

Business Process Conceptualizations and the Flexibility-Support Tradeoff

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Abstract

Purpose – Many organizations struggle to achieve their desired levels of business process flexibility and support. However, these two capabilities conflict with each other and different tradeoffs have to be made. In this paper, we analyze different process conceptualizations and discuss their implications. We argue that the conceptualizations we adopt to think (conceptualize) about business processes affect the way we model them, which in turn result in different flexibility-support tradeoffs.

Design/methodology/approach – A set of properties is proposed to compare process conceptualizations: dominant concept, contract, and existential and representational properties. Using these properties, several process conceptualizations are analyzed and integrated in a comparison chart, which highlights different flexibility-support tradeoffs. The storytelling method is adopted to support the analytic process.

Findings – We show how different process conceptualizations result in different flexibility-support tradeoffs. We suggest that we need to intervene on a set of properties of process conceptualizations to achieve different flexibility-support tradeoffs.

Research implications – This research contributes to understanding the relationships between process conceptualizations, process modeling, and the flexibility-support tradeoff. A comparison chart helps organizations analyze their desired levels of flexibility and support using a set of properties.

Originality – The extent of covered viewpoints makes this study unique in the process management field. Such effort provides a contribution towards a more multidisciplinary discussion of process models, which integrates different process conceptualizations.

Keywords Business Process Management; Process Conceptualizations; Process Modeling; Process Flexibility; Process Support

Paper type Conceptual paper

1 Introduction

Modern organizations operate in a fast-changing world characterized by disrupting events of varying degrees of seriousness, from the mundane (e.g., operational faults) to the extreme (e.g., earthquakes) (Röglinger *et al.*, 2022). Organizations require the capability to respond to these events at the operational level, this is often described as *process flexibility* (Cognini *et al.*, 2018). At the same time, organizations also need IT to help them manage their business processes (Vom Brocke, Van der Aalst, *et al.*, 2021). The use of IT in addressing these needs is often described as *process support* (Van der Aalst, 2013). For brevity, we use the term 'support' in the rest of this paper to denote the IT structures and systems that encapsulate process logic.

Van der Aalst *et al.* (2005) use a metaphor to highlight that a surgeon in the operating room needs both process flexibility and support: the surgeon needs supporting structures to operate; but the actual support depends on the situation and may change when facing life-threatening events. Most modern organizations face this challenge. Without support to everyday processes, it is difficult to effectively function as an organization; and without flexibility, it is difficult for the organization to operate successfully.

However, a problem with process flexibility and support is that these two desirable capabilities conflict with each other (Van Der Aalst *et al.*, 2009). For instance, using the operating room metaphor, the surgeon may face situations where excessive support, e.g., rigorous rules and procedures, may result in lack of flexibility. Conversely, the surgeon may also face situations where the lack of information, protocols and standard procedures may dramatically affect action, decision making and co-operation. For many organizations, increasing support decreases flexibility and vice versa. This happens because support requires some things about

the process to be predefined (modeled), while flexibility requires some things to be left open. Therefore, different tradeoffs have to be made, which leads to the *flexibility-support tradeoff*.

In this conceptual paper, we argue that *the conceptualizations we adopt to think (conceptualize) about business processes affect the way we model them, which in turn result in different flexibility-support tradeoffs*. We justify our argument by analyzing the flexibility-support tradeoff and related problems in three logical steps:

1) First, we define an ontology with a set of properties of process conceptualization, which defines a foundation for comparing process conceptualizations;

2) Using the ontology, we analyze several process conceptualizations identified in the literature and discuss how their properties lead towards different modeling approaches and cause different flexibility-support tradeoffs; and

3) We finally develop a comparison chart, which explains the relationships between process conceptualizations, process modeling, and the flexibility-support tradeoff.

Because of the extent of process conceptualizations considered, this study is unique in the process management field. The study provides both conceptual and practical contributions. At the conceptual level, it contributes towards a more multidisciplinary discussion of business processes integrating different conceptualizations; and provides conceptual scaffolding necessary to explore new hybrid approaches to the flexibility-support tradeoff. At the practical level, it helps organizations analyze their desired levels of flexibility and support using a set of properties and a comparison chart.

