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HOW ORGANIZATIONS COLLABORATE IN THE DIGITAL TRANSFORMATION TOWARDS SUSTAINABILITY

Research Paper

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Abstract

Digital transformation is already changing and improving our society towards sustainable development. However, this process is complex and often requires collaborative efforts between organizations. To better understand how organizations collaborate in the digital transformation towards sustainability, we present a case study of digital transformation in Denmark's district heating. Using the theory of Process Multiplicity that explains how a single process can potentially unfold in many ways, we report how private and public companies have collaborated over two years in their digital transformation. Our analysis identifies three processes that explain how these organizations successfully collaborate by 1) establishing ownership of problematic situations, 2) compromising on ideal problem-solving, and 3) setting boundaries in problem-solving. We conclude the paper by discussing how unfolding the collaboration between organizations can nuance our understanding of collaboration in digital transformation in IS research.

Keywords: Digital Transformation, Problem-solving, Sustainability, Process Multiplicity

1 Introduction

Digital transformation towards sustainability is already here – our society is ongoingly changing and improving through a combination of innovative technologies, new business models, and an increased focus on sustainability initiatives within organizations (von Kutzschenbach and Daub, 2021). That being said, it is a complex process that requires considerable effort to succeed. Organizations need knowledge on environmental, economic, and social sustainability as well as the development of innovative technology, rapidly changing markets, multiple implementation domains, and customers. Holding on to the idea that a single organization can encompass all of this knowledge might be an act of hubris since that requires many resources – it is expensive, rigid, and may result in failure (Chesbrough, Henry William, 2003). So, to share the effort and minimize the risk of failure, organizations open up to external influences and expand their partnerships through collaborative actions, including co-creation and co-development (Berman and Marshall, 2014). However, in opening up to external influences, the organizational boundaries become ambiguous – almost porous – introducing new ways of collaborating (Chesbrough, 2003). These new ways of collaborating are called *ecosystems* (Tan *et al.*, 2015) or *networks* (Vial, 2019) and are paramount for the success of digital transformation towards sustainability (Svangren *et al.*, 2021). In furthering this view, digital transformation can involve human infrastructuring work, where *digitalizing through partnering* is a pivotal underlying process towards sustainability (Svangren *et al.*, 2021). Digitalizing through partnering is described as a process of sharing and accessing missing resources, i.e., knowledge, which is in accordance with research on collaboration in digital transformation (Berman and Marshall, 2014; Hanelt *et al.*, 2021). That being said, Svangren *et al.* (2021) only assert *what* kind of collaboration is important in a digital transformation towards sustainability, lacking the nuance on *how* this dynamic process unfolds.

For this purpose, organizations already part of an ecosystem or a network are ideal for studying how they collaborate in practice. Against this backdrop, we present our research question:

How do organizations collaborate in a digital transformation towards sustainability?

To answer our research question, we conducted a single-case study (Yin, 2009) of digital transformation towards the 4th generation district heating in Denmark (Lund *et al.*, 2014). In this case study, we followed how two organizations – Aalborg Forsyning and Watts A/S – collaborate in their digital transformation towards sustainable heating consumption. Using the theory of Process Multiplicity (Pentland *et al.*, 2020), we identified how the two organizations perform their collaboration, which gave us insights into actions and relations that form the collaborative process. These insights helped us unravel how organizations can collaborate in the digital transformation towards sustainability.

2 Related Research

In the following, we introduce related literature on collaboration in digital transformation, highlighting selected research in this area of IS research. Then, in section 2.2, we present the theory of Process Multiplicity – focusing on its' key theoretical concepts - and explain how we can apply it to unveil organizational collaboration in the digital transformation towards sustainability.

2.1 Collaborating in Digital Transformation

Literature concerned with the digital transformation process explores how existing companies transform themselves to succeed in the emerging digital world (Nambisan, Wright, Feldman, 2019). However, the success of the digital transformation is not trivial, and if not competently managed, this process may fail in delivering the intended digital services (Hafseld, Hussein, Rauzy, 2022). The digital transformation process often implies changes to business models, digital infrastructures, potential value propositions (Ross, Beath, Mocker, 2019), and embracing new ways of collaborating (El Sawy and Pereira, 2013; Kopalle, Kumar, Subramaniam, 2020; Hietala *et al.*, 2021). These new ways of collaborating – networks or ecosystems – require further changes in organizational structures and processes (Hanelt *et al.*, 2021). Examples of the necessary changes are: establishing cross-functional teams (Dürr *et al.*, 2017; Ross, Beath, Mocker, 2019), involving customers in becoming value co-creators (Piccini, Gregory, Kolbe, 2015; Carroll *et al.*, 2021) or establishing strategic partnerships with external organizations (Bitran, Gurumurthi, Sam, 2007). These organizational structures and processes changes help support collaborative knowledge flows within and across organizational boundaries (Chesbrough, Henry and Bogers, 2014). Thus, in establishing these cross-organizational knowledge flows, the organizations in digital transformation become a part of *digital business ecosystems* – business environments shaped by a network of interdependencies enabled through digital technologies (Kopalle, Kumar, Subramaniam, 2020, p. 115). These business environments are turbulent and fast-paced due to rapidly changing markets, customer expectations, and emerging digital technologies (El Sawy and Pereira, 2013). This turbulent environment makes it challenging to maintain stable roles, activities, actors, and relations that characterize a regular business ecosystem (Adner, 2017; Hanelt *et al.*, 2021, p. 1171), resulting in non-linearity and equifinality in the collaborative process. The literature on digital transformation has a rich understanding of *what* collaboration characterizes digital transformation. Yet, the literature falls short in describing *how* this dynamic process unfolds. Hanelt *et al.* (2021) proposed that digital business ecosystems can be understood using configuration theory (Meyer, Tsui, Hinings, 1993) to identify logical structures of change. We, however, present the theory of Process Multiplicity (Pentland *et al.*, 2020) to capture the underlying processes of *how* organizations collaborate in the digital transformation towards sustainability.

