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How Does Artificial Intelligence Promote Change and Stability of Organizational Routines? The Role of Automation and Augmentation

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Abstract: *This paper examines the influence of artificial intelligence (AI) on the change and stability of organizations. We focus on automation and augmentation as key dimensions of AI and elaborate their effects on organizational routines. AI can promote change of organizational routines through capacitating new actions or reframing patterns of actions, but also their stability through shielding actions and adhering to actions. Moreover, we suggest that these mechanisms can occur simultaneously and sequentially in different parts of routines. This paper contributes to research on automation and augmentation by explaining how these two applications form a duality. While prior research suggested that actors iterate between both applications over time, we suggest that zones of automation and augmentation coexist within different parts of the action patterns of the same routines. Seen this way, humans and AI work hand in hand to perform those routines. We also contribute to Routine Dynamics research by suggesting mechanisms through which AI may lead to the change and stability of routines.*

Keywords: AI, algorithms, artificial intelligence, digital transformation, duality, routine dynamics.

1. Introduction

The ability to change is crucial for contemporary organizations and their routines, allowing them to respond to dynamic environments and devise solutions to the problems they encounter (Mahringer & Renzl, 2018; Renzl et al., 2021; Ritter et al., 2021; Wenzel et al., 2021). Importantly, the increasing adoption of artificial intelligence (AI), and the replacement of human actors by software, may influence the ability of organizations to change. The actions of artificial intelligence, however, may follow a different logic than the actions of humans. Despite the importance of AI, we know little of how AI influences organizational change and stability. This paper, thus, examines the question 'how does the adoption of AI promote change and stability?'.

More specifically, we focus on two key applications of artificial intelligence in organizations—automation and augmentation (Langer & Landers, 2021; Raisch & Krakowski, 2021; Tschang & Almirall, 2021). While automation refers to machines taking over human tasks, augmentation implies that people closely work together with machines to perform a selected task (Raisch & Krakowski, 2021). Seen this way, automation and augmentation may have different effects on organizations, and thus, they may influence organizational change and stability in different ways. Raisch and Krakowski (2021) further suggest that organizations often employ automation and augmentation in conjunction, outlining that the two mechanisms "are not only separable and conflicting but in fact fundamentally interdependent" (Raisch & Krakowski, 2021, p. 203). We build on these arguments and elaborate what it means for automation and augmentation to form a duality instead of a dualism (Farjoun, 2010) in the context of organizational change and stability.

To better understand the role of AI for organizational change and stability, we draw on recent research on organizational routines, commonly labeled 'Routine Dynamics' (Feldman & Pentland, 2003; Feldman et al., 2021; Feldman et al., 2016). These scholars define routines as "repetitive, recognizable patterns of interdependent actions, carried out by multiple actors" (Feldman & Pentland, 2003, p. 95), and conceptualize them as entwined processes of patterning and performing (Danner-Schröder & Geiger, 2016; Feldman, 2016). While performing refers to the actions that people carry out in practice, patterning refers to the recreation of patterns of actions across time and space, in situ. Therefore, organizational routines can both lead to change and stability, because actors may pattern routines similar to the past or in changing ways (Goh & Pentland, 2019; Pentland et al., 2020). As organizations are composed of routines (Feldman, 2000; Nelson & Winter, 1982), this lens represents a suitable window of inquiry to understand the adoption of AI and how it influences the change and stability of organizations.

Drawing on these insights, we follow the view that routines can be seen as patterns of related actions (Pentland & Feldman, 2007). When organizations adopt AI, they may augment or automate some of these actions and relations of the routine patterns (what we label ‘zones of automation and augmentation’). In a hiring routine, for instance, the front end may be automated (e.g., pre-selecting candidates) but the back end (e.g., interviewing) may still be a completely analog activity. This argument reveals how automation and augmentation can be seen as a duality: if some actions and relations are augmented while others are automated, both applications co-exist within particular routines. As these actions are interdependent (e.g., selecting candidates is a prerequisite for interviewing), automation and augmentation are mutually constitutive, thus forming a duality.

Moreover, we suggest four different mechanisms through which AI can lead to change and stability of routines (i.e., capacitating, reframing, shielding, adhering), each of which may be enabled through automation or augmentation. Viewing automation and augmentation as a duality helps us to see that actors can employ several of those mechanisms in conjunction in a specific routine. In sum, our arguments suggest how automation and augmentation can simultaneously be applied in the same routine, and how they can change routines or keep them stable over time.

2. Theoretical background

2.1. Change and stability of organizational routines

While traditional research viewed organizational routines as relatively stable entities (Nelson & Winter, 1982), a stream of research labeled ‘Routine Dynamics’ has challenged this view (Feldman et al., 2021). These scholars define organizational routines as “repetitive, recognizable patterns of interdependent actions, carried out by multiple actors” (Feldman & Pentland, 2003, p. 95). Seen this way, routines can both, account for change and stability.

Feldman (2000) and Feldman and Pentland (2003) examined hiring as a prototypical example of a routine. They argue that hiring has all the qualities of a routine, because it is repetitive (e.g., performed multiple times for different positions), it involves a pattern of actions (e.g., posting the job, screening applicants, pre-selecting, performing interviews, selecting an applicant, confirming the position, and issuing a contract), which is recognizable (i.e., people know how hiring is typically carried out), actions are interdependent (i.e., it is not possible to issue a contract without selecting an applicant), and it involves multiple actors (e.g., recruiters, applicants, contract specialists). Drawing on the case of a student housing organization, Feldman (2000) shows that the hiring routine changed substantially over time, rather than remaining mostly stable as traditional research suggested.