The rest of this paper is organized as follows. We first give some background information about this research. Next, we introduce the analytic method and example we use in our study. We adopt the process storytelling method and use an example model and associated stories to discuss different process conceptualizations and implications on the flexibility-support tradeoff. We then propose an ontology with a set of properties, which can be used to compare process conceptualizations. Following that preliminary work, we analyze six different process conceptualizations. Each conceptualization is discussed using our example. We use storytelling to show how different conceptualizations cause different flexibility-support tradeoffs. We then synthesize the discussion in a comparison chart. Finally, we present some discussion points and conclusions.

2 Research Background

The tensions between achieving desired levels of process flexibility and providing appropriate levels of support are well-recognized in the process research community. Process support involves *backing business processes with IT*, which may include different approaches such as analysis, modeling and guidance (Van Der Aalst *et al.*, 2009). Process flexibility is the ability to *efficiently deal with changes and evolving needs and constraints of the process execution environment* (Reichert, 2018). The flexibility-support tradeoff denotes that the desire to support the consistent and effective execution of a business process and the desire to not constrain its execution can conflict with each other (Van Der Aalst *et al.*, 2009).

In contemporary organizations, processes are often embedded in IT. Therefore, process flexibility and support are contingent on the specific characteristics of IT systems, which can vary in a continuum between unstructured and structured. A highly unstructured system is expected to provide high process flexibility but low support, and a highly structured system is expected to provide high process support but low flexibility. In between these two extremes, the actors involved in the process may find varying degrees of flexibility and support.

2.1 Prior research on the flexibility-support tradeoff

There have been previous studies discussing the tensions between process flexibility and support from a technical viewpoint. For instance, Van der Aalst *et al.* (2009) suggest moving away from the traditional ‘imperative’ approach and instead adopt a ‘declarative’ approach. The imperative approach provides a precise definition of tasks and control-flows necessary to execute the process, while the declarative approach defines what conditions and constraints must be fulfilled to achieve the business goals, without prescribing how it should be done (Goedertier *et al.*, 2015). The declarative approach is considered to provide a better flexibility-support tradeoff than the imperative approach (Van Der Aalst *et al.*, 2009).

IT solutions have also been proposed to attenuate the constraints imposed by IT systems on process flexibility (while maintaining support). For instance, common solutions involve allowing actors executing the process to make ad hoc changes, promoting flexibility-by-design, varying the granularity at which processes are modeled, and enabling blank sections in process models, so that actors may decide later what to do (Cognini *et al.*, 2018; Reichert, 2018; Reichert and Weber, 2012).

At a more sociotechnical level, previous studies have focused on the context dimension of process, organization and environment (Vom Brocke, Baier, *et al.*, 2021; Vom Brocke *et al.*, 2016), and tensions between process modeling and organizational flexibility (Albuquerque and Christ, 2015; Beverungen, 2014).

Other tradeoff studies in business process management (e.g., Antunes, 2011; Auer *et al.*, 2014; Heckmann and Maedche, 2018) do not address the specific tradeoffs between process support and flexibility.

None of these previous studies offer an integrated view, provide the range of conceptual options we are seeking, and allow processes to be conceptualized in such a way as to allow the potential for organizations to consider different flexibility-support tradeoffs. Our focus on a wide variety of process conceptualizations, and consideration for a variety of flexibility-support tradeoffs, are the distinctive aspects of our study.

3 Research Approach

3.1 Storytelling method

The foundation of knowledge about business processes is the individual and shared understandings of organizational actors. We use process stories as a vehicle for tapping into this knowledge, considering how different process conceptualizations can emphasize different aspects of knowledge within the process.

Storytelling has been advocated as an effective approach to process analysis (Antunes *et al.*, 2013, 2019; Haggège and Vernay, 2019; Simões *et al.*, 2018), because stories are simple and intuitive, can act as powerful communication tools, can express complex situations in simple ways, and are creative (Antunes *et al.*, 2019; Haggège and Vernay, 2019). Storytelling depends on practical good reason and argumentation to provide warrants for accepting arguments, instead of using inferential reasoning (Fisher, 1984). We build on this method and use process stories to analyze a range of process conceptualizations.