2.2 Process Multiplicity

Process Multiplicity is defined as a duality of ‘one’ and ‘many’ (Pentland *et al.*, 2020) – a single process can potentially unfold in many ways. A *process* is defined as a set of sequentially related actions that

unfold over time. It is important to note that actions, which constitute a process, are not self-contained entities – they are becoming in relation to others’ actions (Feldman, 2016). To illustrate Process Multiplicity and present its’ theoretical concepts (see Table 1.), Pentland *et al.* (2020) successfully use a metaphor of crossing a meadow. Potentially, there are many ways to cross a meadow (the notion of equifinality). When a person walks across a meadow, they perform one specific enactment of how this process could unfold (performance). When the process of crossing a meadow is repeatedly performed, paths are being formed (patterning). Yet, Pentland *et al.* (2020) argue that people are prone to follow the existing paths; thus, paths are a dynamic product of the performances and potentially guide future performances (reinforcing the paths). Finally, the complete set of ways a person could cross a meadow is defined as a space of possible paths.

Theoretical concept	Definition
Process	A set of sequentially related actions that unfold over time
Path	A sequence of actions of how a process could unfold
Performance	One specific enactment of a specific path
Patterning	The process of forming and reinforcing paths through repeated performance
Space of possible paths	The complete set of ways a process could be performed based on the observed data
Action	What people do or say
Relation	An empirically observable sequence of two actions

Table 1. Key theoretical concepts in Process Multiplicity theory (Pentland et al., 2020)

These theoretical concepts help explain Process Multiplicity and operationalize it, presenting clear distinctions between complex phenomena and providing focus. In this paper, we focused on the performances (Mahringer and Pentland, 2020) of collaboration between organizations. In examining how organizations perform collaborative processes, it is possible to appreciate how the underlying processes shape and reshape, weaving the fabric of organizational collaboration in the digital transformation towards sustainability.

3 Method

In this paper, we study the collaboration between two organizations – Aalborg Forsyning and Watts A/S. Aalborg Forsyning is a utility company that provides district heating to the municipality of Aalborg in Denmark. Over the last decade, Aalborg Forsyning has been working towards producing heat based on renewable energy. Aalborg Forsyning initiated this process due to the forthcoming shutdown of the local coal-fired power plant in 2028, which is currently producing heat. In anticipation of future changes, Aalborg Forsyning wants to digitally transform district heating to engage consumers and make them use heat more efficiently through information technology. Therefore, Aalborg Forsyning partnered with Watts A/S – an electricity provider and a developer of an energy assistant application – *Watts*. This application provides hourly consumption data on heat, water, and electricity. The overall purpose of the Watts applications is to inform consumers about their consumption and, based on this, potentially change their behavior towards more sustainable energy consumption. The two organizations are a part of a more extensive partnership that works together towards sustainable development in the energy sector in Denmark. At the core, the partnership consists of Watts A/S, Aalborg Forsyning, and Helsingør Forsyning. Other utility companies are also a part of the journey; however, their physical and digital infrastructures do not fully support the Watts application (e.g., installing smart meters). Anel (parent company of Watts A/S) is now primarily active as part of the board of directors, mainly having strategic influence. We have followed the collaboration between Aalborg Forsyning and Watts A/S over the past two years. We saw how their partnering has developed and evolved – it stood the test of time, only strengthening over the years. Due to this persistence, we find this collaboration interesting to unravel as an example of how two organizations collaborate in the digital transformation towards sustainability.

While following how the two organizations collaborate, we noticed that the two companies usually collaborate to solve problematic situations. Therefore, to unveil how Aalborg Forsyning and Watts A/S collaborate, we conducted an embedded single case study (Yin, 2009) of problem-solving processes. The units of analysis were single performances of problem-solving. One way of capturing performances is through narrative (Pentland, 1999). Therefore, in our inquiry into problem-solving, we conducted narrative interviewing (Jovchelovitch and Bauer, 2000) with several relevant stakeholders from both organizations over two years (see Table 2).