Routine Dynamics scholars explain the change and stability of routines by conceptualizing them as processes of performing and patterning (Danner-Schröder & Geiger, 2016; Feldman, 2016; Turner & Rindova, 2018). Performing refers to the actual doings and sayings of people in practice. It may include interviewing a specific job candidate for a specific job at a specific point in time. Patterning, by contrast, refers to the creation of repetitive patterns of actions in situ that reflect the routine. In the hiring routine, for instance, a recruiter may signal to a colleague that interviewing ought to follow the pre-selection of candidates, and that it is not possible to hire somebody without an interview. In this situation, she or he recreates the pattern of the routine.

Pentland and Feldman (2007) suggest that narrative networks are a useful way to better understand the change and stability of routines. The central idea is that a routine can be represented as a network, in which nodes represent actions and ties show which actions follow other actions. They argue that “[t]he narrative network provides a straightforward way to describe organizational change because patterns can be changed by adding or removing fragments and adding or removing connections” (p. 792). When actions and/or ties are removed from or added to the narrative network, this represents a change in the routine (Goh & Pentland, 2019).

Moreover, technology may substantially influence whether routines remain stable or change (Berente et al., 2016; D'Adderio, 2014; Glaser, 2017; Omidvar et al., 2023; Pentland & Feldman, 2008). Pentland et al. (2022), for example, show that technologies can lead to various outcomes ranging from extreme change to extreme stability depending on how they are performed. If a technology adds many new actions that can flexibly be recombined in the narrative network, change is more likely. In contrast, if a technology is rather restrictive in allowing new actions, stability is more likely. While Routine Dynamics research has considered the relevance of technologies, however, research on how artificial intelligence may influence the stability and change of routines is rare. Hence, we now review research on AI, specifically focusing on automation and augmentation.

2.2. Artificial intelligence: automation and augmentation

Ever since its introduction in the 1950s, AI was aimed at “making a machine behave in ways that would be called intelligent if a human were so behaving” (McCarthy et al., 1955, p. 1). Towards this end, chatbots, robots and sophisticated algorithms have been developed, and these developments increasingly pervade our lives—be it in work contexts or the private realm (Brynjolfsson & McAfee, 2014; Loureiro et al., 2021; Von Krogh, 2018). Consider ChatGPT or related AI advancements as options.

Nowadays, AI represents an umbrella term, covering numerous facets, such as machine learning or deep learning, whereby disagreement exists about how to interpret ‘artificiality’, what actually makes an algorithm ‘intelligent’, and where to draw a boundary in terms of what constitutes AI and what shall not be considered AI. In any case, many authors seem to conclude that “it’s all just math at the end of the day” (Finlay, 2021, p. 10), and that it represents a cognitive technology (Davenport & Mahidhar, 2018).

It is in this connection that most scholars and practitioners lay emphasis on the cognitive aspect of AI, aspiring to optimize organizations (Brynjolfsson & McAfee, 2014). This mantra is perhaps best reflected in the debate about *automation*, which examines whether tasks and processes within organizations can be pursued autonomously and more efficiently (Benbya et al., 2021; Davenport & Mahidhar, 2018)—in its extreme form without any human interference. Initiatives and conceptions in managerial practice have been launched to foster automation, among others the idea of an ‘Internet of Things’ and ‘cyber-physical systems’ (Ashton, 2009) in the United States, or ‘Industry 4.0’ in Germany (Lasi et al., 2014). Against this backdrop, it is not surprising that automation is sometimes interpreted as a holy grail. However, the praises and aspirations are predominantly addressed from a managerial and technological perspective with a focus on blue-collar jobs, where labor is by and large tedious, repetitive and at times even potentially harmful for workers (Daugherty & Wilson, 2018; Davenport & Mahidhar, 2018). Nonetheless, it is argued that automation represents a threat for the workforce as substantial amounts of jobs might be lost in the mid-term run, causing widespread fears (Ford, 2013; Frey & Osborne, 2017).

In contrast, the term *augmentation* refers to employing AI to improve human-machine interaction (Davenport & Kirby, 2016; Raisch & Krakowski, 2021), which is sometimes deemed being “the only path to sustainable competitive advantage” (Davenport & Kirby, 2016, p. 204). Towards this end, a fruitful collaboration between humans and machines can take manifold forms, basically making a distinction between the way machines can improve the performance of humans and vice versa (Daugherty & Wilson, 2018). Accordingly, research provides managers with advice on how to implement an augmentation strategy, in the sense that organizations can create new jobs or tasks for humans (Daugherty & Wilson, 2018; Davenport & Kirby, 2016). Machine relations manager, for instance, is a new job that could be created for humans; similar to a human relations manager in the traditional business world. Moreover, prompt engineer is another new job role when it comes to designing prompts for AI applications based on large language model such as ChatGPT.

Instead of creating completely new jobs, Davenport and Kirby (2016) focus on different tasks that might be alternatives for how to work with machines and elaborate on the specific skills that employees need to enact those tasks. For instance, they suggest that humans could *step up above* automated systems and “let the machine do the things that are beneath you, and take the opportunity to engage with higher-order concerns” (Davenport & Kirby, 2015). Davenport and Kirby (2015) advice to “find ways to rely on machines to do your intellectual spadework.” Other alternatives are *stepping aside*, which relies on tacit knowledge or interpersonal knowledge, an ability that AI is not capable of; *stepping in*, which means that AI experts monitor and modify the function and output of AI; *stepping narrowly* is for experts in areas in which AI has not yet been used for; and *stepping forward* builds on the idea to find new ways to apply AI.