Storytelling about processes can help analyzing a range of situations. It can be used to analyze an individual narrative of a process (Figure 1a). This can be seen as one of the basic “raw ingredients” of process knowledge. Multiple narratives may be used to enhance and extend process knowledge, e.g., explaining cases and variations (Figure 1b). These “raw ingredients” can subsequently be combined to build generic process models. In this process, some of the details may be lost (Figure 1c). Individual stories can also be combined with each other to create a knowledge structure with multiple action possibilities. This aims to capture the multiple viewpoints and variations, which are typically missing from generic models (Figure 1d). Finally, the aggregate of process stories can also be used to analyze the organizational constraints of a process, identifying what should be done to achieve certain business goals but leaving space for variations (Figure 1e) (Goedertier *et al.*, 2015).

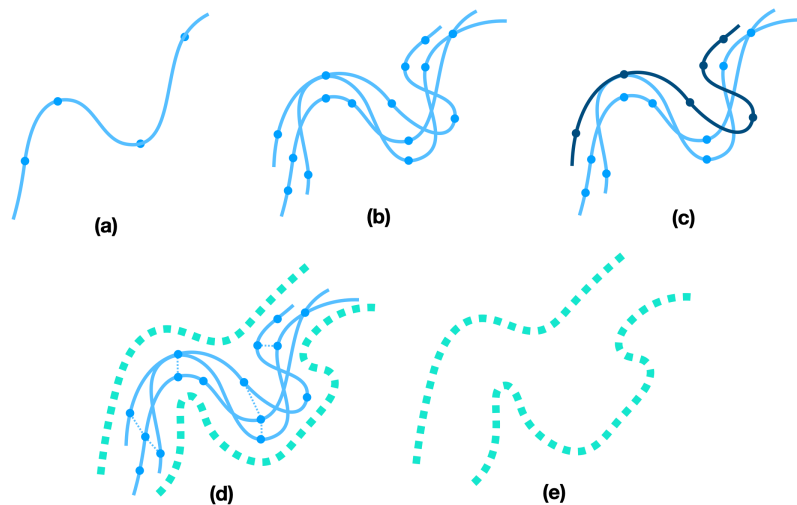


Figure 1 – Storytelling method can be used to: (a) individual narrative of a process; (b) multiple narratives with variations; (c) design generic process model; (d) provide knowledge structure with multiple action possibilities; and (e) characterize organizational constraints of a process.

3.2 Example

The example we use to argue about the flexibility-support tradeoff is the process used by a major tertiary institution for assessing the ethical implications and approving research projects before they are conducted. The ‘ethics application process’ was analyzed based on the existing online application system, support documents, and interviews with users.

The process model defined by the institution (‘example model’, for brevity) is shown in Figure 2. The applicant completes an online application form and submits it for review. If it is a student application, it must be approved by the supervisor, otherwise it is forwarded to the committee administrator. If it is anonymous research, it directly goes to the committee chair. If minor changes are required, the applicant makes them and returns the application back to the chair. If major changes are required, the process is restarted. If the research is not anonymous, it must be approved by the whole committee. The administrator sends it out to two reviewers who submit their recommendations to the chair. From there, the process continues in the same way.