Data collection	Stakeholders
10 semi-structured narrative interviews with Watts A/S	<ul style="list-style-type: none"> Pod Owner responsible for R&D Pod Owner responsible for partnering with Utility companies CEO responsible for the vision for Watts A/S
8 semi-structured narrative interviews with Aalborg Forsyning	<ul style="list-style-type: none"> Project Manager responsible for Watts application roll-out IT-Project Manager responsible for digital infrastructure Energy Supply Manager responsible for the vision of the digital transformation of district heating.

Table 2. Data collection activities

In this study focusing on the problem-solving process, we recognize the relevant stakeholders as organizational employees that have a *decisive role* in the problem-solving process. Based on this criterion, we bring forth the interviews with the CEO at Watts A/S, Pod Owner from Watts A/S – responsible for partnering with utility companies – and Project Manager from Aalborg Forsyning – accountable for the partnering with Watts A/S. The interviews’ purpose was to gather narratives – problem-solving stories – to gain insight into actions and relations that establish collaboration performances between the two organizations. We used interview guides and recorded the interviews through online interviews. Finally, findings were presented and discussed with the involved stakeholders to verify their relevance.

Theoretical concept	Operalization	Definition
Process	Thread	A set of sequentially related actions that unfold over time
Path	Path	A sequence of actions of how a process could unfold
Performance	Narrative	One specific enactment of a specific path
Pattering	Change in paths	The process of forming and reinforcing paths through repeated performance
Space of possible paths	Number of possible paths	The complete set of ways a process could be performed based on the observed data
Action	Node	What people do or say
Relation	Arrow	An empirically observable sequence of two actions

Table 3. Process Multiplicity concepts in our analysis (adopted from (Pentland et al., 2020))

Based on the collected data, we present two narratives that encapsulate two performances of collaborative problem-solving in a digital transformation. We analyzed these two illustrative narratives of problem-solving between the two organizations through the following steps:

- 1) Listen to all recordings, transcribe, and read the transcriptions to familiarize yourself with the empirical data.
- 2) Critically identify quotes in the data and code these appropriately in relation to the theory of Process Multiplicity (see Table 3).

- a. Based on the theory of Process Multiplicity, search for actions – sayings and doings – to identify problem-solving narratives.
 - b. Combine the narratives into two coherent problem-solving performances.
- 3) Using abductive reasoning (Brinkmann, 2014) and guided by *astonishments*, we elicit the underlying processes that illustrate how organizations can collaborate in the digital transformation.

4 Findings

This section presents how Watts A/S and Aalborg Forsyning collaborate in their digital transformation with two narrative performances of how the two organizations problem-solve. These narratives are reconstructed sequences, single performances, in a multiplicity of problem-solving processes. The two narrative performances unveil the three underlying processes that characterize collaboration between the two companies: 1) Establishing ownership of a problematic situation, 2) Compromising on the ideal problem-solving, and lastly, 3) Setting boundaries in problem-solving.

4.1 The first narrative of a collaborative problem-solving performance

The first narrative of a performance regards collaborative problem-solving between Aalborg Forsyning, Watts A/S, and Helsingør Forsyning. Helsingør Forsyning is an exciting partner for Watts A/S; as a utility company, they are unusual because they supply their consumers with water, heat, and electricity. This distinction allows Helsingør to have a stronger connection to their consumers, a broader overview of their market, and more data points, which is particularly valuable for Watts A/S. Furthermore, Watts A/S gained knowledge of all three domains (water, heat, and electricity) while working with the same partner to understand these domains more effectively. Helsingør Forsyning shared the vision regarding digitalization and sustainability and had the physical and digital infrastructure supporting the Watts application's implementation. However, the success of the Watts application (the growing number of active users) made it a valuable technology for Watts A/S board of directors. They saw an opportunity to commercialize the application – Watts A/S was told to advertise and sell electricity through the Watts application. This decision resulted in a direct conflict of interest between Watts A/S and the Helsingør utility company.

But then it happened that our board of directors forced us to sell electricity. And so does Helsingør. Suddenly, Watts is a platform where we sell electricity. And it does not harmonize that Helsingør must attract their customers over to the Watts application. We are suddenly competitors – Pod Owner, Watts A/S

This problematic situation is interesting because it was unanticipated and involved multiple problem stakeholders. Watts A/S had never imagined selling electricity when the partnership was established. This situation illustrates that the problems that negatively affect a partnership do not solely derive from the partners themselves but can emerge unexpectedly from the dynamic environment in which this partnership was established. Aalborg Forsyning entered this problematic situation when they became aware of the possible cost of this issue. Firstly, the price was losing a partner; secondly, the problem has “occupied Watts A/S resources. And it has had an impact on how quickly changes could be made that everyone was calling for” (Project Manager, Aalborg).

