

ORGANIZING COMPLEXITY: AN INDUCTIVE INQUIRY INTO ALGORITHMIC ROUTINES EXPANSION

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ABSTRACT

We know little about how, through the expansion of the space of possible paths, routines transition in a situation of ever-increasing complexity. Drawing on data from an ethnographic study, we propose insights on how routines expand while remaining functional. Charting the transitional phases of an algorithmic routine that is undergoing a significant expansion, we describe four representative performance moments and explicate three cycles between these moments that enable us to develop a theoretical model for organizing increasing level of complexity in algorithmic routines expansion. Our contributions include insights into routine expansion, standardization, flexibility, and interdependence, addressing gaps in existing research.

INTRODUCTION

How do routines expand while organizations go through significant growth phases? How do routine dynamics change when new routine participants and new artifacts are added to the routine? How do organizational actors manage the increasing complexity in organizing in such situations? We know little about how, through the expansion of the space of possible paths, routines evolve in a situation of ever-increasing complexity (Pentland et al., 2020). Research on standardization and flexibility explores how actors manage variations in performances by strategically employing actions and artifacts (LeBaron et al., 2016; Spee et al., 2016; Turner & Rindova, 2012). Routine studies also reveal the effort required to standardize processes in extreme contexts (Danner-Schröder & Geiger, 2016; Suarez & Montes, 2019), highlighting the importance of suppressing some actions (possible paths) to establish efficient processes. We also know that, in daily enactment of routines and through their background knowing and knowledgeable improvisations, organizational actors practically cope with minor disturbances and malfunctions without high-level analytic reflections achieved through detachment from the routine (Chia & Holt, 2006). But in substantial organizational changes, significant malfunctions can threaten the routine's functionality and lead to a total routine breakdown, which necessitates a higher level of reflection-on-action (Yanow & Tsoukas, 2009). With the increasing level of complexity in routine expansion, we need to know more about the processes through which organizational actors keep routines in check and avoid dysfunctionality in routine performances; however, our knowledge is limited as routine expansion is hugely unexplored.

THEORETICAL BACKGROUND

Process Multiplicity in Routine Dynamics

Recent process research highlights the critical tension between singular processes and the multitude of potential pathways they may take, a concept foundational to understanding process multiplicity (Cloutier & Langley, 2020; Khandker, 2017; Langley & Tsoukas, 2017). Despite its clarity, operationalizing multiplicity in empirical research has proven challenging, leaving theorists grappling with its significant implications (Pentland et al., 2020). The complexities of process multiplicity manifest in various research streams, particularly in organizational change and routine dynamics. Efforts to alter processes often uncover numerous potential pathways, complicating the mapping of current states and the envisioning of new trajectories (Golden-Biddle, 2020; Huising, 2019). Similarly, studies on organizational routines reveal high-performance variation, presenting a paradox of consistency amidst change (Danner-Schröder & Geiger, 2016; Birnholtz et al., 2007). Further exploration into standardization and flexibility illustrates how actors manage performance variations through strategic actions and artifacts. This underscores the challenge of linking singular processes with numerous potential paths and how actors navigate these variations to instigate change (Spee et al., 2016; Turner & Rindova, 2012). Pentland et al. (2020), building on the concept of “alternate pathways” operationalize process multiplicity as a “space of possible paths.” This approach emphasizes analyzing sequential relations between actions, adopting a relational perspective that views processes as constituted by dynamic, unfolding relations (Emirbayer, 1997; Tsoukas & Chia, 2002). Research into routines in extreme contexts highlights the need for process standardization to suppress certain actions to enhance efficiency, stability, and predictability (Danner-Schröder & Geiger, 2016; Suarez & Montes, 2019). For instance, organizational actors prioritize activities in catastrophe management and establish strict routine actions that limit performance variability. Other scholars note that while the dynamics of single routines may expand, the dynamics of routine clusters can restrict and serve as a selection mechanism in organizational practices, suppressing certain paths (Kresmer & Schreyogg, 2016).