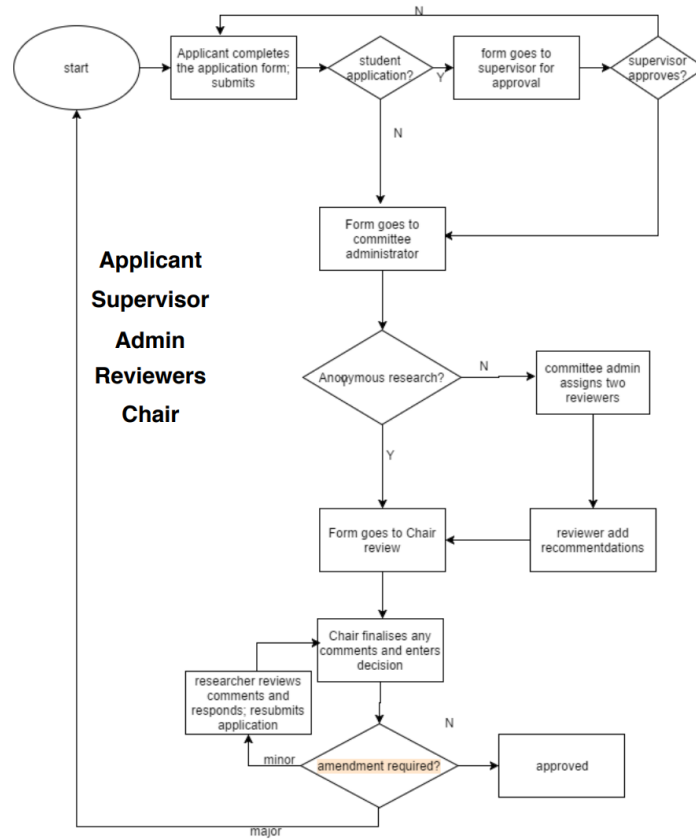


Figure 2 – Example model

We also collected twelve different individual process stories from various stakeholders, including regular applicants, student applicants and supervisors, the committee chair, the committee administrator, and reviewers. We use these stories to analyze and compare different process conceptualizations.

4 Ontology of Process Conceptualization

In order to compare different process conceptualizations, some basis for integrating and comparing different worldviews is required (Wickson *et al.*, 2006). We use and extend the properties proposed by Antunes *et al.* (2019) into the ontology shown in Figure 3.

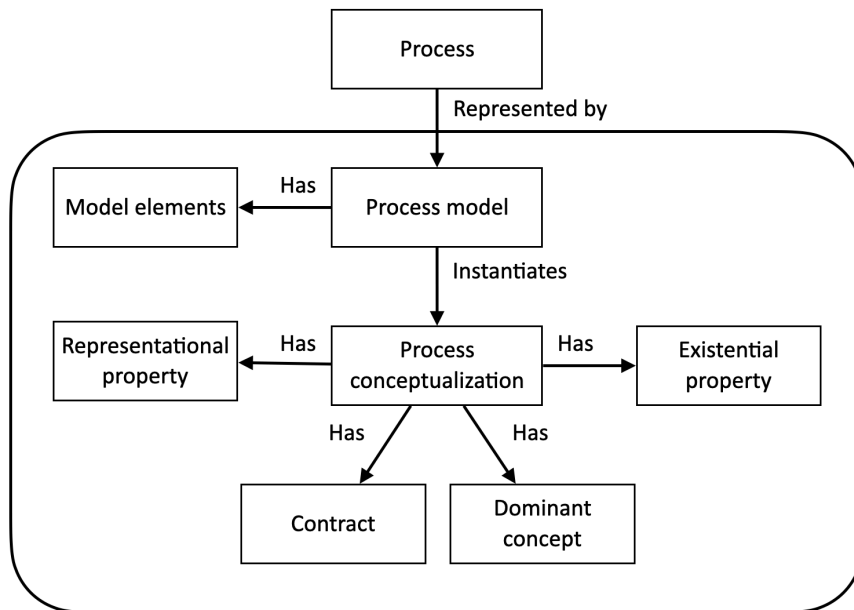


Figure 3 – Ontology of process conceptualization

A process is represented by a **process model**, which defines an abstraction of the world using a set of **model elements**. Common model elements include activities, events and precedence constraints (Van der Aalst, 2013). The process model instantiates a **process conceptualization**, which reflects the modeler's worldview of the world of processes (Sprinkle *et al.*, 2007). We identify four properties of process conceptualization.

An important property is the **dominant concept** (or centrality (Shahrah and Al-Mashari, 2021)). From an ontological standpoint, the dominant concept highlights the lens used to examine the world of processes (Langley *et al.*, 2013). For instance, many researchers regard the process as composed of tasks, therefore suggesting that the world of processes is built around an explicit account of what has to be done to realize business goals (Pedrinaci *et al.*, 2008). However, other dominant concepts may be adopted (Table 1).

