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Fluid Socio-Technical (Trans)formation of an AI system

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Abstract

The paper applies a flow-oriented perspective to examine how temporal conditioning of the flows of people and digital technologies dynamically shape socio-technical formation and the transformation process of an AI (artificial intelligence) system. Drawing on an in-depth case study of a financial accounting services company that was developing and deploying an AI system in its work process enabled forming a flow-based genealogical account of the fluid process of socio-technical (trans)formation. This allows to explore how delays to AI system deployment can arise from impediments to the dynamics of creation, sensing, and undergoing of possibilities for action wherein the flows of practices and actions involved cannot reach favorable conditions to form correspondence along the (trans)formative system-development path.

1. Introduction

Organizations are keen to deploy models based on machine learning (ML) in their processes, since these models yield higher degrees of effectiveness and efficiency than human-based operations do [1]. The shift in which organizations are implementing ML models has recently been fueled and enabled by the proliferation of Big Data. The principle behind utilizing ML models in knowledge work is usually straightforward: identify a potential use case, design and develop a specialized AI system for it, and deploy it for use after testing. Knowledge work organizations predominantly consist of professionals such as data scientists or accountants who create, utilize, and disseminate knowledge and information. However, there exist managerial difficulties [2, 3] associated with ML models which often result in delays in development. These difficulties are related to requirements connected with the quantity and quality of training data required, difficulties in foreseeing how the model's accuracy may change during development, problems in scaling ML models, and the fragile nature of ML models.

Motivated by the proliferation of ML utilized in AI systems and the persistent delays observed in their

development, we ask: “*Why do AI system development and deployment projects experience delays in knowledge work organizations?*”

Instead of looking at the AI system design and development as originating from actors participating in it and exercised in interactions among them, we consider how temporal conditioning of the flows of people and digital technologies fluidly shapes the formation and transformation of an AI system [4]. We take a flow-oriented approach to explore how the dynamics of creation, sensing, and undergoing shape the formation of the idea, design, and development of an AI system. This enables gaining a sense of the fluid socio-technical (trans)formation of such a system, which allows us to explain how and along which flowing lines of action the system is created and continues (trans)forming.

To see how the temporal conditioning unfolds in AI systems' development and deployment, we sampled an organization that successfully implemented such a system in its work process. Drawing on the flow-oriented approach made us able to identify how generative and degenerative dynamics in the process of AI system development among involved practices and technologies can cultivate or stifle conditions for meaningful action along the (trans)formative path.

2. Literature review

Amid the resurgence of AI research [3], precise definition of AI remains difficult to pin down. For our purpose, we use a definition offered by Kaplan and Haenlein [5], in which AI is a system that is able “to interpret external data correctly, to learn from such data, and to use those learnings to achieve specific goals” (p. 17). While this is not the most thorough definition, it describes the type of system addressed here perfectly.

Scholars' growing attention to AI in organizational context has led to a gradual shift from a predominantly technical perspective to an increasingly socio-technical one [6, 7]. The traditional AI paradigm suggests that powerful machines could process data and produce new knowledge without domain experts' involvement [8]; however, more recent arguments contend that

organizational AI cannot be considered a “plug-and-play” technology [3] and that it requires close collaboration on the part of AI developers and domain experts throughout the development process [7, 9].

Notwithstanding contemporary AI systems’ remarkable capabilities, certain limitations render a vision of self-sufficient machine experts non-viable. Moreover, these limitations cannot be overcome by means of technology alone. Most of the problems lie instead in epistemological misconceptions of AI’s capabilities and in the restricted nature of the social context in which the AI is developed. Systems based on AI notoriously suffer from the frame problem [10]: AI agents cannot competently perform an action in environments for which they lack predetermined rules. Therefore, seemingly all-powerful algorithms may be unable to deal with dynamic events that would be trivial for humans to handle. Domain experts can significantly contribute to the development process by helping adjust the frame to fit the task. Organizational AI developed in isolation from the social context in which the domain experts operate may lead to systems failing to account for broader implications of their use [9, 11]. That could produce especially troubling consequences given the lack of diversity in AI research and industry [2]. For example, the impact of implementing AI in an organization varies between stakeholders; therefore, excluding some stakeholders from the development process could bring about perceived breach of social contracts and, in the end, failure of the project [12]. Hence, these processes become more complex than those in traditional IT development projects [6, 7, 9]. Such complexities may lead to unexpected hurdles in the development and deployment of an AI system, ultimately delaying the project.