In sum, the discourse on process multiplicity wrestles with the challenge of understanding the intricate relationships between singular processes and their potential pathways. Researchers aim to illuminate the dynamics of processes and their complex action interplays by operationalizing process multiplicity and exploring its implications across various contexts. However, empirical studies remain sparse, and our understanding of how routines evolve amidst growing complexity through expanding possible paths is limited (Pentland et al., 2020).

Practical and Deliberate Coping

Addressing the need for a deeper understanding of agency, action, and practice, Chia and Holt (2006) propose a shift from a traditional strategic ‘building’ mode—characterized by deliberate, purposeful activities—to a ‘dwelling’ mode where strategy emerges through non-deliberate everyday coping, without explicit intentions. They argue that strategic intent is inherent in adaptive actions, shaped more by an internalized disposition from past experiences than by deliberate planning. Yanow and Tsoukas (2009) build on this by integrating Schön’s reflection-in-action and phenomenological accounts of practice, providing insights into the evaluative dimensions of competent practice, the nature of surprise, and improvisation. Their framework emphasizes the importance of everyday practices in understanding organizational strategic behavior, highlighting how reflection-in-action, catalyzed by surprises from organizational actors

and artifacts, ranges from non-deliberate adjustments to deliberate thematic responses. In their daily routines, organizational actors often cope with disturbances through their background knowledge and improvisational skills, without needing high-level analytic reflections. For instance, Suarez and Montes (2019) show how actors use heuristics in response to routine disruptions, drawing from their subjective perceptions in extreme situations. However, significant malfunctions or organizational changes necessitate deeper reflection-on-action to maintain routine functionality amid complexity (Yanow & Tsoukas, 2009).

Organizational growth, as a significant change, we believe can provide an interesting context to study the processes through which organizational actors keep routines in check and avoid dysfunctionality in routine performances despite the ever-increasing level of complexity in routine expansion. However, our knowledge is limited as routine expansion is hugely unexplored empirically and undertheorized in organizational studies. Hence, in this article, we ask: *How do organizational actors organize daily work in the presence of increasing complexity in an algorithmic routine expansion?*

CASE DESCRIPTION AND METHODS

To answer our question, we conducted an ethnographic study at SMARTER, a German IT consultancy specializing in implementing algorithmic document management systems (DMS). DMS streamline document interactions and storage across organizations. Founded in 2016 with just five employees, SMARTER has experienced a high rate of growth, expanding to 30 employees by 2018 and becoming one of Germany's five most successful DMS consultancies by 2023, with 56 employees. SMARTER's overall vision is to design the algorithms of DMSs for customers in such a way as to optimize their reusability at scale for multiple client organizations. This provides the basis for a scalable solution yet also meets each project's context-specific demands, including the diverse IT infrastructures, filing rules, and other clients' specific document management requirements. Consistent with this vision, SMARTER purposefully avoids writing complex context-specific algorithms for a single client and instead writes algorithmic scripts as generically as possible to optimize their reuse in multiple contexts. Accordingly, SMARTER designs algorithms by coding each action at the script level. So, even if the sequences of actions are different in different customer organizations (e.g., individual actions run in a different order), SMARTER designs the different DMS through reusable scripts. The firm further applies the principle of optimum reusability in designing these scripts as modules to ease the mixing and matching different algorithmic scripts from the pool.

In an inductive inquiry, we followed the company founders, and the other organizational actors joined the company during six years of study. We gathered over 600 pages of field notes in 87 hours of observation (40 hours of participant observation and 47 hours of non-participant observation). We conducted 26 hours of interviews in this qualitative research. We then triangulated and complemented these data sources with over 2000 pages of secondary documents produced by the company as internal emails, bulletins, and artifactual representations of internal processes. We observed the changes in all organizational routines but closely followed changes in the central consulting routine of developing algorithmic DMS solutions for clients. We used theoretical sampling to reach our data saturation and analyzed data in a grounded approach using open and axial coding and constant comparative technique (Strauss & Corbin, 1990).