For our purposes, it needs to be noted that AI differs from traditional technologies. Research on ‘Sociomateriality’ emphasizes the role of artifacts, and it assumes that these artifacts have agency (Leonardi, 2011; Orlikowski & Scott, 2008). At times drawing on ‘Actor Network Theory’ (Latour, 2005; Sele, 2021), artifacts and human actors have the same ontological status, as they are both ‘actants’ that relate in a network. Hence, human and non-human actors are treated equally, as “technologies have agency, operationalizing material agency as technology’s ability to act on its own” (Leonardi, 2011, p. 164). Such a perspective puts emphasis on the potential role and impact of technology. AI, however, can be seen to have even more agency, as it can also carry out actions autonomously, potentially in creative ways. Take for instance self-innovating AI, which is “distinct from other digital technologies, given its potential to evolve into both a general-purpose technology and a method of inventing” (Hutchinson, 2020, p. 628).

In sum, we argue that automation is assumed to be relevant for routine tasks and supposed to heighten efficiency, oftentimes resulting in a situation where the human becomes obsolete or at least partially out of the loop. In contrast, augmentation is by and large reserved for more complex and creative bundles of tasks where the human can or shall not be left out of the loop.

What remains yet underexplored is the way AI influences organizations in light of automation and augmentation. Raisch and Krakowski (2021) offer insights into this direction when they argue that automation and augmentation are not distinct approaches but interdependent in a sequential order. This implies that organizations start with augmentation to train AI until satisfaction, then the process is automated until conditions change, and another period of augmentation is necessary to improve AI. Seen this way, automation is the ultimate goal and augmentation is the means to reach full automation. As Raisch and Krakowski (2021) put it, automation and augmentation should not be seen as a dualism, but rather as a duality (Farjoun, 2010). The notion of duality, which is often contrasted with the notion of dualism, means that elements constituting a phenomenon are not separate by nature, but they are mutually constitutive. As Farjoun (2010, p. 203) notes, “[d]uality resembles dualism in that it retains the idea of two essential elements, but it views them as interdependent, rather than separate and opposed.” Considering the aforementioned, hence, a dichotomous conception of automation or augmentation seems to be too short-sighted and simple, which is why a more nuanced conception is needed.

Despite those initial advances, management and organizational research has mainly studied AI from “a narrow technical perspective” (Glaser et al., 2021, p. 4) that allows organizations to operate more effectively, timelier and at lower costs (Brynjolfsson & McAfee, 2014). Understanding AI solely as a tool imposes several limitations: (1) AI is viewed as an independent entity endowed with power without understanding the implications of AI; (2) AI is seen as distinct from the social conditions around AI, thereby obscuring how AI is embedded in organizational routines in conjunction with other (non-)material actants; and (3) AI is understood apart from the contextual, environmental, and institutional features that prevent observers from noting how AI has developed beyond the purely technical domain (Glaser et al., 2021). A narrow technical understanding of AI in performing work also considers organizational routines as stable entities (Cyert & March, 1992). The computational construction tends to ‘black box’ AI (Bailey & Barley, 2020; Faraj et al., 2018; Meske et al., 2022), assuming that AI-based routines are ex-ante programmed and performed as intended by the designer (Wegener & Glaser, 2021).

We argue, thus, that a deeper elaboration of the relationship of AI with change and stability in organizations is necessary. Here, we focus on organizational routines, which have proven to be a suitable lens to understand change and stability of organizations (Feldman & Pentland, 2003). Yet, we currently lack a good understanding of how AI, as a specific kind of technology, may influence the change and stability of routines. The time for such inquiry is ripe because of the increasing relevance of AI in various routines (Glaser et al., 2021), and because change is a key condition for the prospering of organizations. Hence, we ask the question: ‘How does the adoption of artificial intelligence promote change and stability?’

Table 1: How artificial intelligence promotes change and stability

Mechanism			AI application	Examples from business practice
Change	Capacitating	Artificial intelligence enables new actions and relations that were not possible before or that required excessive resources.	Automation & augmentation	• ‘Uniphore’ and ‘Sybill’ develop AI-applications that can be used to detect customer emotions in sales routines in real time, which is difficult to do without AI. This enables salespeople to detect which features or products customers prefer, and use that information to adapt their sales pitch. Hence, the performance of the sales routine can be more adaptive. • ‘Merck’ uses AI to speed up or even enable the innovation process when it comes to drug development. Towards this end, the predictive models not only forecast the viability of a novel compound, but it becomes possible to obtain an explanation why a certain compound will work or why not. Hence, the AI performs new actions in the product development routine, which were difficult to perform without AI. • ‘Aleri Deviation Monitoring’ uses AI to identify outliers in a confusing mass of (potential) customers that can have either a negative or positive effect on sales success, enabling the identification of promising target groups. Based on this information, marketing routines can start to approach those customers. Moreover, products within the R&D routine and production routine can be adapted to fit new demands.
	Reframing	Artificial intelligence helps actors to revise their previously held conceptions about the pattern of actions of a routine, which helps them see it in a new way.	Augmentation	• ‘Ideanote’ creates new business ideas based on pre-specified parameters such as customer groups or market trends. This may help to reframe strategizing routines, as new business models are detected. • ‘Celonis’ provides an AI that can automatically detect patterns in business processes from vast amounts of data and suggest how to change those processes. Hence, it may suggest new patterns of actions that have not been envisioned before. • ‘Airbus Autodesk’ indicates previously unknown ways of designing, developing and producing different parts of an aircraft, such as using a different material, a different design and a different production way for dividing walls inside the aircraft A-320. This may offer new ways of designing in the airplane development routine.
Stability	Shielding	Artificial intelligence blocks influences that could change actions and relations.	Automation	• ‘Intel’ uses a highly automated production facility for their chip production. Here, it may be difficult for staff to observe and reflect on the actions carried out by the robots. The robots may not change their actions. • ‘Amazon’ uses a fully autonomous moving robot called ‘Proteus’ in their warehouses. While the robot adapts its course to the situation, it does not change the action pattern of the routine. • Customer recommendation mechanisms at ‘Netflix’ are constantly improved towards the individual needs of customers. As the AI improves in the course of the viewing experiences, human intervention is not necessary. However, how these recommendations are created remains unclear for users and regular employees.
	Adhering	Artificial intelligence prevents actors from deviating from established actions, due to sequential interdependence or escalating commitment.	Augmentation	• In the ‘BMW i3’ assembly in Leipzig, a robot works directly with the employees on the assembly line. The robot is applying the adhesive to the windshield before the human employee overtakes. Due to the close interaction, the human actor needs to adhere to the action pattern. • An Austrian restaurant uses robots to serve their customers. Due to the high investments in those robots, it may be difficult to change the actions of serving customers. • ‘Empolis’ provides digital twin solutions and an AI-based application to support service staff (e.g., who maintains wind turbines). First, various sensors provide data to a digital twin, which simulates performance issues and can generate optimization opportunities. Second, based on this information, the program provides technicians with information and guides them through a maintenance process. As the AI and program stores all information, the human technician needs to adhere to the instructions of the AI.