Thus, even though the problem did not directly affect the relationship between Watts A/S and Aalborg, solving the problem did. Therefore, Aalborg Forsyning was a mediator in this story, reminding the other partners of the shared goal to digitally transform the energy sector towards sustainability. Watts A/S presented their commitment to solving this problem to the board of directors, deciding to rethink the marketing strategies and remove the direct advertisement for Helsingør. This problem-solving became a process of learning from previous mistakes.

The problem was solved to avoid the problematic situation and prevent losing potential partners in the future. The concern for the future also seems to be the primary motivator for Aalborg, in their case, a lack of resources to solve other issues that would affect them directly. Yet, if the motivation for the

problem-solving process was directed at the future, the inspiration for solving the problem originated from the past. The past in this problem-solving regarded the expectations towards each partner and the shared goal of digitally transforming the energy sector towards sustainable energy consumption.

4.2 The second narrative of a collaborative problem-solving performance

The second narrative of a performance regards the collaborative problem-solving between Aalborg Forsyning and Watts A/S. In the partnering between the two organizations, Aalborg Forsyning is primarily involved in developing the Watts application for district heating. They are an active partner, highly invested in making this digital transformation succeed. Aalborg Forsyning is a public organization pressured by policymakers and other regulations to reduce its CO² emissions and produce heat based on renewable energy. However, district heating is challenging to transform. First of all, the existing infrastructure (network of pipes carrying heated water) is fixed and expensive to change. Second, the consumers are hard to engage in heat consumption. Therefore, Aalborg Forsyning and Watts A/S undertook the project of engaging the consumers in their consumption through the Watts application.

We can optimize the district heating network, make life better for the citizens, and make the network much greener – it will be able to run on much greener energy. So there are a lot of positive domino effects we can put into play by just being together about solving these tasks – CEO, Watts A/S

The second narrative performance regards the problematic situation of visualizing district heating in the Watts application. This problematic situation might be perceived as small compared to the suspense in the first narrative. However, both organizations were highly engaged in this collaborative problem-solving to visualize district heating in a meaningful way for the consumers.

This excessive attention to detail stems from the shared understanding that even the tiny elements can impact consumer engagement; both Aalborg Forsyning and Watts A/S did not want to leave it to chance. Aalborg Forsyning hired an external organization to conduct consumer research to understand consumers' perceptions of district heating. Aalborg Forsyning later applied the insights in deliberative workshops with Watts A/S, where employees from both organizations met to design, argue, and listen. All stakeholders could then present their point of view; it did not matter which organization they came from before they entered the problem-solving process. They were equal in this problem-solving. After several workshops, they agreed on a design solution that satisfied all parties involved.

This problem-solving process was about establishing a shared view of district heating and determining how this shared view can be represented in the Watts application. When both organizations agreed on the solution to this problematic situation, the shared view of district heating became materialized. Thus, the solution to this problematic situation is a symbol of district heating and an expression of this collaborative problem-solving performance.

4.3 Process threads in collaborative problem-solving

The two narrative performances unveil three underlying processes that characterize the collaborative problem-solving between Aalborg Forsyning and Watts A/S (see Figure 1.). The first process is establishing ownership of a problematic situation (yellow thread in Figure 1.). The second process is compromising on the ideal problem-solving (green thread in Figure 1.). Lastly, the third process is setting boundaries in problem-solving (red thread in Figure 1.). The arrows in the figure represent relations between the actions in a process thread. These processes are pervasive in the collaborative problem-solving between the two companies, even though the two identified narrative performances are distinct from each other. We use a metaphor of threads to describe how these three processes seamlessly emanate and adapt to the problematic situation, weaving the fabric of collaborative problem-solving in the digital transformation towards sustainability. In the following sections, we present the three processes. These process threads are distinct but interrelated. The interrelatedness is evident in the

shared sequences of action. We will not delve into all actions described in the model but make cuts where it is most useful to explain the processes as clearly as possible.