Another property is the type of **contract** the conceptualization adheres to. This notion is borrowed from object-oriented software design, where contracts define the obligations and benefits of a specific software design (Meyer, 1992). Different types of contracts can be defined, which suggest different ways in which the world of processes benefits from process models. For instance, a common type of contract is control-flow, which stipulates the order of tasks in a process (Van der Aalst, 2013). Such ordering is essential to allow IT to manage, control and automate tasks (Ezekiel *et al.*, 2019). However, other types of contracts may be considered.

We also consider the **existential property** of the conceptualization, which captures the dependencies between process design and execution in the world of processes. Often researchers establish that process models prescribe the process execution (Pedrinaci *et al.*, 2008). Therefore, the model must exist *ex ante* the execution. However, other types of dependencies may be considered.

The **representational property** defines what a process model is intended to represent in the world of processes. A process model is often considered to represent a generic case, reducing undesired details and options to retain only essential knowledge (Polyvyanyy *et al.*, 2015). However, other possibilities may be considered.

Often in the business process literature, the term 'process' refers to a 'real process', which occurs in the real, contextualized world, while 'process model' refers to an artefact representing the generic aspects of a real process (e.g., Beverungen, 2014). We find these definitions equivocal, as process models can represent generic, specific, or collection of cases. The use of the existential and representational properties helps clarifying the terms.

5 Analysis of Process Conceptualizations

The ontology can now be used to discuss different process conceptualizations. These conceptualizations highlight different aspects of process models, which we summarize in Table 1 and discuss below.

Table 1: Summary of analyzed process conceptualizations

Conceptualization	Dominant concept	Contract	Existential property	Representational property
Imperative	Task (required business activities to reach a goal)	Control-flow (defined activities and flows are controlled during process execution)	Ex ante (model must exist before process execution)	Class (generic case)
Instance-based	Task	Task-flow (activities and flows are extracted from process execution)	Ex post (model is created after process execution)	Instance (particular case)
Declarative	Constraint (property or dependency between business activities in a process)	Declarative (constraints must be satisfied at the end of the process execution)	Ex ante	Class (generic constraints)
Actor-centric	Actor (involved business actor, which can be human or not)	Choreography (actors publicly commit to certain tasks)	Ex ante	Class (generic commitments)
Patterns of action	Action (anything that links actors in the process)	Patterns of action (actors are interconnected through recognizable patterns of action)	Ex post (past patterns of action) and ex ante (model influences action)	Network (of patterns of action, which retains 'history')
Process stories	Narrative element (any knowledge about the process, e.g., events, actors, tasks, decisions, and emotions)	Narrative (process execution is interpreted by the reader)	Ex post (past cases) and ex ante (model helps making decisions)	Collection (of stories, each describing a particular case)

5.1 Imperative

5.1.1 Overview

The notion of **task**, referring to some operations that have to be performed in a certain way, usually takes the center stage when discussing processes in a process management context (e.g., Vom Brocke and Mendling, 2018). This conceptualization adopts **control-flow** as contract. Control-flow confers business logic to the process, “gluing” the operations together from start to finish (Ezekiel *et al.*, 2019). Therefore, the model has an imperative (or prescriptive) nature (Goedertier *et al.*, 2015).

This conceptualization adopts an **ex ante** existential property: a model must exist before the process is executed (Pedrinaci *et al.*, 2008). The relevance of this property for the world of processes is obvious: in combination with control-flow, it enables management, control and automation of process execution (Van der Aalst, 2013).

This conceptualization adopts a **class** representational property. The term ‘class’ refers to a generic entity that represents a category of ‘things’ in a domain (Parsons and Wand, 2000). In the world of processes, class represents a generic set of operations. Even though the process execution in the real world depends on concrete aspects, they are left out of the model to focus on the core aspects of the business (Andaloussi *et al.*, 2020). This conceptualization is so dominant in the process management literature that is often left for the reader to infer that the model is defined ex-ante, represents a generic case, and defines a set of control-flow rules that determine the process execution (e.g., Zelt *et al.*, 2018).