3. How artificial intelligence promotes change and stability in routines

To answer our research question, we apply a narrative-based theorizing style (Cornelissen, 2017) and develop a process model with a set of mechanisms that help to understand how artificial intelligence promotes change and stability of routines. Process theorizing focuses more broadly on the enabling conditions and processes allowing these mechanisms to emerge (Cornelissen et al., 2021). Thus, we analyzed automation and augmentation in the patterns of actions in various business examples, and we identified four mechanisms related to routines. Two of those mechanisms, which we label capacitating and reframing, reveal how the adoption of AI may enable change in organizational routines. Two further mechanisms, which we label shielding and adhering, explain how the adoption of AI may lead to the stability of organizational routines. We draw on different practical examples to illustrate those mechanisms, and we link each of these mechanisms to automation and augmentation. Table 1 summarizes the four mechanisms that we discuss.

3.1. Mechanisms of how artificial intelligence promotes change

The first mechanism that we identified is *capacitating*. By capacitating we mean that artificial intelligence enables new actions and relations that were not possible before or that previously required excessive resources. Put differently, artificial intelligence enables specific actions that are difficult to perform solely by humans. It is well known that technologies can enable new actions (Kiwan & Lazaric, 2019; Sergeeva et al., 2020) and lead to change or stability (Berente et al., 2016; Orlikowski, 1996; Pentland et al., 2022), but in the context of AI this is often related to breaking through the complexity generated by big data (O'Leary, 2013). According to Feldman (2000) actors can strive for change when outcomes fall short of ideals, such as efficiency. Here, AI can help to use resources more efficiently.

For instance, the 'German Research Center for Artificial Intelligence' has developed an algorithm that is able to detect and classify plastic waste in rivers in Asia (Wolf et al., 2020). The 'APLASTIC-Q – Machine learning algorithm' uses images gathered by drones, satellites or mobile phone cameras to identify larger amounts of plastics in rivers, and it can also classify the plastic. This innovation may change the plastic removal routine of local NGOs, as it may substitute actions of screening rivers manually for plastics and enable concerted removal initiatives at specific locales. Moreover, the results can be used to detect emitters of large amounts of plastics. Hence, regulatory routines may start to incorporate more targeted efforts to mitigate plastic pollution. Capacitating here relates to augmentation because the actions of the AI are directly related to human actions, and both are closely weaved together in practice.

In addition, artificial intelligence is increasingly used to automatically detect fraud. Financial fraud is very difficult to detect by humans, but algorithms can identify patterns of fraud (Ryman-Tubb et al., 2018). For example, 'HSBC' or 'Danske Bank' use an AI-based fraud detection algorithm. The AI monitors transactions, transaction locations and IP addresses. Therefore, cashless transaction routines may change to increasingly adopt actions of identifying, persecuting and reporting financial fraud. According to Wilson and Daugherty (2018) "the fight against financial fraud is like an arms race" because better detection leads to more creative ways of fraud possibilities by criminals. Hence, AI models need constant updating. Moreover, different countries require different models adjusted to the regional requirements. Therefore, many data analysts and IT professionals are needed to be one step ahead. As the actions of detecting fraud can be performed solely by the machine and are not immediately reflected on by human actions, this example is representative of automation.

The second mechanism of how AI adoption can lead to routine change is *reframing*. By reframing we mean that artificial intelligence helps actors to revise their previously held conceptions about the pattern of actions of a routine, which helps them see it in a new way. Routine Dynamics research has also shown how actors may start to see their routine in new ways (Cohendet & Simon, 2016; Feldman, 2000; Rerup & Feldman, 2011). Dittrich and Seidl (2018), for example, show how actors started to consider new ends in their routines, which led them to change their actions. Research on organizational creativity has also shown how actors can reframe their ideas (Hargadon & Bechky, 2006), and it has been recognized that AI can contribute to innovation (Haefner et al., 2021). We apply this insight to the more specific context of patterns of actions. We suggest that reframing is related to augmentation, because it requires the interaction of actors and machines.

AI, for instance, is used in product design routines, such as the development of an armchair. ‘OpenAI’ allows for combining text and images to come up with potential solutions. In that case, information, such as the task of creating an armchair that looks like an avocado, must be provided. By combining text and images, ‘OpenAI’ can take two unrelated concepts and put them together in new ways that create an innovative product that is still functional (Heaven, 2021). Similarly, actors can provide ‘Autodesk’s Dreamcatcher’ AI with information such as weight requirements for a chair or price of materials. A designer can also add information about other preferred chairs. The AI then provides thousands of designs according to the pre-specified set of criteria. In a next step, the human designer can set further criteria and choose the chairs she likes or doesn’t like, so that the AI can rework the designs from the first round. Through this iterative process, the design routine changes drastically, but companies also need to change their purchasing routines, as they require new materials, which then leads to changes in production routines to actually build these new chairs (Wilson & Daugherty, 2018).