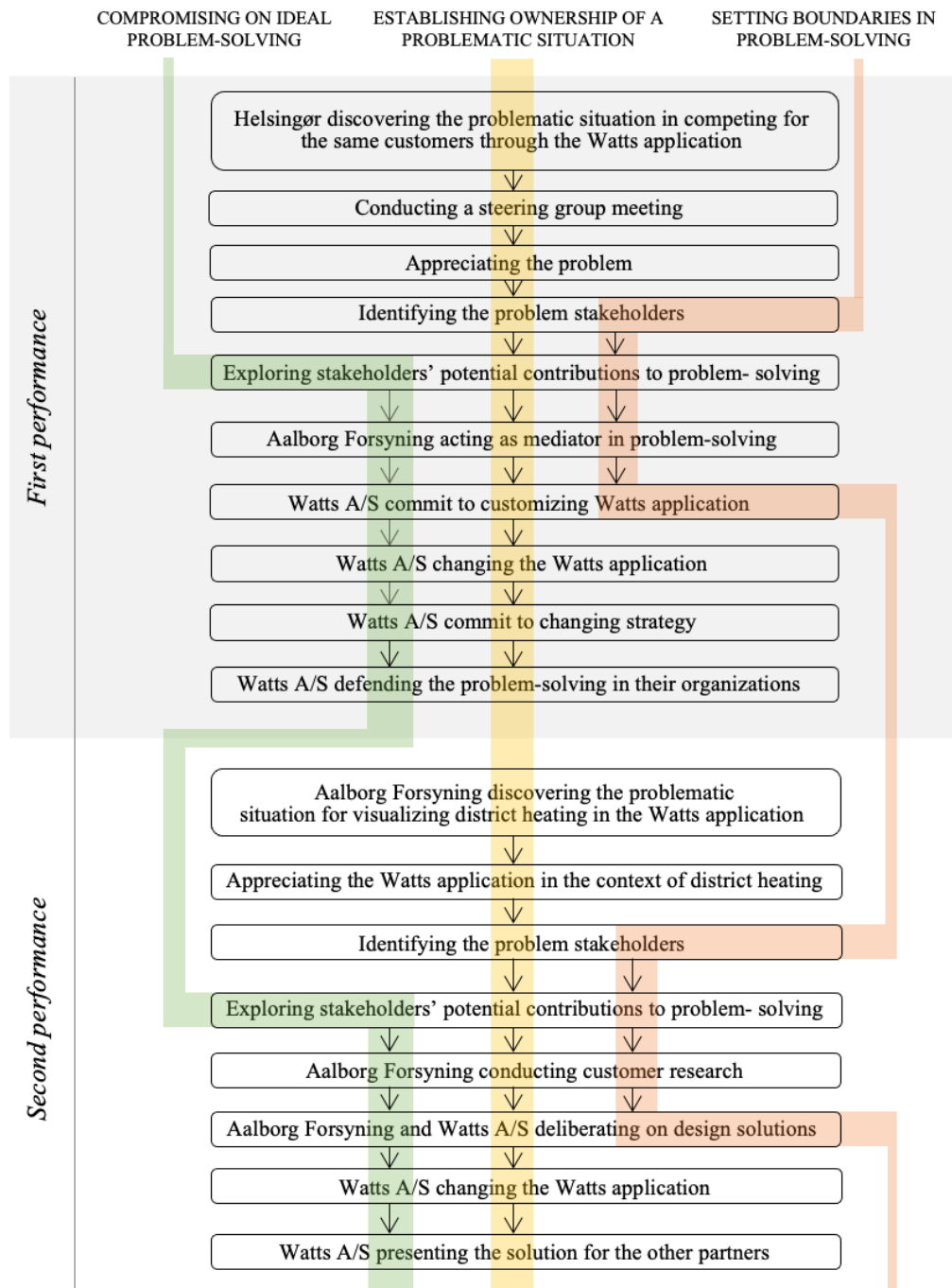


Figure 1. The three process threads in the two performances.

4.4 Establishing ownership of a problematic situation

We found that establishing ownership of a problematic situation is essential in collaboration between the organizations. Establishing ownership is a process that extends throughout the two performances of collaborative problem-solving and involves the problem owners' commitment to problem-solving, the partnership, and the consumer. Therefore, this process is more about taking *responsibility* in a problematic situation and is less about taking *control* of the problem-solving process.

4.4.1 First performance

In the first narrative performance, the process of establishing the ownership of the problematic situation begins with Helsingør discovering that Watts A/S promotes electricity on the Watts application. In discovering the problematic situation Helsingør Forsyning became an owner of the problem – committing themselves to find a solution within the partnership. Watts A/S established ownership of the problematic situation by conducting a steering group meeting inviting all the partners to appreciate it, thus showing that they take this issue seriously and, in solving this problem to avoid similar problematic situations in the future. The purpose of a steering group meeting was to recognize relevant stakeholders and appreciate the problem situation. In appreciating the problem situation, the partners saw the potential consequence, e.g., losing a Helsingør as a key partner. This dilemma made the collaboration difficult – essential resources such as time and money were used on this problem, thus taking resources away from accomplishing the shared goal of digitally transforming the energy sector toward sustainable development. Thus, the problematic situation extended beyond a disagreement between two partners – it affected the whole partnership. Therefore, Aalborg Forsyning chose to take ownership of the problem situation and enter the problem-solving, committing to solve the problem and further the shared goal of the partnership.

