output suitable for their needs. Sub-dashboards were developed as a workaround for performing multi-level analysis to address the inter-dependencies between processes and sub-processes, which led to production of ambiguous interpretations of analysis.

User-Tailordness. The users were quite familiar with their previous systems for process and data analysis. Different tools were used by different users based on their familiarity and experience with the tool. The respondent mentioned Celonis is user-friendly; however, they also mentioned that there exists resistance to use Celonis because it is designed to provide standard features without addressing specific needs.

User Related Challenge. Users' familiarity with old tools and techniques caused the risk of users creating their own dashboards by spending significant amount of time on personalisation. Furthermore, with the customisation, the alignment with the available or required data also posed a major risk. Respondents mentioned that the development of useful technical features was not an issue; however, whether or not these features would be used by the end-user to create useful insights was yet a concern. Training and development had been recognised as a major challenge by the respondents. Staff with different level of technical capabilities required a wide variety of training interventions.

4.2 Enablers of Process Mining

Four process mining enablers were identified, which are summarised in Table 3 and described below.

Table 3. Identified process mining enablers.

Enabler	Definition	Reference interview quotes
Actionable insights	Users' ability to take meaningful actions resulting from process mining analysis	*With excel you were testing your hypotheses and seeing what the outcomes were and making changes based on that. Whereas now you are able to actually explore and find new areas to target (A7)*
Confidence in process mining	User's trust and confidence in the accuracy, reliability, and applicability of process mining	*I think it was because they had large data-sets and that you run into the limits of using just excel and I think they didn't always know of other possibilities well, we showed them what else was possible but I guess the reason they came to us was the limitations with their current methods (A9)*

(*continued*)

Table 3. (*continued*)

Enabler	Definition	Reference interview quotes
Perceived benefits	Expected individual and organisational benefits associated with process mining	*We saw possibilities in Celonis beyond the process mining itself. In the way we wanted our reports, we used Celonis for it. Another way of using Celonis is to set up a dashboard that will help us analyse processes within APG but more thoroughly (A3)*
Training & development	Actions and activities performed to improve awareness, familiarity, and users skills to use process mining tools in the organisation	*First . . . we demoed the dashboard . . . we just show an impression of the dashboard, this dashboard has this and this . . . no more in depth questions about how do I see this. Just this is what you see in the dashboard. [Then] we will plan more sessions for just a few users and we will go more in depth with them (A8)*

Actionable Insights. The participants explained the ability to generate actionable insights is a key factor driving the Celonis adoption. Users with analytical mindsets and above average technical competencies are increasingly using the system to address their operational intelligence needs. The capabilities to perform deeper analysis are well-appreciated by the stakeholders. By using the insights provided by Celonis, the staff can now visually see the actual progress and bottlenecks that restrict achievement of their key performance indicators. *. . . it was like the tool for the time, they had to finish their target within 180 days, we showed them that by far they didn't reach that goal. And they didn't know where to improve it, waiting times, and how to improve it. So we, after two week, we said this is (exactly) what the process is doing, you have wrong date, days, we see only you have achieved only 55% of the goal of finishing the process within 180 days, but even in those cases we showed them how much time it would take and where the bottlenecks were, and what the waiting time was, we showed them with very good clarity (A6).*

Confidence in Process Mining. The participants acknowledged dashboards were instrumental in maintaining self-service capabilities for users. There was a strong consensus on the effectiveness of Celonis in assisting users to perform complex analysis in an easy-to-use manner. The confidence in Celonis' ability to provide evidence-based information has resulted in signs of increasing use in APG. *That one [dashboard] doesn't lie. That's what I like about it, the system is proven by itself, it's developing, Celonis itself is developing. . . the management saw more and more possibilities in the way Celonis provides a view on it, so they*

wanted more and more information out of Celonis, or into Celonis to make it better visible for them (A3).