Another example shows how companies such as ‘BASF’ and ‘John Deere’ developed AI that helped farmers in the agriculture business to reframe their farming routines (Gerhardt 2023). In this example, the goal of implementing AI was to predict future crop yields based on data on weather and historical harvests. Throughout the process, however, AI helped to see the routine in different ways, providing real-time recommendations on how to increase productivity. AI advised which crops to plant, on which field to grow them, and how much nitrogen needs to be used in the soil. This example shows how augmentation enabled a novel approach to improve farming.

3.2. Mechanisms of how artificial intelligence promotes stability

We also suggest that the adoption of AI can promote stability through two different mechanisms. First, *shielding* means that artificial intelligence keeps away influences that could change actions and their relations. Hence, actors do not reflect on these actions and relations. It is well known that participants can shield the action patterns of routines to prevent changes (Bertels et al., 2016; Danner-Schröder & Geiger, 2016; Geiger et al., 2021). In that sense, “enacting standardization refers to activities to keep the workflow on track and to lock-step performances” (Danner-Schröder & Geiger, 2016, p. 652). We take this argument to a different context, as we argue that the AI (rather than humans) can shield actions. We suggest that shielding is related to automation, because specific actions and relations are kept away from actors’ immediate actions.

A practical example for shielding is the use of chatbots. A virtual chatbot called ‘Aida’ answers frequently asked questions based on historical data. In a bank, for instance, ‘Aida’ answers questions such as how to open an account. This chatbot is also able to analyze the tone of voice of callers to respond accordingly and to ask follow-up questions. This chatbot can handle around 70 percent of calls on its own, whereas the human actor in the background supports the other 30 percent. Since ‘Aida’ works most of the time independently, the human actor first of all does not know what the chatbot recommends to customers. Hence, it shields customer contacts from the human actors. Moreover, the human actor can work on other tasks, such as more complex customer concerns.

Furthermore, marketing tools such as ‘HubSpot’ enable the automated creation, management and execution of targeted and personalized marketing campaigns. Existing information is used to place appropriate content along the buying process. It may be difficult to identify how these suggestions are created, and the algorithm does not change its patterns of actions.

Second, we suggest that *adhering* is a mechanism of how AI promotes stability. Adhering means that AI prevents actors from deviating from established actions, due to sequential interdependence or escalating commitment. Routine Dynamics has shown that patterns of actions might be difficult to change due to interdependencies between routines or because of affordances when introducing new technologies (Aroles & McLean, 2016; Kremser & Schreyögg, 2016; Kremser & Sydow, 2022; Omidvar et al., 2023). We argue that this mechanism affects augmentation because it locks in the actions of humans.

The ride-sharing platform ‘Uber’, for instance, built its business around an AI core. Towards this end, algorithms do not only facilitate the matchmaking between those who seek a ride and those offering a ride. Instead, AI pervades almost all kinds of Uber-related activities (Rosenblat, 2018), even to the observation that Uber-drivers are managed by algorithms (Möhlmann & Henfridsson, 2019). When drivers log into their Uber-app they are monitored by the algorithm. The algorithm provides specific instructions for drivers on where to go, how to get there, and which rider to pick up. For drivers, it is impossible to perform their actions without relying on the app. Moreover, the algorithm penalizes drivers if they diverge from the instructions (e.g., they get less orders or may even be banned from the platform).

Along similar lines, Omidvar et al. (2023) report how 'Moody's rating algorithms' played a role in the financial crisis. Though the algorithm was slightly modified over time, and thus was assumed to be ever more sophisticated, actors did not question its underlying premises, but kept relying on it (i.e., escalating commitment). Due to sequential interdependence, analysts and the rating committee kept relying on the scenarios generated by the algorithm when they performed the credit rating routine. This lack of managerial reflection in practice accompanied by an increasing faith in the (allegedly) ever more sophisticated algorithm culminated in misinterpreting and failing to foresee the 2009 financial crisis.

3.3. Dynamic interplay of the mechanisms

As we focus on automation and augmentation as a duality, we can see that both applications refer to specific actions and relations in the action pattern of an organizational routine, rather than the routine as a whole. This approach is suitable because, in practice, different AI tools are blended, and there are rarely tasks that are only carried out through machines without any human intervention. Automation refers to specific actions and the relations between those actions that are carried out by machines. Augmentation, by contrast, refers to relations between actions carried out by machines and another action carried out by humans. Hence, our view suggests that there are 'zones' of automation and augmentation in the action pattern of a routine.

In the following, we use the example of the hiring routine to show the dynamic interplay of the four mechanisms reframing, capacitating, shielding, and adhering within and across the zones of automation and augmentation. Applying a process view along the hiring routine and its typical actions (Black & van Esch, 2020), we start with the outreach to potential applicants, going then through the screening and assessing of applicants, and finally coordination of accepting or rejecting applications.

Figure 1 illustrates the prototypical pattern of actions of the hiring routine. Actions that are carried out by humans are displayed as circles, while actions carried out by machines are displayed as squares. Several of those actions are labeled in the graph (black font). The green areas depict where change happens through capacitating or reframing, while the red areas signify stability through adhering or shielding. Moreover, Figure 1 includes the labels A to D, which we use as references in the following text.

Hiring aims at searching as broad as possible and as targeted as possible at the same time for filling the respective vacancies (Black & van Esch, 2020). Since digital job markets like 'Monster' or 'LinkedIn' emerged, and the cost of uploading applications decreased, the number of applications per advertised position has increased tremendously. Hence, it is becoming more and more difficult for organizations to work through the enormous amount of data to find and retain adequate employees. Towards this end, AI-enabled services support and advocate the hiring routine.