*Solving the commercialization problem was not solely about accommodating the demands of a partner; it also became about how can Watts maneuver in this – **Project Manager, Aalborg Forsyning***

The problem owners – Helsingør, Watts A/S, and Aalborg Forsyning – were identified as the problem stakeholders. Each problem stakeholder explored how they potentially can contribute to problem-solving, thus, living up to their ownership of the problematic situation. Aalborg Forsyning lived up to their ownership of the problem by acting as a mediator in problem-solving. Aalborg Forsyning elevated the discussion above the disagreement between Helsingør and Watts A/S, reminding them of what they agree on – the shared goal to digitally transform the energy sector towards sustainability.

*I think (CEO at Watts) called me a gatekeeper at one point or another. ... When someone starts going in a direction that is not okay, then I actually tend to say – Well yeah, but how was this partnership established? – **Project Manager, Aalborg Forsyning***

Watts A/S lived up to their ownership of the problem by customizing the Watts application so that Helsingør customers did not receive the promotions on electricity from Watts A/S, which Watts A/S implemented in the Watts application. Furthermore, Watts A/S and their board of directors committed to changing their strategy to avoid future conflicts of interest.

4.4.2 Second performance

In the second performance, Aalborg Forsyning discovered that the icon, which visualizes district heating in the Watts application, needed to be redesigned to communicate district heating more clearly to the consumers. In discovering this problematic situation Aalborg Forsyning took ownership of it, committing to accommodating consumer needs in collaboration with Watts A/S. Watts A/S established ownership of the problematic situation by committing to enter the problem-solving process together with Aalborg Forsyning. Here, Watts A/S took ownership of the problematic situation by appreciating the Watts application in the context of district heating. At the same time, Aalborg Forsyning took ownership of the problematic situation by conducting consumer research to understand consumer perception of district heating. These actions go beyond what both partners expected from each other; thus, they reinforced the established ownership of the problematic situation by exercising their commitment to problem-solving.

*They [Aalborg Forsyning] go in and are active players and bring real value to the table concerning the app's development. They also do this when we discuss how the User Interface – should be designed
- **Pod Owner, Watts A/S***

After the problem stakeholders had explored and exercised their contributions, Aalborg Forsyning and Watts A/S began to collaboratively deliberate on the design solutions. In the process of deliberating, Aalborg Forsyning and Watts A/S met as equal problem owners. Both partners contributed with their ideas, concerns, and arguments and listened to each other until all problem owners were satisfied with the final visualization of district heating.

It is okay for everyone to say what one thinks. But it is a question of whether you want to keep trying again and again and again till we hit the right thing, so everyone thinks it is cool – Project Manager, Aalborg Forsyning

When Watts A/S and Aalborg Forsyning completed the deliberation process by agreeing on the solution, Watts A/S changed the Watts application, thus finalizing the problem-solving process. Later, Watts A/S presented the solution for the other partners, showing continued commitment to the solution.

4.5 Compromising on ideal problem-solving

Compromising on the ideal problem-solving is the second process identified in the organizations' collaborative problem-solving. Being part of a partnership, the problem owners compromise on the ideal problem-solving to deliver shared value (now or in the future) and not solely to themselves. In the two performances, compromising on ideal problem-solving is about involving and accommodating other partners in the decision-making.

4.5.1 First performance

The process of compromising on ideal problem-solving begins with exploring problem owners' potential contributions to the problem-solving process. First, the problem owners – Helsingør Forsyning, Watts A/S, and Aalborg Forsyning – had to consider whether they were ready to compromise. Helsingør Forsyning was not willing to compromise. Instead, Helsingør Forsyning viewed the problematic situation as a decisive moment – to remove the promotion from the shared platform or leave the partnering. This ultimatum made collaboration between Helsingør Forsyning and Watts A/S difficult – both parties had obligations to their organizations, which maintained them in the problematic situation.

It would be super annoying if Helsingør went away, but we can not completely change our strategy just because they were a good partner from the start. It's tough, but this is how it is. – Pod Owner, Watts A/S

Due to this stalemate in problem-solving, Aalborg Forsyning entered the problem-solving process as a mediator to negotiate a compromise on the ideal problem-solving by presenting an outside perspective on the problem situation. Trying to negotiate a compromise in this problem-solving was not a naïve endeavor. Aalborg Forsyning was aware of the ultimatum presented by Helsingør Forsyning but chose to advocate for a solution that kept Helsingør Forsyning as a partner.

Either you can accept it [Watts selling electricity on the application] or you can not, and it ended up with Watts not being allowed to promote the electricity product through the app – Project Manager, Aalborg Forsyning

In the end, because Watts A/S chose to compromise, they committed to customizing the Watts application temporarily. Watts A/S removed the electricity promotions from the shared platform. This compromise was not only about accommodating a partner's ultimatum but also about avoiding ending up in a similar problematic situation with other potential partners, which resulted in Watts A/S committing to rethinking its commercialization strategy. In this problem-solving process, Watts A/S chose to compromise on the ideal problem-solving and committed to rethinking their commercialization strategy. Furthermore, the process of compromising on ideal problem-solving continued when Watts A/S defended the solution to their board of directors. Thus, compromising on ideal problem-solving is an ongoing process because the compromise manifests in the solution to the problematic situation.