To understand the process of developing the ML models and AI systems that set in motion changes and travails in organizations, use a theory of socio-technical transformation proposed by Mousavi et al. [4]. It offers an alternative way to view how flows of people and digital technologies temporally condition the ways in which the flowing lines of action are continuously becoming. From such a flow-oriented, rather than actor-centric, perspective, the originators of formation and transformation are not the self-contained entities involved in the ongoing process; instead, the socio-technical (trans)formation is seen as stemming from the becoming and conditioning of historical and new lines of action that create new possibilities for action along the flows as they contingently enter confluence, converge, and become corresponding or fall out of correspondence with one another.

Two concepts central to the flow-based approach are correspondence and flow. Flow refers to a quality that comes about as previous lines of action are absorbed

and continuously woven into new paths [13]. Accordingly, entities are seen as always in the making as they are swept forward and animated along the flows of action. The flow-oriented approach marks an important shift in the notion of time, from a chronological order (chronos) to kairotic time (kairos) extending beyond a single timeline. Attention moves to kairotic timing and the varying temporal qualities of flows of action. Such temporal qualities as rhythms, tempos, intensities, timeliness, and directionalities have their conditioning aspects and thereby entail specific (trans)formative dynamics. Figure 1 illustrates different temporal qualities of flows, for example, Action A and B sharing same tempo, and Action C illustrates how iterative loops cause shifts in rhythm and directionality of action. Instead of time elapsing in a uniform chronological past-present-future order, kairotic timing brings to the fore timely moments and timing of those moments as confluences of various flowing lines of action, each with particular temporal qualities, arise along a shared path [4] – such as that of an AI system’s development process. These flowing lines of action and their confluences that shape the patterns of lines in a continuous open-ended process can be depicted as a kairotic meshwork [14] as exemplified in Figure 1.

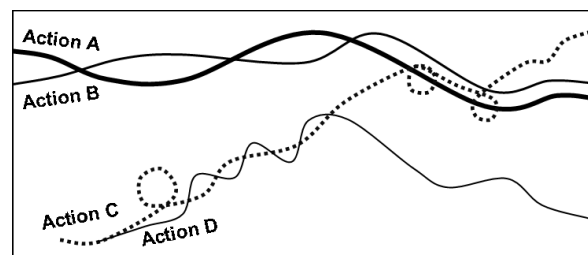


Figure 1. Time as a kairotic meshwork

Correspondence is a notion developed by Ingold [14, 15] for what occurs when multiple flowing lines of action are being woven together such that specific (trans)formative dynamics of creation, sensing, and actualization may emerge. In Figure 1, Action A and B are in loose correspondence and the lines of action fall out of it but remain closely converged and synchronized. Furthermore, there is initially close correspondence among Action C and D as they are tightly coiled around one another, but as the lines of action fall out of correspondence, the coiling unravels. To give rise to the (trans)formative dynamics in socio-technical flows, however, the flowing lines of action must gain correspondence, through three modalities: timing, attentionality, and undergoing. These modalities entail a moment of kairotic timing, an attentional orientation, and an experience of undergoing, per Mousavi Baygi et al. [4]. Timing affords creating conditions for new

possibilities for action along flows, attentionality for sensing possibilities for action, and undergoing for actualizing them along a (trans)formative path. As correspondence gives rise to the dynamics of creation, sensing, and actualization, the flowing lines of action can become co-responsively interwoven, in their conceptualization. The process (trans)forms the temporal qualities and trajectories of socio-technical flowing lines of action that comprise and shape the path of an AI system project.

Overall, the flow-oriented approach allows one to account for the ongoing nature of AI system (trans)formation and its vibrancy as several flowing lines with their temporal qualities enter mutual confluence. Therefore, an AI system's design, development, and deployment entails corresponding dynamics along various co-responsive flows of action. From this perspective, we can explain how the lines of action (trans)form an AI system project and the entities involved in it. In turn, directionalities of action shift along a socio-technical (trans)formative path and can lead to delays in the AI system project if correspondence cannot be gained among pertinent lines of action.

3. Method

We took an exploratory approach to our preliminary analysis, applying the novel IS theory of socio-technical transformation. We used purposeful sampling [16] to identify an appropriate empirical setting for this study. We set criteria to select a suitable case organization: 1) the organization had to be planning to deploy ML model(s) for use in its knowledge-work processes; 2) the employees using the AI system had to be knowledge workers, and; 3) we had to be able to collect data over the course of the AI system project to analyze how the process unfolds at the various levels of the organization. We selected a large Finnish company, referred to as CloudAccounts (pseudonym), which met these criteria. The company specializes in delivery of financial accounting and payroll-administration services to other firms. CloudAccounts sought to utilize ML models in its processes for this work. The company was structured with several local offices, in Finland, that offer financial services and had also established a shared service center (SSC) to concentrate specific lines of work in one location, where dedicated teams could handle financial accounting processes for accounts payable, accounts receivable, and general-ledger accounting. Moreover, the firm set up an AI innovation unit to develop and deploy ML models to automate and augment financial accounting work tasks by means of the historical data accumulated over the years.