Perceived Benefits. The use of Celonis is gradually increasing at APG, and the participants have already started to see the future benefits of Celonis for different stakeholder groups. One such area was attributed to conformance checking capabilities of the tools used. The ability to provide a holistic process overview by incorporating the complex process dependencies and inter-dependencies was well-perceived by respondents. *I guess it would be interesting for an auditor to look at a large amounts, large transactions and if large transactions need to have a certain signature, then maybe you could build it in a rule. Ok, the process needs to follow this for large amounts and the signature needs have to be checked otherwise it's non-conformation and if it's non-conformance then we look into why it happened. (A9).*

Training and Development. Various training and development activities were introduced to assist staff. Workshops were used to introduce concepts and develop users' skills. Users were also given hands-on demonstrations of the key features of Celonis. The development team took responsibility to provide training support to the end-users. *We had a workshop of an hour, to get to know it. We looked at it: how should you start? But it was based on an existing dashboard. When I started a new one for myself, I just clicked everywhere until I was ready. Learning by clicking, just do it, you cannot break it (A5).*

5 Discussion

In this section, we discuss our the relationships between the challenges and enablers of process mining adoption at APG. These relationships spoke to the tension that results from competence-enhancing discontinuity whereby there exists the pull to the old legacy processes and systems and a pull towards novel practices and processes. In doing so, we integrate relevant literature to present consensuses and contradictions. Following, we also provide insights into how APG perceived our findings.

5.1 Interrelationships Between Challenges and Enablers

In order to explore the links between challenges and enablers of process mining, we used NVivo's cross-tab query with a 'Near' operator. A 'Near' operator is used to identify the words within a specified word distance from each other. The results of the Near query are illustrated in Table 4.

"Actionable Insights" were found to be associated with collaborative tensions, data and information quality challenges, and process complexities. The value of process mining capabilities to provide interesting, valid, and useful insights was acknowledged by the respondents as a key enabler that counters the users'

Table 4. Interrelationships between challenges and enablers.

	Actionable insights	Confidence in PM	Perceived benefits	Training & development
Governance issues	**0**	**0**	0	1
Collaborative tensions	2	0	0	2
Data & information quality	3	8	2	1
Technical challenges	0	0	0	0
Process complexity	1	0	1	0
User tailoredness	0	1	0	0
User issues	0	1	0	0

intentions of continued use of old practices and tools, *I was quite happy with the dashboard, and these guys here at asset management used it not for the process, because the processes here are handled differently, but to show the people what they can do with Celonis, so actually I used it as an example (A2).* The respondents also referred to process mining as a viable technique to overcome the process complexities and reduce the information overload on users by generating meaningful insights: *Our processes are kind of different so one process can have 7 sub-processes or 7 ways to flow into other processes, have like one happy path so its all different per process. We adapt our dashboard to the process. So this one process has like seven or eight ways of possible happy flows, so how many have go through happy flows, 1, 2, 3, 4, 5, 6, to 8. From that point we analyse, so whatever question the business has we try to implement it into the dashboard and try to analyse what are the bottlenecks (A8).* The case details explain that the trust and confidence in process mining systems are dependent on the accessibility to, and reliability of, data sources. [28] recommended the use of ontologies to define the scope and cases from the data sources, depending on the nature of data requirements by diverse users.

The next relationships relate to the "Confidence in Process Mining" and Data & Information Quality challenges, User Tailoredness, and User Issues. As respondents mentioned, their confidence in process mining developed because of the completeness and consistency of information that Celonis provides. The end users' confidence in the data-core used by the organisation for the dashboard operations paved the way to maintain their trust in the process mining accuracy: *Sometimes, you just have to state that clearly the hypothesis was not correct, because the data states otherwise, and the data is 100% correct. If you find out that really isn't possible, then you have to go back and see if the data is correct (A2).*

On the other hand, the standardised nature of dashboards was mentioned as a potential risk for users' experiences with their old and specifically customised dashboards; hence, the standardised features may act as a factor contributing to their continued use of legacy systems, leading to process-continuity of old

practices: *Those dashboards [legacy] really have the features they like and they need, and nothing else. And now there will be a dashboard that is not specially made for them personally, so there might be a risk that they keep using their own information base (A1).* Our observations are aligned with the findings discussed by [29], which states that information quality is a key determinant with an indirect effect on user trust and risk reduction.