4.5.2 Second performance

In the second performance, the process of compromising also began with exploring the problem owners' potential contributions to problem-solving. Aalborg Forsyning and Watts A/S had to define to what extent they were willing to compromise on resources, customer-centricity, and decision-making. In searching for a compromise, the decision-making was not equally distributed between Aalborg Forsyning and Watts A/S. Even though Aalborg Forsyning is the one who identified the problematic situation – Watts A/S makes the final decision on any potential changes in the Watts application. Aalborg Forsyning is aware of this imbalance; however, they still experienced a fair problem-solving process – they were able to express their opinions, and Watts A/S listened.

*Because Watts pays, it should be up for the discussion how much they should listen to us. But I think that all of us were allowed to comment and were heard [...]*It was a good process – **Project Manager, Aalborg Forsyning**

Watts A/S, being a decision-maker, made room for deliberation, which entails providing and listening to arguments on the design solution; thus, searching for a mutual ground. Therefore, Watts A/S is compromised on their decision-making power by accommodating and involving Aalborg Forsyning as much as possible in problem-solving.

We listen to them. Of course, we do not do everything they say; after all, it is us who develop Watts. But we will go to great lengths to make sure they are happy. And it means listening to good arguments – **Pod Owner, Watts A/S**

Through the deliberation, Watts A/S and Aalborg Forsyning agreed on a visual design solution that all approved; thus, reaching a mutual compromise. Watts A/S committed themselves to the compromise by implementing the agreed design and presenting it to the other partners. Similar to the first narrative performance, in the second narrative performance, compromising on ideal problem-solving is an ongoing process, extending beyond the problem-solving process because the delivered solution is rooted in the compromise – the compromise endures.

4.6 Setting boundaries in problem-solving

Setting boundaries in problem-solving is the last process that we identified as fundamental in collaborative problem-solving between Aalborg Forsyning and Watts A/S. We found that boundaries between the partnering organizations are neither fixed nor continuously ambiguous. Instead, the boundaries emerge every time organizations perform a problem-solving process – shaping and reshaping depending on the problematic situation in the digital transformation towards sustainability.

4.6.1 First performance

In the first narrative performance, the boundaries between the organizations begin to shape when organizations identify the relevant problem stakeholders. In identifying problem stakeholders, the organizations draw the boundaries of inclusion (and exclusion), assessing who is “us” and who are “them” in this problem-solving. Aalborg Forsyning does not have a direct conflict of interest with Watts A/S. Despite that, Aalborg Forsyning saw this as a joint problem, thus, setting new boundaries in the problematic situation.

The whole issue here is whether Andel [parent company of Watts A/S] should be able to use their platform to sell their electricity product, but it collides with Helsingør. This is an issue that we have run into – **Project Manager, Aalborg Forsyning**

The boundary-setting process becomes apparent in the language. The Project Manager uses the pronoun “their” and the pronoun “we” when referring to the ownership of the problem. Boundaries become more defined when each stakeholder explores their potential contributions to problem-solving; this action determines boundaries based on the limitations of resources and abilities to solve this problem.

Helsingør Forsyning clarified their boundary at the beginning of the problem-solving process by stating their ultimatum – to withdraw the promotion of electricity in the Watts application or leave the partnership. Aalborg Forsyning saw the potential to become a mediator in problem-solving and, in this role oscillating between the boundary set by Watts A/S and Helsingør Forsyning. Taking on the part of mediator, Aalborg Forsyning sought to help solve the problematic situation quicker, working towards furthering the shared goal of digitally transforming the energy sector in Denmark toward sustainable development.

It is very much such a community thing, we want to move forward with this [digital transformation], and we do it together – Pod Owner, Watts A/S

Having Aalborg Forsyning as a mediator, oscillating between the boundaries, enabled the partnership to solve this problematic situation and shape and reshape it. As a result, boundaries in problem-solving are transactional – becoming in relation to actors, problematic situations, and reciprocity.

4.6.2 Second performance

In the second narrative performance, the boundaries between the organizations also begin to take shape when organizations identify the relevant problem stakeholders. The stakeholders explored their potential contributions to problem-solving. In this problem-solving process, both Aalborg Forsyning and Watts A/S entered each other's respective areas of expertise, thus blurring the boundaries between the two organizations. In this problem-solving process, both organizations went the extra mile – Watts A/S appreciated Watts application in the context of district heating, and Aalborg Forsyning used its resources to conduct customer research. Because both organizations performed a high level of engagement in problem-solving, the two organizations were able to deliberate on design solutions. In deliberation, the boundaries became increasingly more dynamic. Deliberating has shaped and reshaped the boundaries based on the presented arguments, design solutions, and differentiating views on the consumers' needs.