FINDINGS

Charting the expanding phases of the (algorithmic) consulting routine (adding new actants in terms of employees, artifacts, algorithmic scripts, and clients), we observed four major representative performance moments of our algorithmic routine and explicate three transitional cycles between these moments that enable us to develop a theoretical model for daily organizing in the presence of an increasing level of complexity in an algorithmic routines expansion.

Representative Performance Moments

In the first (representative) performance moment, Claus (the central actor, one of the two founders of the company) conducts workshops at client locations to draft the workflow for the DMS solution. He uses a digital questionnaire called 'the mind map' to structure these workshops, documenting all relevant details. Using a visualization tool, he conceptualizes the workflow, aiming to reuse scripts from previous projects wherever possible. Once the client approves the proposed workflow, an implementation concept is drafted, serving as a contractual document outlining project scope, milestones, and technical details. Then, in the back-office, programmers develop algorithms based on this implementation concept, and the DMS is installed on the client's server using an installation checklist. Claus frequently assists programmers in translating the constructed workflow to a script level and helps to allocate scripts for reuse on other customer servers. His exceptional background knowing aids in recalling suitable scripts for reuse. In the testing phase, SMARTER identifies and fixes bugs, with Claus or the programmers addressing client-reported issues as needed. Throughout the routine, Claus plays a central role in designing and refining the DMS, leveraging past experience and facilitating smooth project execution.

In the second performance moment, SMARTER experiences a notable uptick in client demand for their services. To cope with the growing number of DMS projects, SMARTER recruits additional staff. Among them was Alex, a newly hired assistant tasked with accompanying Claus to workshops and adapting the implementation concept. However, Alex soon realizes that beyond the information contained in the mid-map, further details are necessary. He devises a workaround by directly requesting additional information from Claus. Despite the implementation concept serving as the contractual foundation between SMARTER and the client, Alex detects that it does not encompass all essential project details. Alex uncovers this when he asked the programmers how they were using the implementation concept. They responded that they don't use every chapter and refer to Claus or clients to enquire specific information. Moreover, even when technical aspects and requirements were clarified, new programmers sought guidance from Claus on DMS installation procedures due to insufficiently defined steps in the installation checklist. Additionally, they turn to Claus for assistance in assembling the DMS at a script level, lacking oversight of the 200+ existing reusable scripts across various client servers. Overall, in moment two, Claus functions as the bridge between codified artifact knowledge and the practical information required for routine execution.

In the third performance moment, the demand for DMS projects grows, requiring more staff and scripts. With Claus managing workshops and recalling script alone, his heavy workload makes him unavailable, causing him to become a bottleneck in the routine. To address Claus's unavailability, new hires like Andrea (head of programming) and Katia (customer support) take on additional responsibilities, leading to a more structured division of labor. At this moment, we observed that the consulting routine started to fan out in three slightly separated sets of action patterns: project clarification with the customer, DMS installation and configuration, and customer request management. While Claus still supports routine actions but no longer carries the primary

responsibility in programming and managing customer requests. In response to their roles, actors aimed to reduce Claus's involvement as a bridge between practical knowing and routine enactment. They developed or modified artifacts to improve information exchange by codifying more knowledge in artifacts and creating control points to make routine performance more transparent (e.g., design principles for programming or a ticket system with objective parameters to prioritize bug fixing). However, Claus does not adhere to the new performances and creates workarounds by providing advice for the programmers not in alignment with the design principles, or overrides the ticket system and assigns tasks to employees on a spontaneous basis.

In moment four, the separation into three separate routines is rigorously and deliberately enforced. Artifacts connecting the routines (the implementation concept and ticket system) enable the transparent flow of information between now fully separated routines. The separation of the routines is noticeable in how actors were involved in these routines as actors are only allowed to act in one of the three routines to ensure that no one is able to bridge the routines intersections. This restriction is in place to ensure that all essential project information is consistently codified into the boundary objects. So, the routines' interfaces are clearly defined, and the routines can be enacted independently. Also, there has been a significant change as Claus is no longer involved in any of the three routines, even though SMARTER has an increasing number of client projects and a need for specialists in these routines and keeps hiring new actors.