AI-enabled candidate sourcing algorithms like 'Pandologic' support the job listing. They help recruiters improve the wording of the requirements in the job posting and ensure balance between being informative but not scaring candidates off. Hence, these algorithms *capacitate* actions of crafting job postings, that many recruiters struggled with before the availability of such AI applications. Label A in Figure 1 illustrates the example of the capacitating mechanism applied in the hiring routine within the zone of augmentation.

Similarly, algorithms like 'ChatGPT' are increasingly assisting to set the right tone of appreciation in the communication with applicants. In these cases, AI may enable new actions and relations that were not possible before to *capacitate* actions (i.e., targeted, individualized and professional communication), so that the appropriate candidates are pre-selected for the job and are staying there longer with increasing retention rates in this process. Hence, AI augments and changes these actions of the hiring routine.

Other AI applications, such as 'Monster Talent Management' or 'Bamboo HR', can be used to detect employees that are searching for jobs, but have not applied for a position in the company at stake, yet. Using these AI tools may enable organizations to *reframe* their hiring routine, which was previously aimed at selecting solely those people that applied to job postings, to proactively approach people that have not yet applied. Hence, in this case, AI-enabled search and outreach fosters change in the pattern of actions of the hiring routine not only at the front end but potentially also leading to the change in other actions and relations. For example, when recruiting is extended geographically it might become more complicated to conduct personal interviews with each applicant. Hence, actors may start to adopt virtual formats, changing the routine. Label B in Figure 1 illustrates the example of the reframing mechanism applied in the hiring routine within a zone of augmentation.

Moving on to actions of screening applicants, AI enables instant reviewing and prioritizing large numbers of CVs. ‘Ideal’, a provider of AI-enabled screening tools, reports a significant drop in the time-to-hire from an average of 24 to 9 days. The automation of the process clearly represents an efficiency gain, while at the same time AI is *shielding* this part of the routine, since it blocks influences that could change actions and relations. When AI uses pre-selected filters, other elements such as recruiters’ gut feelings are discharged, potentially leading to stability of the hiring routine. Label C in Figure 1 illustrates the example of this shielding mechanism applied in the hiring routine within the zone of automation.

Applicants who passed screening are then evaluated in the assessment phase of the hiring routine. AI enabled tools and analytics like ‘HireVue’s’ video-recorded interviews may support the assessment. Aspects like keywords, body language, and tone are analyzed by ‘HireVue’ and a detailed list of candidates of best performers is automatically selected. Then, AI-powered background checking from ‘Checks’, ‘Intelligo’ or ‘GoodHire’ may be applied, where a software scans databases to verify the applicants’ details, such as criminal records, credit rating and references (Albert, 2019). When used in organizations, however, how and why AI selects the best candidates remains inaccessible to recruiters. Hence, these actions of assessing applicants may be *shielded* from the awareness of the participants of the hiring routine, for whom its inner operations remain a black box. AI-enabled automation shields for stability since it blocks influences that could change actions and relations while remaining opaque.

In the assessment phase, recruiters often use standardized tests or simulations. For example, candidates for internships at ‘Unilever’ spend about 20 minutes playing 12 neuroscience-based games on the ‘Pymetrics’ platform to test personality traits like ability to focus, memory, risk orientation, and their ability to read emotional versus contextual cues (Feloni, 2017). In an augmented process collaboratively developed with the HR experts at Unilever, the results are then measured against benchmarks of exceptional employees in different roles who also played the games. Here, we see mechanisms of *adhering*, since AI-enabled assessment prevents recruiters from deviating from established actions due to inter-dependency with the benchmarks. Recruiters are bound to stick to the suggested AI-enabled assessment. Thus, adhering stabilizes the hiring routine. Label D in Figure 1 illustrates the example of the adhering mechanism applied in the hiring routine within the zone of augmentation.

Successful candidates are typically invited for a personal interview and a company experience day, as in the case of ‘Unilever’. Here, they interact with people in a purely analogue format. Candidates get a feeling for the organization, its people and its culture and how they would fit and vice versa. Then, the process enters the final stage where it is important to create a positive and professional experience also for those applicants who are rejected, because they might be a good fit another time or for positive word-of-mouth comments, for example in the social media. Moreover, candidates who experienced the recruiting routine positively, are more likely to accept the offer in the end (Jarrahi, 2018).

AI-enabled chatbots are used to smoothen and improve the routine, covering the whole process from confirming the receipt to communicating the final decision. In this connection, chatbots can inform the applicants at any stage about where they are in the system and what are the next steps on a 24/7/365 basis. Chatbots may answer questions about the job, like salary range and education benefits, as well as possible start dates. The automated process in the final stage of the hiring routine, however, *shields* influences that could change actions and relations. Applicants’ questions or complaints that may not be anticipated by the chatbots will not be heard, and organizations might miss valuable feedback. Here, the stabilizing effect of shielding prevents the possibility of change. As we have seen along the hiring example, the mechanisms of capacitating, reframing, adhering, and shielding exist throughout the process, with changing and stabilizing effects on the hiring routine.