3.1. Data collection

We conducted 53 semi-structured interviews between January 2020 and June 2021. Of these interviews, 33 were with accountants who were using the AI system; 17 were of senior accountants impacted by the system; and one interview each with the director of the SSC, the team leader for accounts payable and receivable, and a data scientist who had a central role in designing, developing, and deploying the AI system. These interviews lasted 40-105 minutes. In parallel with the interviews, we attended meetings with the team at the AI innovation unit. While these were not recorded, they kept us informed and yielded insight into the overall process of the AI system's design and development. Topics discussed related to what the team is currently aiming to achieve with the ML models and AI system and how they are progressing with the design and development process. Also, we received organization-internal documents that, for example, outline the unit's mission and introduce the team.

3.2. Data analysis

With the data analysis, we set out to identify central events, various practices forming part of the AI system's (trans)formation process, and experiences of individuals, and form a flow-oriented genealogical storyline for the emergence and unfolding of the design and development of that system and its algorithmic action. Genealogy is a specific type of historical account [17] and a mode of inquiry that spotlights contingent correspondences that turn out to be fundamental to the process of ongoing (trans)formation [4]. A flow-oriented genealogy thus aids in teasing apart the dynamics of the conditions that give rise to possibilities for action along the flows [4].

The same researcher conducted all the interviews, taking notes, and thus became immersed in the data and deeply familiar with the material's nuances. A flow-oriented perspective made it possible to carry out preliminary analysis and produce a detailed illustrative narrative of the case company's socio-technical transformation. We began by preparing a storyline of the overall process based on our interview with a data scientist who had been involved in the AI design and development from the beginning. Interview notes informed us of how the accountants' experiences and perceptions of the AI system evolved over time and what the interviewees saw as important moments or events over the course of this process thus far. This material allowed us to take their views into account and incorporate them into the storyline [18]. We then considered the general storyline in light of the flow-oriented approach, by considering the three modalities

of correspondence (timing, attentionality, and undergoing) in parallel with extracts from interviews of key informants (p. 62) that pertained to piloting and testing of the AI system. This helped reveal several distinct views of the design and development process. Finally, all the authors examined the findings from this preliminary analysis, to catch possible inconsistencies.

4. Findings

By means of a genealogical story and the sensitizing lens of the three modalities of correspondence, we illustrate how the conditions for the AI system were formed, how it was brought into being and continues (trans)forming, and why it ended up taking nearly two years to shape the AI system to correspond more closely with the requirements and temporal qualities of the accounting practices.

4.1. The making of conditions for an AI system

The move toward creating and actualizing the envisioned AI system was made possible by an earlier decision by CloudAccounts to put more emphasis on the development of its cloud-based accounting information system (AIS). Maintaining that focus for more than five years, in total, was crucial to transforming the financial accounting data flow largely from a paper-based endeavor into an electronic, digital one over that time. This gradual shift in data flow created favorable conditions for collecting digital structured data created by CloudAccounts clients' business transactions, data that could be utilized in training the AI system's models.

We begin our story in June 2019, when a new innovation unit was formed with the purpose of actualizing the potential of AI in accounting practice. An introduction posted on company's intranet reveals the ambitious mission of the unit: *"Our goal is not only to rethink the current processes, but also to simplify various decision-making problems. Using historical data CloudAccounts collected over the years, we can teach machines to think like people in some specific situations. Imagine how different and easy the workflows might become if we are able to use automatized knowledge and help of previous generations!"* The innovation unit's more immediate goal is to kick off the design and development of a specialist AI system that can handle tasks constituent to purchase-invoice processing. Automating this processing is a prominent business case for use of ML models, in that it includes repetitive work. The company saw potential for an ML model to be trained on large volumes of data to deal with relatively straightforward tasks such as predicting a correct account posting and, on this basis, trigger new algorithmic action.

4.1.1. Formation of an AI system. In November 2019–February 2020, the CloudAccounts innovation unit, consisting of two data scientists, two service designers, and the head of the unit, begins planning the pilot phase for the new AI system, which is still in the early stages of the design and development process. In February, to get the piloting going, a small group of accountants who handle the accounts payable process and its related task of processing purchase invoices are chosen from the CloudAccounts financial services SSC to begin testing the fledgling AI system and give feedback. Because the center's accounts payable teams are responsible for the handling of hundreds of client companies' purchase-invoice processes, their tasks include making correct account postings based on the purchase invoices' information and checking (and validating the correctness of) each posting and the VAT values in those invoices. For these work tasks, the accountants have been, for the most part, working through large volumes of purchase invoices by making account postings manually in the AIS. Since they carry out these tasks daily, the accounting specialists and accountants have become attuned to the activities of this accounting practice, thus possessing sufficient experience and expertise to point out how the AI system should be adjusted to accommodate the needs of said practice.