"Perceived benefits" of process mining superseded the data & information quality challenges. The dashboards' capability to provide information in a modular, focused, and yet integrated overview of associated processes positively influenced the end-users' ability to comprehend the complexities involved. *About the dashboards, so like I said, the process knowledge is at a higher level within APG. Processes can be grouped into customer journey, so whenever someone retires they first get for instance, we have like process A, then process B, then process C, then process D, and all of these processes contribute to one customer journey, and this dashboard shows information about the customer journey itself (A8).* Our findings confirm the recommendation by [24] that users' awareness of the benefits of process mining can help overcome the challenges associated with enterprise adoption.

The "Training & Development" activities were mentioned as a viable option to overcome governance issues, collaborative tensions, and data & information quality challenges. The participants appreciated the clearly-defined training responsibilities that have helped them to understand the process mining tool and to troubleshoot problems: *The tool Celonis has been released by [development] team, so basically what I would usually say if you don't know Celonis at all, they [users] will come ask me about the dashboard, I don't understand, how does this work, how can I filter stuff, but we maintain the dashboard not the tool. So if they have questions about the tool they should get training by [development] team. That's what I proposed and that's what hopefully we will do (A8).* Along similar lines, the interaction with the development team for training purposes helped ease the collaborative tensions between different departments: *We are working together with [development team], who had more knowledge than I have about Celonis (A2).* The vital importance of training was also acknowledged by previous studies [6,26,27].

The insights gained from the above analysis reflect the two sets of practices that create the competence-enhancing tensions in organisations embarking in process mining initiatives. We did not identify an enabling counter factor to reduce the impact of technical challenges. Our findings resonate with [22], which states that technical system quality does not have a direct or indirect organisational impact. We concur that the technical challenges were not perceived as a barrier, because most technical issues are hidden from the end-users. The confidence in process mining was mostly observed as an enabler for the new practices (i.e. in this case process mining); however, it may contribute to user frustration towards unfamiliar dashboards/features as well. Figure 1 illustrates the interrelationships between the identified challenges and process mining enablers.

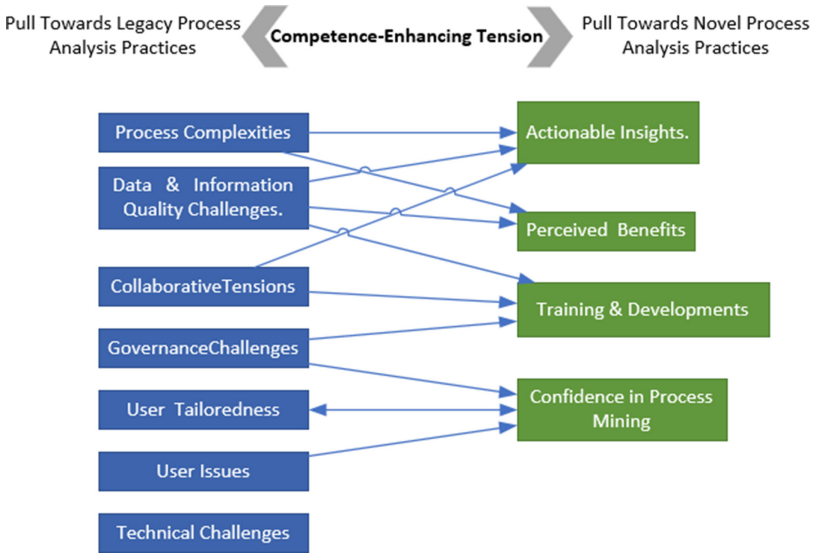

Fig. 1. Competence-enhancing tensions.

5.2 Reaction of APG

We provided the findings of this paper to APG. Overall, our findings align with APG's perception of the situation, and also mention some issues which are already addressed. For example, at the time of the interviews, distinction of roles (data owner(s), dashboard owner, dashboard maintainer, dashboard builder, etc.) was under development, and have been implemented and communicated since. This already makes the way-of-working and expectations and responsibilities clear. In the meantime, APG has also set-up a 'self-service' team next to the teams that build the dashboards. The self-service team is the go-to point for end-users and maintainers of the dashboards built; hence, it streamlines support. Some other findings mentioned by respondents were already addressed in the weeks and months before the interviews; for instance, balancing between generic and custom dashboards. Furthermore, because of the 'data-core' (the central data warehouse) concept and the application of the DAMA-DMBOK data management approach [23] APG is actually fostering discussions on aligning terminology within APG, providing insights in the data quality in the source systems, and thus enabling combining data from different (legacy) systems.