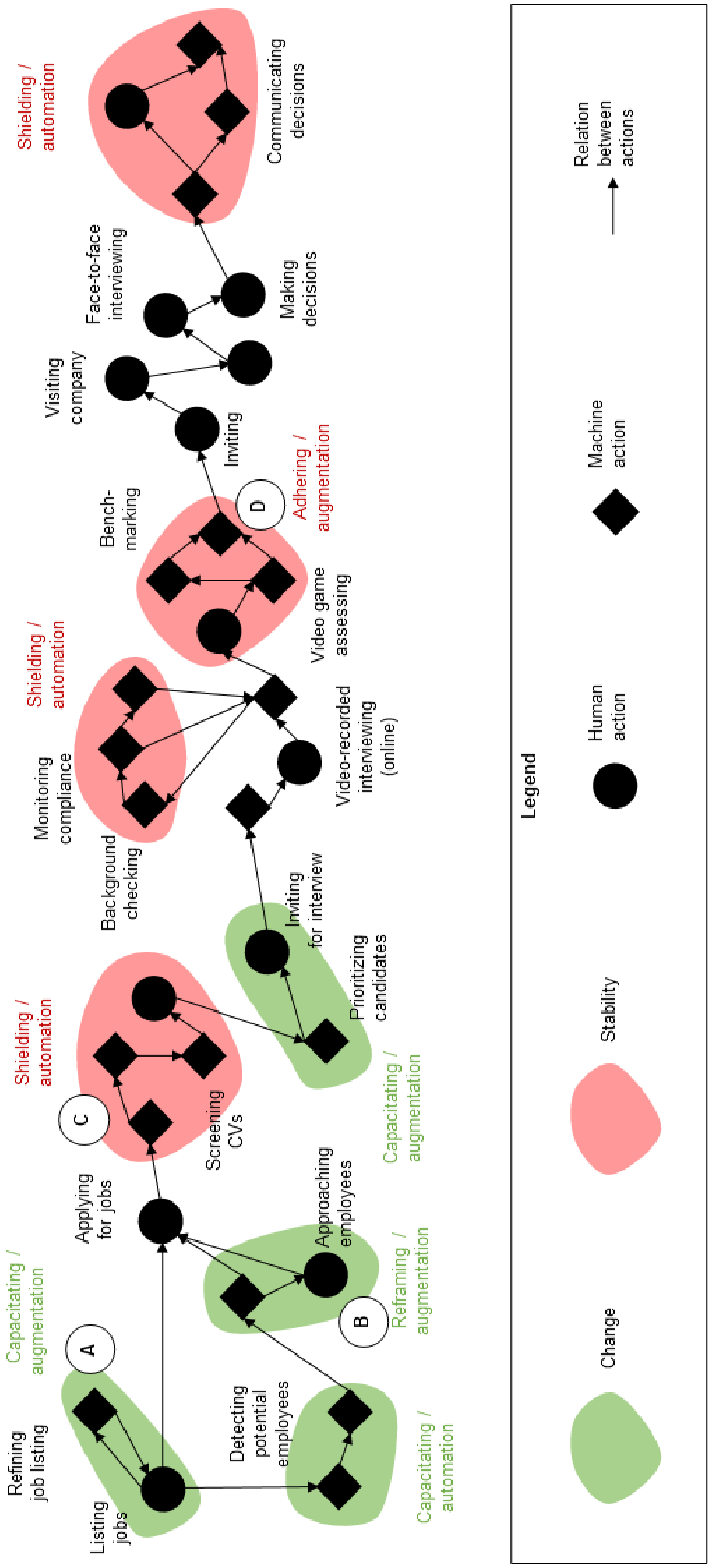

Figure 1: Automation and augmentation in the pattern of actions of the hiring routine

4. Discussion

In this article, we elucidate the relationship of artificial intelligence and organizational routines, and more specifically how routines remain stable or change through AI. We suggested that AI can promote change in routines through capacitating and reframing. We further argued that AI can promote the stability of organizational routines through two mechanisms, which we labeled shielding and adhering. Moreover, we proposed that automation and augmentation can occur in different parts of the pattern of actions of routines and over time, which we were able to see because we considered both applications as a duality. We next elaborate the implications of our arguments. More specifically, we argue that our conceptualization offers a more nuanced picture of automation and augmentation as a duality, and a better understanding of AI-based stability and change in routines.

4.1. Conceptualizing automation and augmentation as a duality

Research suggests that automation and augmentation are not distinct approaches but are interdependent in a sequential order. As Raisch and Krakowski (2021) argue, when AI is implemented into a routine, humans first train the AI, which refers to augmentation. If the AI works as intended, the very same routine is automated. Hence, humans are not involved in performing the routine. Later, when external conditions change, the routine is augmented again, which means that the human comes in (again) to revise the AI. Raisch and Krakowski (2021, p. 203) argue that “augmentation is the driver and outcome of automation, and the two dimensions of AI develop and fold into one another across space and time.” Even though this research reveals that automation and augmentation are sequentially interdependent, it rather focuses on ‘the routine’ as the unit of analysis. One particular routine is either automated or augmented, with the ultimate goal to automate the routine for as long as nothing changes. We extend this understanding in two important ways.

First, our theorizing develops a more nuanced picture of automation and augmentation of organizational routines. We argue that it is not a whole routine that is automated or augmented, but only specific actions and relations of the pattern of actions that characterizes a routine. Hence, there are different zones in the pattern of actions that are either automated or augmented. When actors enact the capacitating mechanism, for instance, new actions and relations are created. But in the very same routine, other actions and relations may remain rather stable, hence shielding any change from this part of the pattern of actions. Hence, we agree with Raisch and Krakowski (2021) that automation and augmentation form a duality rather than a dualism (Farjoun, 2010), but we argue that the duality is not only a matter of sequentially shifting between automation and augmentation over time, but that zones of automation and augmentation can exist simultaneously in one particular routine.

Hence, we advance the duality argument by revealing that automation and augmentation are mutually interdependent, but not in the sense of iterating between prolonged phases of training and execution. As our example of the hiring routine shows, the first part of the routine may be automated (e.g., screening and prioritizing the incoming applications) before the next part is augmented (e.g., assessing candidates with video games and measuring them against benchmarks). Hence, our approach indicates that augmentation is not only the driver and outcome of automation (Raisch & Krakowski, 2021), but the two applications mutually constitute each other. Screening and prioritizing influence the assessing, and the assessing provides input for the next round of screening and prioritizing of applications. Hence, the interdependent enactment of the two dimensions within one routine allows for the enactment of the routine.