Proceeding from the piloting feedback, obtained in February to August 2020, the data scientists make gradual adjustments to the ML models. However, to understand how the accountants undertake the daily processing of purchase invoices, the innovation unit personnel involved in the design and development process deem it necessary to become more acquainted with the flows of action involved in financial accounting, especially purchase-invoice processing. Data scientist Veronica later recalls, *"Through that cooperation [with accountants], we found out so many different insights we had, like a lot of unnecessary and even [harmful] constraints on the data we were getting. And yeah, it helped us a lot, a lot a lot – so many different bugs. Help of pilots and accountants was, I don't know, golden."*

4.1.2. Transformation of an AI system. Having improved the ML models used in the AI system in accordance with the feedback and grown acquainted with intricacies of financial accounting, the unit takes another step forward with the development process: in September 2020, it moves from piloting to testing the system in production use for around 100 client companies. It takes only a few weeks to notice, however, that the AI system is producing inconsistent and inaccurate outputs. This alarms the accountants since the incorrect outputs have knocked the work out of rhythm and increased the workload in cases in which

the AI system is in use. The AI developers receive negative feedback because the system necessitates much more checking and validation of account postings and VAT values than previously needed.

Working on the issues related to the ML models' accuracy, the innovation unit makes a significant breakthrough in November 2020. Thus far, the data scientists had worked with a limited test-environment database. Gaining access to the production database in October 2020 adds the full set of historical data from each client company to the ML models' training. Thanks to accuracy improvements, some of the accountants begin again seeing the AI system as a potential tool to improve their work: as December 2020–February 2021 unfolds, it is now corresponding better with their practices. Now, an accountant can activate the AI system used in the AIS client-specifically based on the system's estimates of what its accuracy would be for the client in question. The purpose of the AI system is to supply predicted values for account postings and VAT amounts for purchase invoices to increase the level of automation in the invoice handling process. Those ML-based predictions that do not exceed a set confidence-level threshold are highlighted, and the system lists them in a new widget in the AIS for the accountant to check. Here, the user either corrects or approves the proposed postings and VAT values.

This breakthrough notwithstanding, a considerable ongoing issue with one ML model is leading to erroneous VAT-deduction postings that create problems for both the accounts-payable process and the general-ledger accounting process, which uses the purchase invoice data to generate monthly reports. This issue has persisted for several months, and when, in December 2020, the AI system is brought into use for a large percentage of the CloudAccounts' client companies, accountants grow increasingly frustrated with the situation since they have no easy way to check and validate the VAT deductions. To ameliorate the situation, the AI systems' developers add a new column to the value-validation reports, specifically for VAT deductions. This gives the accountants an overview whereby they can compare the values with historical postings to check for deviations. Though this addition to the report renders the various activities more aligned again, the underlying problem with the VAT-deduction ML model remains.

In March 2021, Veronica, who had been investigating the VAT-deduction problem for months, suddenly is able to spot a couple of bugs that are producing a combination of problems in the ML model. With the bugs fixed, it all begins to work as intended. Nearly two years after establishment of the innovation unit, the ML models are finally producing accurate

outputs, and the AI system is ready for full production deployment in April 2021.

4.2. Timing and seizing timely opportunities

Proceeding from the above storyline, we can see how different historical lines of action and their timely kairotic correspondences put the idea of an AI system's design and development in motion. The storyline also outlines how the innovation unit's activities of design and development, in combination with the feedback received from accountants, conditioned the (trans)formation of these flows of action and, moreover, led to deploying an AI system for purchase invoice processing that created a new flow of algorithmic action.

Several historical lines of action started to come into confluence and form correspondence in the timely creation of conditions favoring AI system development initiative to gain prominence. In addition to increasing use of AIS gradually at CloudAccounts, new knowledge-work automation technologies such as robotic process automation and AI systems, had been gaining prominence in financial accounting. Furthermore, the company was facing competitive pressure to enhance its operations, and the top management had identified a strategic need to step up its digital transformation via new automation technologies. As these historical lines of action began to converge and correspond, the conditions were created for establishing an AI innovation unit.