5.1.2 Example

The example model in Figure 2 uses this conceptualization. We can see it focusses almost exclusively on tasks, and more specifically on administrative tasks required to obtain formal approval (e.g., ‘send to committee’). This has many implications regarding the flexibility-support tradeoff. It dissociates the ethics application process from the wider research process that it is part of; and it privileges administrative control. Important aspects of the process are not represented, including communication with supervisors, mentors and ethics advisors about how to design the research to minimize ethical risks.

This conceptualization elevates the importance of administrative control at the expense of the lived experience of the researcher and the complexity inherent in the practice of research. Applicants must improvise to get approval. This could be argued as providing flexibility for the applicants, but since they need to pass administrative control, their autonomy is limited.

5.2 Instance-based

5.2.1 Overview

It has long been recognized that modeled processes can and often have to be executed in different ways (Reichert and Weber, 2012). Every process execution involves specific settings, events and resources (Antunes and Mourão, 2011; Ploesser *et al.*, 2010). Therefore, individual cases have been of interest to the research community (Lukyanenko *et al.*, 2019).

This conceptualization adopts the **instance** representational property. We use the term ‘instance’ to refer to a specific ‘thing’ belonging to a class in a domain (Parsons and Wand, 2000). In the world of processes, instance models play a central role in explaining the specifics of process execution, which do not conform to prior generalizations (Lukyanenko *et al.*, 2019). This conceptualization adopts the **ex post** existential property because models represent completed process executions. The value of this conceptualization has been accentuated by research on process mining, which concerns discovering how real-life processes are de facto executed by extracting knowledge from event logs (Schönig *et al.*, 2015).

Like the imperative conceptualization, this conceptualization uses **task** as dominant concept. Regarding the contract, it concerns **task-flow**: the flow of activities performed in a case.

5.2.2 Example

Storytelling highlights the generic and opaque nature of the example model and how these characteristics impact the flexibility-support tradeoff. Stories show that failed applications are common but not modeled. The model allows for the application to be rejected initially and returned to the applicant for major amendments. However, it can happen that this occurs more than once before the application is finally approved. Greater attention to what happens with failed applications would point to the need for more support for researchers, so that required amendments do not block the conduct of research.

5.3 Declarative

5.3.1 Overview

The limitations of the imperative conceptualization have led to alternative propositions, of which the declarative conceptualization has attracted much interest (Goedertier *et al.*, 2015; Reijers *et al.*, 2013; Shahrah and Al-Mashari, 2017). This conceptualization defines a **declarative** contract: everything is allowed unless it is explicitly forbidden (De Giacomo *et al.*, 2015). The dominant concept becomes the **constraint**: a property or dependency between business operations, which must be satisfied at the end of the process execution, but that may be violated during execution (Reijers *et al.*, 2013).

This type of contract can assist in a better flexibility-support tradeoff (Van Der Aalst *et al.*, 2009). On the one hand, constraints give latitude to do things differently. On the other hand, the desire to control the process and avoid incorrect or undesirable outcomes is still supported. The extent of control depends on the constraints that are declared.

Since constraints must be declared before process execution, the existential property is **ex ante**. The model describes some generic aspects of the process, focusing on what may violate business rules, policies, and resource constraints (Goedertier *et al.*, 2015). Therefore, the representational property is **class**.

5.3.2 Example

While the example model shows the set of tasks and relationships required to gain approval from the ethics committee, it misses an essential aspect of the process, which concerns supplying adequate information about the research. Some stories are very insightful about specific information requirements, including details about data collection methods and responsibilities of researchers. Applications are often rejected for lack of such information. To compound the problem, stories show that the feedback provided about failed applications is often not understood by the applicants. The model also does not indicate that, in essence, the applicants only need to comply with two compulsory tasks, submit the proposal and gain approval from the ethics committee, as the other tasks are either informative or can be deviated by the applicant.

5.4 Actor-centric

5.4.1 Overview

The dominant concept can be changed from task to **actor**. To execute the process, actors need to collaborate with others and commit to realize what others ask them to do. Collaboration usually follows this protocol: the requesting actor defines “how much should be done”, and the requested actor defines “how little is accepted” (Meyer, 1992). This protocol requires actors to publicly commit to perform certain tasks but gives them flexibility to privately decide how they are done.