6 Conclusion

Process mining technologies aim to provide data-driven support to business process management initiatives and as such are being introduced in many organisations across many industries worldwide. To obtain tangible ongoing benefits

from process mining, organisations need to adapt and incorporate process mining tools into business process management initiatives. In this paper we performed an exploratory, inductive case study of the factors that influence process mining adoption in organisations. To this end, we conducted interviews at a large Dutch pension fund in the early stages of adoption of process mining. Through repeated analysis and literature study, the importance of the continuity lens emerged. Through thematic analysis, we identified 7 challenges related to the adoption of process mining, and 4 enablers to overcome the challenges. Using the insights from the data, we present an initial framework explaining how challenges and enablers of process mining interact. The case is limited to a single organisation's experience. The findings of this study will be beneficial for the organisation embarking into their process mining journey. We propose future research to further explore the relationships identified by focusing on organisations with mature use of process mining.

References

1. van der Aalst, W.M.P.: Process Mining - Data Science in Action, 2nd edn. Springer, Cham (2016). https://doi.org/10.1007/978-3-662-49851-4
2. van der Aalst, W.M.P., Pesic, M., Song, M.: Beyond process mining: from the past to present and future. In: Pernici, B. (ed.) CAiSE 2010. LNCS, vol. 6051, pp. 38–52. Springer, Heidelberg (2010). https://doi.org/10.1007/978-3-642-13094-6_5
3. Anderson, P., Tushman, M.L.: Technological discontinuities and dominant designs: a cyclical model of technological change. Adm. Sci. Q. **35**(4), 604–633 (1990)
4. Azemi, E., Bala, S.: Exploring BPM adoption and strategic alignment of processes at Raiffeisen Bank Kosovo. In: BPM Forum, vol. 2428, pp. 37–48 (2019)
5. Bazeley, P., Jackson, K.: Qualitative Data Analysis with NVivo. SAGE Publications Limited, Thousand Oaks (2013)
6. Bostrom, R.P., Olfman, L., Sein, M.K.: The importance of learning style in end-user training. MIS Q. **14**(1), 101–119 (1990)
7. Brynjolfsson, E.: The productivity paradox of information technology. Commun. ACM **36**(12), 66–77 (1993)
8. Brynjolfsson, E., Hitt, L.M.: Beyond the productivity paradox. Commun. ACM **41**(8), 49–55 (1998)
9. Brynjolfsson, E., Rock, D., Syverson, C.: Artificial intelligence and the modern productivity paradox: a clash of expectations and statistics. Technical report, National Bureau of Economic Research (2017)
10. Buijs, J.C.A.M., Bergmans, R.F.M., Hasnaoui, R.E.: Customer journey analysis at a financial services provider using self service and data hub concepts. In: BPM, vol. 2428, pp. 25–36 (2019)
11. Caldeira, J., e Abreu, F.B., Reis, J., Cardoso, J.: Assessing software development teams' efficiency using process mining. In: ICPM, pp. 65–72. IEEE (2019)
12. Canjels, K.F., Imkamp, M.S.V., Boymans, T.A.E.J., Vanwersch, R.J.B.: Unraveling and improving the interorganizational arthrosis care process at Maastricht UMC+: an illustration of an innovative, combined application of data and process mining. In: BPM Industry Forum, vol. 2428, pp. 178–189 (2019)
13. Christensen, C.M., Overdorf, M.: Meeting the challenge of disruptive change. Harv. Bus. Rev. **78**(2), 66–77 (2000)