Transitional Cycles

In the first cycle (transition from moment one to two), we identified that routine participants, orbiting around a central actor, constrain variations in their performances through *practical coping* by drawing on their background knowing gained through daily routine enactments and 'reflection-in-action', as well as reliance on the central actor to control the expansion of possible paths and to prevent the routine from malfunctioning. We labeled this cycle 1 "absorbed copying". This enabled them to deal with minor errors and malfunctions to keep the routine in balance without deliberate efforts to contract the routine.

Explaining the transition from performance moment two to three, we identified a second cycle, which we labeled "*deliberate coping*." In this cycle, the routine participants began to reflect 'on' the routine, and we observed the emergence of systematic control mechanisms for contracting the space of possible paths. However, although measures of reflective expansion and contraction were in place, the central actor had the knowledgeability to sideline the intended and codified flow of information in the routine or interfered spontaneously with the sequences of routine and overrule decisions made by control mechanisms resulting from the deliberate coping. Although cycles 2 and 3 were about 'reflection-on-action', we identified that in the third cycle (transition from moment three to four), named "unweaving expansion", the routine participants engaged in an even higher level of analytical reflection. In so doing, they detached themselves from the routine to deliberately plan how to change the routine. Here, the recently joined routine participants played a critical role as they reflected on the routine through what we labeled *thematic intentionality*. This resulted in sidelining the central actor and ultimately splitting the consulting routine into three interdependent routines using performance objects in the form of well-defined interfaces.

DISCUSSION AND CONCLUSION

Our paper makes three significant contributions to the extant body of research on routine dynamics and organizing complexity. First, our study contributes to the ongoing dialogue on

routine multiplicity and process dynamics, emphasizing the balancing act between expanding and contracting the space of possible paths within routines (Pentland et al., 2020; Van de Ven & Poole, 1995). We illustrate how participants manage routine complexity through a nuanced interplay of expansion and contracting mechanisms. While at early stages of expansion, they rely on *reflection-in-action* and background knowing to practically cope and to maintain routine balance, in more advanced and complex stages of routine expansion routine participants undergo a transition to a more analytical or theoretical reflection, termed ‘thematic intentionality’ (Chia & Holt, 2006; Yanow & Tsoukas, 2009). When their work focus was interrupted, indicating ineffective or non-operative deliberation, they adopted a detached analytic stance to comprehend the underlying mechanisms. In this mode, participants engaged in detached reflection, actively planning to modify the routine to control increasing complexity, transforming the routine into an ‘object’ for the first time. This high level of analytic attitude, unlike previous practical coping, decontextualizes the phenomenon, examining its features and attempting to relate them to one another.

Second, we extend research on standardization and flexibility. So far, research on standardization and flexibility examines the way actors purposefully either limit variations in performances or try to increase them (Danner-Schröder & Geiger, 2016; Spee et al., 2016; Turner & Rindova, 2012). This line of research has examined how participants balance competing pressures for standardization and flexibility, the actions they take and the artifacts they use to either standardize or flexibilize their performances. We extend this line of research by showing how actors purposefully limit variations in performances through not only the background knowing they grasp through daily routine enactments and *absorbed coping* (reflection-in-action), but also the capability to fully detach from the routine and shift to a more analytic reflection through *deliberate coping* and *thematic intentionality* (reflection-on-action).

Third, we contribute to research on routine interdependence and integration (Becker & Murphy, 1992; Lawrence & Lorsch, 1967; Kremser & Schreyogg, 2016; Puranam et al., 2012) by demonstrating how participants use performance objects to split a single routine into three interdependent routines. This strategy controls the complexity of routine expansion by limiting possible paths. Programming interfaces ensure coordination among routines, maintaining predictability of results. Despite task interdependence, actors in a focal routine remain somewhat unaware of actions in other routines, even with task interdependence. Emphasizing the role of performance objects, we show how, through routine expansion and interface design, a single routine can split into three connected yet semi-autonomous routines, allowing independent enactment without waiting for inputs from other routines or the involvement of routine participants in more than one routine at any given time.

REFERENCES AVAILABLE FROM THE AUTHORS