As the new flowing line of AI system design and development practice and the flow of accounting practice began converging and briefly entered correspondence for the first time during the piloting, new possibilities for action started to form. The following quote illustrates an opportune correspondence among situational lines of action that cultivated favorable conditions during the AI system development:

Veronica: Before COVID-19, when we were at the office – and we have flexi-logic [hot desking] and usually next to our team there were sitting random people but there was one lady who had been doing accounting for, like, decades [...] – we asked the lady, if she is interested to help us, because we really need it. [...] She was really curious about the way we work and the [...] algorithms we are trying to design, and her input was really valuable. I remember that, out of that, I figured out that kind of invoice-type model. It was through cooperation with her I came up with it eventually. Sometimes it's enough just to see what's the first line and then just to make [a] conclusion [on] whether to go "Next" [purchase invoice] or not. Because before joining [CloudAccounts], I've never had anything to do with accounting, so I had to kind of [chuckles] learn these sorts of things from scratch.

As this extract attests, the emergence of the ML models used in the AI system was not solely an outcome of deliberate design and development practice; the models were shaped and formed on the foundation of the correspondence among the flowing lines of practice that then carried on transforming. Although the AI innovation unit worked intensively to find solutions, without the timely feedback of accountants and the opportune moment along the flowing lines of action, the trajectory of the design and development practice would not have become more aligned with accounting practice. Thus, as timing was off among the flowing lines of action, this in part led to delays in the AI system project as the lines of action could not gain correspondence.

Another important turning point in the trajectory of designing and developing the AI system was when data scientists gained access to the AIS's production database. Because the data scientists initially had to work with test-environment data only, the ML models' training was insufficient, and the resulting low accuracy. This led to AI system producing erroneous outputs. While this disturbed the accounts-payable accountants' day-to-day work rhythm on account of the additional checking and validation activities, enhancing the ML models with timely data flow did improve the relevant model's accuracy: though algorithmic action still yielded faulty outputs at this point, there were far fewer errors than before. This accentuates the point that the data scientists' delayed access to production data and the timing being off created difficulties and problems that rippled all the way through the accounting work as the conditions were not met for algorithmic action to gain fuller correspondence with accounting practice.

In sum, this outline highlights how possibilities for action either emerged or were suppressed via the conditions created by the timing of various individual flows of action. Also, it reveals the centrality of timing to rendering contingent lines of actions and their temporal qualities more aligned with one another. While kairotic correspondences create new action possibilities, mistiming can impede the formation of convergence and correspondence among the flows of action leading to delays in the AI system project.

4.3. Attentionality and sensing possibilities for action

Our approach enables demonstrating also how exposure and attunement to the various flowing lines of action and their temporal qualities gives rise to conditions for sensing possibilities for action. Thus, we unveiled how being attentive to the temporal qualities (e.g., rhythm and the intensity of the flows of action) can shape formation of correspondence. The resulting perspective affords explaining how the flows of action

move from contingent confluences to the beginnings of convergence and greater resonance with one another, creating fertile ground for correspondence.

Even though the technical development of the ML-based algorithm at CloudAccounts and the ways of applying the ML and AI platforms' features can be attributed to the design and development team's data scientists, success required the AI innovation unit's personnel to become exposed – and, thereby, attuned – to accounting practice. Likewise, the accountants who participated in piloting, testing, and giving feedback had to become exposed and attuned to the AI system's algorithmic action and, to some extent, to AI system development practice. In this process, the accountants had the important role of teaching the data scientists and service designers basics of accounting, so that they could become attuned with the intricacies and rhythms of the relevant accounting practice.

As all the new flowing lines of design and development practice for the AI-based system, and the algorithmic action, met with the historical flow of accounting practice in a contingent confluence for the first time in piloting, the initial impetus was created for the design and development practice's greater alignment with accounting practice. As this quote from an accountant David illustrates, the innovation-unit staff's efforts to understand the purchase-invoice processing more deeply became frustrating on occasion: *Because I have been part of piloting and testing from the beginning, the data scientists lean on me quite often and ask me – and I have to look into – things I don't know about: why it's been done this or that way. [...] At the beginning, I was immensely interested in being part of this kind of project, and when I was responsible for testing that was interesting, but now [chuckles] it is a bit frustrating every now and then since I haven't done that client's postings and I would need to know why it has been done in that way because "you did it like this before, so why is it now done like that?"*

This example showcases the data scientists' work to attune themselves to the accounting practices first, so that they would be able to tune the ML models such that the algorithmic action would converge more fully with accounting practice. The tuning proved helpful later too, when they moved on to testing the AI system with a larger number of clients and then implementing it for those clients that met the prerequisites for activating the AI system. Attuning thus aids in sensing possibilities for action and thereby permits the design and development process to progress so that the converging lines of action end up corresponding with one another at some point. However, attuning itself can be a timely process and if it is not accounted for in the AI system project schedule, it can lead to unexpected delays. Nevertheless, as the innovation unit became more aware of the requirements

of accounting practice, this assisted its staff in sensing new possibilities for action. For example, when the data scientists set the confidence level to 75% ensure that the system catches errors in AI-generated postings, the resulting excessive highlighting of purchase invoices as uncertain not only increased the accountants' workload significantly but also threw off their attunement to the flow of algorithmic action. Instituting data-driven confidence thresholds later, instead of a static threshold led to the AI system highlighting uncertain purchase-invoice posting suggestions more accurately.