We talked, and the funny thing was that on both sides, there were divided views. So it was not because it was one side against the other side, not at all. It was very much based on what we thought the user needed. We all represented users – Project Manager, Aalborg Forsyning

In this performance, the boundaries were not set between organizations; they were set between arguments, opinions, and views. This type of boundary setting can be observed within a single organization or a single team. However, having the shared goal of digitally transforming the energy sector in Denmark and user-centricity as a mutual value, Watts A/S and Aalborg Forsyning took joint ownership of the problematic situation.

With Aalborg, we experience that we do it [problem-solving] together, so it is our problem that we must solve in the best way possible. And that as soon as that problem becomes “ours” instead of “yours” and “mine,” the solution will also be better – CEO, Watts A/S

The CEO of Watts A/S uses the pronouns 'our,' 'we,' 'you,' 'ours,' 'yours,' and 'mine' in a dynamic way (e.g., referring to a single organization, the partnership), unwillingly indicating that organizational boundaries become blurred and are shaped and reshaped through problem-solving.

5 Discussion

With our case study of digital transformation towards the sustainable development of district heating in Denmark, we explain how Aalborg Forsyning and Watts A/S collaborate in their problem-solving to address our research question: *How do organizations collaborate in a digital transformation towards sustainability?* In answering our research question, we identified two performances of their problem-solving process (cf. section 4.1 and 4.2). Across these performances, we found three processes that unfold how the organizations successfully collaborate by 1) *Establishing ownership of problematic situations* (cf. section 4.4) which regards the problem stakeholders' commitment to problem-solving, 2) *Compromising on ideal problem-solving* (cf. section 4.5) by involving and accommodating other

relevant partners in decision-making, and 3) *Setting boundaries in problem-solving* (cf. section 4.6) by ongoingly shaping and reshaping boundaries of the problematic situation. These processes are pervasive in the collaborative problem-solving between the two companies, seamlessly emanating and adapting to the problematic situations in the digital transformation.

Our focus on problem-solving performances has revealed not only what is being transformed (problem) but also how transformation occurs (solution) and why (shared values for sustainable development). Thus, we suggest that problem-solving should be a key concern for IS researchers to understand such inter-organizational collaboration (digital business ecosystem) in the digital transformation (Brusoni and Prencipe, 2013). Digital business ecosystems are fast-paced and turbulent, resulting in non-linearity and equifinality in the collaborative process (Hanelt *et al.*, 2021). This turbulence is a result of many “unknown unknowns” that organizations in a digital business ecosystem cannot predict (e.g., unexpected problematic situations); as such, these ecosystems are not expected ever to reach a kind of equilibrium (El Sawy and Pereira, 2013). However, even if equilibrium is never achieved in a collaboration process, using the theory of process multiplicity, it is possible to identify the underlying paths and patterns that are pervasive in this uncertainty. We illustrate this pervasiveness with the three process threads in Table 3 (c.f. section 4.3). Thus, we propose that process multiplicity theory can enrich IS research on digital transformation in the complex setting of sustainable development.

The three identified process threads are helpful for the practitioners who encounter unexpected problems in their digital transformation towards sustainability. While solving the unexpected problems, the practitioners and their collaborators should be aware of who establishes the problematic situation, whether there is a mutual willingness to compromise, and how the boundaries are set in the problem-solving process. We do not advocate planning and negotiating these processes before encountering unexpected problems; the two identified performances are illustrative examples of how these processes take shape and reshape, adapting to the problematic situation. However, our findings indicate that having a shared, unifying goal is useful in problem-solving by elevating the discussions and reminding the collaborators of what they agree on – namely, the unifying goal that guides the collaboration.

This case study has limitations. The first limitation is our focus on the collaborative problem-solving process. This excludes other types of collaborative processes such as information sharing or value creation (Berman and Marshall, 2014). Examining different types of collaboration in the digital transformation towards sustainability might reveal other underlying processes that seamlessly emerge and adapt to the situation. Another limitation of our work is regarding the small scale and scope of our inquiry. We examined two organizations in the context of district heating in Denmark and how they collaborate to solve problems. Therefore, it would be interesting to explore whether our findings are scalable and transferable to other contexts.

6 Conclusion

This paper reports how organizations collaborate in the digital transformation towards sustainability based on a case study of Denmark’s district heating. Using the theory of Process Multiplicity, we analyze how two organizations can collaborate in a digital transformation towards sustainability. Our analysis of two distinct performances of collaborative problem-solving reveal three processes for how these organizations successfully collaborate by 1) establishing ownership of problematic situations, 2) compromising on ideal problem-solving, and 3) setting boundaries in problem-solving. With this analysis, we show that the Process Multiplicity theory can be useful in IS research to unveil the underlying processes of digital transformation towards sustainable development. We also show that problem-solving processes should be a concern for researchers of digital transformation in revealing what is being transformed (problem), how transformation occurs, and why.

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