Second, if we take the duality of automation and augmentation seriously, we also need to take the collaboration of human and machine actors more seriously. Davenport and Kirby (2016) consider augmentation as defining new tasks for humans that are unrelated to machines’ actions, such as stepping up above automated systems or stepping aside to tasks that computers are not good at. At the core of the idea of augmentation, however, is that “humans collaborate closely with machines to perform a task” (Raisch & Krakowski, 2021, p. 193), and are not forced to find new jobs and tasks because the old ones no longer exist. To fully understand augmentation at its core, we need to embrace the close interdependent interaction of humans and machines.

Our approach, which considers the duality of automation and augmentation within different actions of one routine, is helpful as it shows how humans and machines work hand in hand, instead of above, beneath, or next to each other. Stepping up, for example, means finding tasks for humans that are superior to the tasks of AI, thus, indicating that humans and AI enact different tasks or, in our words, different routines. Following our argument, however, those are not different tasks or routines. It is the very same routine, only different parts of it. Therefore, humans and AI work inter-dependently on the same task by enacting the same routine. This is in line with Routine Dynamics scholars, who suggest that actions within a routine are based on performative reflections (i.e., they provide a situation-specific context for each other) while actions across routines are based on pre-established expectations (Geiger et al., 2021; Kremser & Schreyögg, 2016). If actions are reflective of each other, thus, we should also consider them belonging to the same routine.

Davenport and Kirby (2016) exemplify stepping up with the task of discovering a new drug. In their example, the AI is responsible for one task, i.e., searching patterns that suggest that certain molecules could be effective in fighting cancer. Humans, by contrast, perform a different task, i.e., investigating the viability of molecules. Interpreting this example through our lens indicates that it is the same routine of discovering drugs, in which the first actions are enacted autonomously by the AI, but only through this first step the second part of the routine can be enacted by a human testing the viability. When the AI provides implausible suggestions, for instance, humans directly react to these actions, which shows the reflective nature of these actions. Therefore, drug discovery can be seen as one routine because humans directly react to actions of the AI (e.g., which options it generates), and it may also include iterations between those actions. Accordingly, these actions constitute each other.

4.2. Explaining the role of artificial intelligence for routine change and stability

A central insight of Routine Dynamics research is that routines can both account for change and stability (Feldman, 2000; Feldman & Pentland, 2003; Pentland et al., 2020). It has also been observed that artifacts, and actants (including non-human actors such as algorithms) play a key role in generating change and stability (D'Adderio, 2011, 2014; Danner-Schröder & Geiger, 2016; Sele & Grand, 2016). We advance those insights by assessing them in the more specific context of artificial intelligence. In this domain, AI can contribute to routine change because it capacitates actions that were not possible before or reframes patterns of actions to enable a new way of seeing routines. On the other hand, we suggest that AI contributes to the stability of repetitive patterns of actions because it can shield actions from the attention of actors, and it can lead actors to adhere to specific actions. Our work addresses ideas being put forward by Omidvar et al. (2023) who showed how the artificial intelligence at Moody’s created stability by emphasizing that AI can also lead to change. Moreover, our work relates to Pentland et al. (2022) who suggested that technologies can lead to different outcomes ranging from extreme stability to transformation, by showing how artificial intelligence, as a specific kind of technology, can produce such dynamics.

Our work links automation and augmentation, two key dimensions of AI, to change and stability of routines. We argue that both automation and augmentation can lead to change in routines. Moreover, automation can contribute to stability via shielding, while augmentation can contribute to stability via adhering. While it may be tempting, thus, to assume that automation is the primary cause of routine stability, we suggest that augmentation can also lead to stability. Here, AI may trap humans into escalating cascades of commitment, potentially causing harmful effects. These insights offer a more nuanced picture of how artificial intelligence promotes change and stability in routines, and organizations.

We also suggested that change and stability can occur simultaneously, for instance, when some actions in routines are kept stable and others change. Considering automation and augmentation as a duality helped us to see this aspect. This argument should sensitize scholars to consider that the unit of analysis is not the routine as an entity, but the pattern of actions (Pentland & Feldman, 2007; Pentland et al., 2020; Pentland et al., 2022). This way, we can move beyond a focus on routines as entities that are either stable or changing, and examine how both dynamics can happen simultaneously. For instance, scholars could use our approach in their empirical work by creating narrative networks for different windows in time, in which they mark zones of automation and augmentation. This may help to understand how AI shapes routines over time in greater depth.

Elaborating on the relationship of AI with change and stability in routines is an important endeavor because change is often seen as a prerequisite for organizational survival and prospering (Mahringer & Renzl, 2018; Renzl et al., 2021; Wenzel et al., 2021). We assume that the rise of AI may even increase turbulence in the corporate environment through the emergence of new business models and markets, which creates additional challenges for firms. A deep understanding of how the use of AI may lead to change and stability can then be used to support the former and prevent the latter. For instance, it may be possible to sensitize people to the adhering effect of AI, and enact practices to prevent AI from shielding certain actions (e.g., annual reviews of routines).

While we have started to conceptualize the relationship of AI and change or stability, there are many questions that future research could examine: how do the four mechanisms that we identified play together simultaneously and over time? What may cause switches between those mechanisms in specific actions? Which characteristics of AI facilitate or impede these characteristics? How do varying zones of automation and augmentation influence the dynamics of a routine? How do different kinds of routines influence these dynamics? Does it make a difference whether zones of automation and augmentation are situated in downstream or upstream parts of the pattern of actions of a routine?

A boundary condition of our elaboration is that we have drawn on the current state of the art of AI, which reflect a rather evolutionary form of change. In the future, more radical forms of change could be possible, suggesting questions such as: Why does AI not completely destruct and replace the existing routine with something never-seen-before? For example, one might consider whether HR selection should be completely performed by AI without having any individual looking at the candidates or influencing the routine in any kind of way. Answering these questions is important to generate a comprehensive understanding of the effect of artificial intelligence on the change and stability of organizations.

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