Veronica: *We thought that "OK, let it be so that if [the confidence for a posting prediction] is more than 75%, we do not highlight [the prediction as uncertain and if it's] less we do." Then we started having many different unhappy accountants [chuckles] [...]. So I thought that "well, having this number 75% just out of a hat, it's not a good idea." So I had a subproject to make this threshold to be data-driven on a daily basis [...]. According to our assessments, accountants became much happier with that when we removed the 75% and started being more data-driven.*

This points to another facet of tuning: as the data scientists were growing attuned to the intricacies and requirements of accounting practice, the ML models reciprocally were becoming more tuned to the accounting practice's flow – for example, through new, improved features and via training from all the production data. With implementation of the AI system's improved ML models and more sophisticated features such as data-driven thresholds, the algorithmic action became better aligned with the temporal rhythms and tempos of the accounts payable process. This, in turn, led to accountants becoming more attentive to the flow of algorithmic action, since it was now part and parcel of the accounts-payable process. The improved process required them not just to validate the correctness of purchase-invoice postings but also deal with the uncertain posting predictions that were listed by the new widget in the cloud-based AIS's user interface.

Overall, there must be changes in the conditioning attentional flows before the flows of action can converge and start resonating with one another such that correspondence can take shape. These changes can come to pass through greater attunement to the practices involved and their related temporal qualities. This fact points to the centrality of attentionality for sensing the possibilities for action. Therefore, the picture is far wider than one of deliberate intention or planned goals shaping technology use which can be difficult to take into consideration in the schedule of the AI project. Therefore, unexpected delays can occur as attuning to sense possibilities for action can be a lengthy process. It is crucial to also understand that AI systems' design and development is a fluid, continuous process and it takes

time to sense possibilities for action that emerge along the flows.

4.4. Undergoing and actualizing (trans)formative opportunities

Finally, undergoing a (trans)formative process opens new paths of becoming whereby one may rediscover and reinvent oneself. The innovation-unit staff and accountants alike had to become exposed and attuned to the flows conditioning the (trans)formation connected with the AI system before they could sense timely possibilities for action.

Both the accountants and the staff of the innovation unit involved in the system's design and development process found themselves swept away and animated by the flows of action from time to time as they were undergoing the process of actualizing the new possibilities for action that had emerged. As they underwent this (trans)formative process, they were rediscovering and reinventing their paths of becoming. As the following two quotes articulate, the AI system's design and development was not merely a process of just getting ML-based algorithms to work; it also featured much more work, beyond data-science activities, than originally anticipated. Veronica: *I've been developing some models in a lab. [...] I had some image that was far from reality. But eventually what I learned is that "actual" data science as [...] we think [of it] usually while we play with models and algorithms and try to tune this or that, well, it's like [that] less than 10% of the time. Majority of time will be spent engineering, communicating, or getting to know this or that, arranging different activities. My perception has been changing with each and every step.*

Veronica: *Imagine: we had at some point around hundreds of companies that were piloting the feature [...]. I had to kinda go inside to retrain everything, to use backtesting approaches to check [thing] out, and it's very time-consuming. It's very, very time-consuming, and it's not like "check this and that" but "then check through the whole history what was there before," like resimulate the situation [with a particular invoice] [...]. I learned that this is a part of a process. It's not just me and the data and tuning, playing with it. It's just... handling very many different requests from many different teams from managerial to pilots, from engineers, architects to database people, and so on.*

These musings highlight how individuals and the innovation unit needed to rediscover and reinvent their paths of becoming during the process of undergoing. This took time as the possibilities for action were created during the process which can be seen as delays from the viewpoint of the AI project, but for the individuals it was a necessary learning process to

become attuned with the other lines of action. Furthermore, because there were plenty of other activities for the four innovation-unit personnel to attend to, the design and development split into several streams of action. Veronica: *Eventually it was not just innovation unit plus developers; it was innovation-unit team, developers, architects, engineers, marketing people, and so on. We were coordinating all our activities on a weekly basis, which was great, and we had a really great project manager who was pushing everything to be done as it should be.*