14. Davis, F.D.: Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q. **13**(3), 319–340 (1989)
15. Dumas, M., Rosa, M.L., Mendling, J., Reijers, H.A.: Fundamentals of Business Process Management, 2nd edn. Springer, Heidelberg (2018). https://doi.org/10.1007/978-3-662-56509-4
16. Eisenhardt, K.M.: Building theories from case study research. Acad. Manag. Rev. **14**(4), 532–550 (1989)
17. Fernández, W.D., et al.: The grounded theory method and case study data in IS research: issues and design. In: ISFW: CC, vol. 1, pp. 43–59 (2004)
18. Flick, U.: An Introduction to Qualitative Research. Sage Publications Limited, Thousand Oaks (2018)
19. Glaser, B.: Theoretical Sensitivity: Advances in the Methodology of Grounded Theory. Sociology Press, Mill Valley (1978)
20. Glaser, B.: Doing Grounded Theory: Issues and Discussions. Sociology Press, Mill Valley (1998)
21. Glaser, B.G., Strauss, A.L.: Discovery of Grounded Theory: Strategies for Qualitative Research. Routledge, London (2017)
22. Gorla, N., Somers, T.M., Wong, B.: Organizational impact of system quality, information quality, and service quality. SIS **19**(3), 207–228 (2010)
23. International, D.: The DAMA Guide to the Data Management Body of Knowledge - DAMA-DMBOK. Technics Publications, LLC, Denville (2009)
24. Kerremans, M.: Market guide for process mining. white paper (2019). https://www.gartner.com/en/documents/3939836/market-guide-for-process-mining
25. Tushman, M.L., Murmann, J.P.: Dominant designs, technology cycles, and organization outcomes. Acad. Manag. Proc. **1998**(1), A1–A33 (1998). https://doi.org/10.5465/apbpp.1998.27643428
26. Lee, S.M., Kim, Y.R., Lee, J.: An empirical study of the relationships among end-user information systems acceptance, training, and effectiveness. MIS **12**(2), 189–202 (1995)
27. Macris, A., Papakonstantinou, D., Malamateniou, F., Vassilacopoulos, G.: Using ontology-based knowledge networks for user training in managing healthcare processes. JTM **47**(1–3), 5–21 (2009)
28. Mans, R.S., van der Aalst, W.M.P., Vanwersch, R.J.B., Moleman, A.J.: Process mining in healthcare: data challenges when answering frequently posed questions. In: Lenz, R., Miksch, S., Peleg, M., Reichert, M., Riaño, D., ten Teije, A. (eds.) KR4HC/ProHealth -2012. LNCS (LNAI), vol. 7738, pp. 140–153. Springer, Heidelberg (2013). https://doi.org/10.1007/978-3-642-36438-9_10
29. Nicolaou, A.I., McKnight, D.H.: Perceived information quality in data exchanges: effects on risk, trust, and intention to use. ISR **17**(4), 332–351 (2006)
30. Orlikowski, W.J.: Using technology and constituting structures: a practice lens for studying technology in organizations. Organ. Sci. **11**(4), 404–428 (2000)
31. Reinkemeyer, L.: Process Mining in Action: Principles Use Cases and Outlook. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-40172-6
32. Rojas, E., Munoz-Gama, J., Sepúlveda, M., Capurro, D.: Process mining in healthcare: a literature review. J. Biomed. Inform. **61**, 224–236 (2016)
33. Saldaña, J.: The Coding Manual for Qualitative Researchers. Sage, Thousand Oaks (2015)
34. Tushman, M.L., Anderson, P.: Technological discontinuities and organizational environments. Adm. Sci. Q. **31**(3), 439–465 (1986)
35. Venkatesh, V., Davis, F.D.: A theoretical extension of the technology acceptance model: four longitudinal field studies. MS **46**(2), 186–204 (2000)

36. Venkatesh, V., Thong, J.Y., Xu, X.: Unified theory of acceptance and use of technology: a synthesis and the road ahead. AIS **17**(5), 328–376 (2016)
37. Wiesche, M., Jurisch, M.C., Yetton, P.W., Krcmar, H.: Grounded theory methodology in information systems research. MIS Q. **41**(3), 685–701 (2017)
38. Wynn, M.T., et al.: Grounding process data analytics in domain knowledge: a mixed-method approach to identifying best practice. In: BPM, pp. 163–179 (2019)