While it was the innovation unit that set the AI design and development practice in motion and had sole charge of it at first, that practice has continued with various streams of AI system design and development action, and the innovation unit's role is still being rediscovered accordingly. A comment from Veronica encapsulates the process of fluidly etching these furrows through the landscape: *"From one team-based project it really transformed to something really well organized, and that's why we managed to finally go live in spring [April 2021]."*

Moreover, the flow of the AI system's algorithmic action now corresponds more closely with accounting practice at CloudAccounts, and the trajectory of accounts-payable activities has been altered simultaneously. As one of the company's senior accountants noted, the AI system has come to correspond more closely with the temporal qualities of the accountants' work than it did when first tested in production use for a limited set of client companies, and she also pointed out how she saw the further transformation of the role of accountant. Kate: *Lately, [the AI system] has been improving tremendously, and [it] will likely improve much more. I just remember back when I started [accounting] studies [and] the lecturer was saying that AI is coming and replacing accountants, and I can say that will never happen, but it is interesting to see what will happen. But, of course, my work has changed such that you aren't necessarily a person processing accounting information anymore but the validator and expert.*

This crystallizes the ways in which accountants at CloudAccounts were rediscovering and reinventing their paths of becoming as they were both swept away and animated by the flows of action and becoming to embody (trans)formative possibilities along the corresponding flow of algorithmic action.

All in all, the findings attest that, amid undergoing the design and development of the AI system, both the innovation unit's and the accountants' action possibilities were continuously (trans)forming. While the AI system's algorithmic action was disruptive to accounting practice at first, it also created possibilities for action that were actualized in the process. As the data

scientists became animated by the flowing line of accounting practice, the flow of algorithmic action itself was transformed. With that action beginning to find a shared rhythm and start forming closer contingent correspondence with accounting practice, it began to condition and animate accounting practice in a new way.

5. Discussion and conclusions

Drawing on the notions outlined in the presentation of findings, we can see that as new lines of action are set in motion, they exert both generative and degenerative effects on the work in an organization. Thus, the new possibilities of action can be actualized in the undergoing of the continuous process. Next, we discuss why delays occurred in the AI system project and reflect on how we applied flow-oriented genealogy.

5.1. Delays in socio-technical (trans)formation of an AI system

Though each flowing line of action comprises three distinct modalities of correspondence, the figure below depicts only confluences and kairotic timing among the main lines of action being shaped in the (trans)formation between the innovation unit's establishment to the AI system's deployment in production use. In Figure 2, line A refers to accounting practice, line B to the flow of financial transactions' data to the AIS, line C to ML models' algorithmic action, and line D to the AI system's design and development practice. The moments shown are when piloting began (1), when testing and limited use of the AI system in a production environment started (2), the design and development team getting access to all historical data (3), and full production deployment of the system (4).

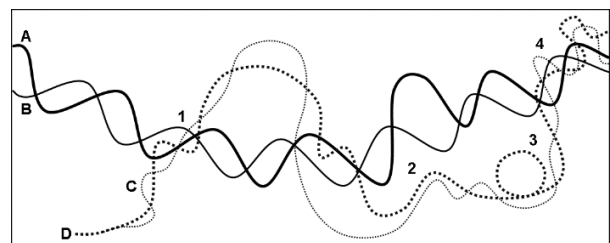


Figure 2. Kairotic meshwork of the AI system project

The figure expresses the idea that accounting practice (line A) and the transaction-data flow (line B) grew duly synchronized once the accountants had a firm grasp of the work tasks that need to be done in a certain order for meeting the deadlines of monthly financial and regulatory reporting. Therefore, there was close

correspondence among the two historical lines of action. To put in motion the new AI system project, the innovation unit brought into being the design and development practice (line D), and that line of action created the ML models' algorithmic action (line C) a while later. The AI system project began with the unit's data scientists having control of ML models' (line C) outputs and understanding what they wanted to achieve with the system. Close correspondence formed among the lines accordingly.

However, once these two lines of action met the other two for the first time as piloting of the AI system began (1), lines C and D fell out of correspondence, since the ML models were not producing the intended outputs. To get design and development practice more aligned with accounting practice, the innovation unit's experts began making sense of the intricacies and requirements of financial accounting tasks related to purchase-invoice processing [1]. Hence, lines D and A were in momentary correspondence when piloting was in progress, forming suitable conditions for making design and development practice converge with accounting practice and creating new possibilities for action. For the data scientists to condition accounting practice through the alteration of financial transaction data flow with new algorithmic action, they had to become conditioned by the very same lines of action. This highlights why delays occur in an AI system project: Both the AI developers and accountants had to "grow into knowledge" [14] through cultivation of kairotic correspondences which were not fully taken into account in a chronological timeline that was planned for the AI design and development project. Therefore, issues in the three modalities of correspondence in a flowing line of action hinder the possibilities of gaining correspondence among the different lines of action that in turn are experienced as delays. Nonetheless, when line D is more attuned with line A, it can sense the action possibilities along the flows as it undergoes the process. This allows actualizing the action possibilities. By point 2 in the figure, line C (algorithmic action) has begun to converge and form correspondence with line D.

Nevertheless, since this moment coincided with the system's testing in production use and its lack of correspondence with accounting practice, accountants experienced disruptions in their work and the workload rose because the ML models had overly strict confidence thresholds and yielded erroneous posting predictions. With the small innovation unit needing to manage various other activities, outside technical development, its attention was split across several issues during the process, which reduced the possibility of timely action. Ultimately, this caused issues in creating, sensing, and actualizing generative possibilities for

action, hence leading to further delays in the AI system project. The disruption to accounts-payable tasks' rhythm and intensity was accompanied by changes to the directionality and trajectory of accountants' practice in that they were now supposed to use the AI system in their work for suitable client companies, thus stepping onto the transformative path toward gradual rediscovery and reinvention of accounting practice.

Another important moment in the process came when the innovation unit gained access to the full production database. With the historical data, they could make a new major iteration in the AI system's development, depicted by the looping of line D. Also, the innovation unit was becoming one of the streams in design and development practice at point 3 in the figure. This created grounds for correspondence of lines C and D while also adjusting the trajectory of these flowing lines of action to be more aligned with A and B. Finally, at the moment of full deployment (4), lines A and B were becoming loosely interwoven with lines C and D, a condition likely to create new, generative possibilities for action. Through this transformation, all the lines of action began either converging or corresponding more closely – albeit not in a fully synchronized manner, since the AI system never completely matched the requirements and temporal qualities of accounting practice. Initially, line A was the dominant conditioning flow as it required D to move, into greater convergence with it. Convergence grew through timely actions in attuning to accounting practice, which allowed possibilities for action to emerge along the flows and led to moments of kairotic correspondence. While simplified, this flow-oriented genealogical account [4, 17] illustrates how one can trace the historical lines of action and their confluences that create the conditions leading to fluid socio-technical (trans)formation of an AI system and its algorithmic action such that they become corresponding and co-responsive with other pertinent flowing lines of action along the same transformative path.

Therefore, as this study underlines, an AI system design and development project is not just a technical endeavor which is why the initially planned schedule for the project gave in several times: To achieve the set goals of the AI project, both the AI developers and accountants had to become attuned to the different lines of action by undergoing the (trans)formative process. This allowed them to actualize the timely action possibilities as they were conditioning and being conditioned by the pertinent flowing lines of action. The flow-oriented genealogical research allows to consider the multiple lines of action that condition the AI project and the becoming of the involved entities as well as the three modalities of correspondence that allow to better

grasp why AI projects are complex and lengthy processes.

Finally we would like to reflect on the use of the socio-technical transformation theory [4]. We began by creating a historical storyline that allowed us to point out matters related to each three modalities of correspondence. Once the historical storyline was created, we found out that the easiest part was in establishing the timing and mistiming of flowing lines of action as respondents stated clearly if they were pleased or dissatisfied about how the AI system development process had unfolded. This allowed to point out when the lines were gaining correspondence or falling out of it. However, it was challenging to tease out the modality of attentionality as it was a much more difficult endeavor to trace the different lines of action with their specific temporal qualities as they became to condition one another in the process. Thus, getting to grips with how attunement to the lines of action unfolded and how that allowed to sense possibilities for action required from us attentiveness towards the constant change in conditioning attentional flows. Once modalities of timing and especially attentionality were established, it was easy to expound from the interview data how the lines of action and involved entities were undergoing the process and became (trans)formed along the (trans)formative path.

5.2. Future research and managerial implications

As future research, comparing flow-oriented genealogical research approach to other socio-technical approaches and discussing their advantages and disadvantages provides a potential avenue for future inquiry. This would allow to further weave the new approach of socio-technical (trans)formation and the becoming ontology into the fabric of information systems research.

Unlike traditional IT projects, new AI system projects bring about potentially transformative shifts to work practices that take time for the organization to absorb. Furthermore, the AI system development projects are characterized by constant testing of tuned ML algorithms based on ML model performance and domain expert feedback which is why the progress of AI system projects might not be a straightforward process due to temporal dynamics. Facilitating active communication and collaboration in the socio-technical transformation process is a key to cultivate and foster favorable conditions, since problems in understanding how to steer the system's and models' development into fuller alignment with work-practice requirements could well lead to consistent delays and postponing system deployment.

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