The actor-to-actor interactions have been characterized as **choreography** (Yongchareon *et al.*, 2015), which is a new type of contract. Choreography is very different from control-flow: while control-flow is explicit about what must be done, choreography makes certain aspects of tasks public and others private. This public/private separation is reflected in the representational property: it considers a **class** of public commitments; what is private is not represented. Considering the existential property, public commitments must be defined **ex ante**. What is privately done can only be fully understood retrospectively.

5.4.2 Example

The example model is centered on administrative controls and emphasizes the relationships between applicant, administrator, ethics committee, and supervisor (in case of student research). However, stories suggest the lived process includes a wider range of actors, such as external supervisors and external members of the research team. Furthermore, the lived process also involves a variety of interactions going beyond the model. For instance, student applicants often informally discussed with colleagues, supervisors, and even the head of the ethics committee to understand how to eliminate roadblocks. By not making such interactions explicit, the example model promotes failed applications and significant rework in the wider research process.

5.5 Patterns of action

5.5.1 Overview

This conceptualization concerns how actors and actions can be interconnected in many ways (forming a network) to achieve organizational goals (Pentland and Feldman, 2007)¹. **Action** is the dominant concept of this

¹ This conceptualization is part of organizational routines theory and is rooted in social theory (Feldman and Pentland, 2003). Organizational routines are necessary building blocks of processes, as organizations rely on

conceptualization. Action is anything that is performed by an actor (human or not) and that links to other actors and actions (Pentland and Hærem, 2015). Unlike tasks, actions do not (necessarily) have associated business goals (Wurm *et al.*, 2021). They essentially serve to connect the actors involved in the process.

The contract in this conceptualization is a social construct rather than a fixed set of rules. The contract is characterized by the **patterns of action** that emerge “in use” (Pentland and Feldman, 2007). Thus, the model is a dynamic social artifact, which reflects the collective understanding of the patterns of action enacted by the organization. Such model is immensely flexible: actors are free to change or create new patterns of action. The model is only bounded by collective agreement, since, beyond a certain point, the process could face insupportable social pressures (Pentland *et al.*, 2020).

Regarding the representational property, the model is a **network** of patterns of action, which is retained at an abstract level, as part of ‘history’ (Pentland *et al.*, 2012). The network does not correspond to the notions of class or instance. It is a more dynamic entity, which constantly evolves with new elements from continual process execution (Pentland and Feldman, 2007). Regarding the existential property, this conceptualization is mainly **ex post**, as the model retains the process history; but it is also **ex ante**, because the model provides structures that socially influence the conduct of work (Pentland and Hærem, 2015).

5.5.2 Example

Storytelling shows that applicants often experience the ethics application in opportunistic ways. For instance, sometimes the applicant has a chance encounter with the head of the ethics committee and discusses specific recommendations on how to apply or re-apply an application. In other stories, applicants search for and gain access to exemplars and modify their projects to increase compliance. In few stories, the head of the ethics committee takes the initiative to reach applicants to discuss the constraints of complex applications, which often must go through multiple rounds. Complex applications are seen as highly frustrating by all actors, and therefore the head of the ethics committee tries to provide guidance, a behavior that is not part of the model. The example model does not underline and support the diverse patterns of action reported in stories, instead promoting a limited, bureaucratic procedure.

5.6 Process stories

5.6.1 Overview

Storytelling is not just a means to elicit and analyze process knowledge, it can also be a vehicle for representing processes. Each individual story explains how actors undertake a set of actions in a specific context. A collection of stories defines how the organization creates and captures value and can therefore be regarded as a process model (Haggège and Vernay, 2019).

The **narrative element** is the dominant concept (Antunes *et al.*, 2019; Simões *et al.*, 2018). A narrative element is any identifiable piece of knowledge that is put into a narrative to describe the process. Examples include events, actors, tasks, decisions, settings, emotions, and attitudes. Stories can illustrate specific and generic cases. Stories can be considered singular units of analysis or can be analyzed together, to identify relationships between them (Antunes *et al.*, 2019).

The contract relies on **narrative**, i.e., the organization of story elements to convey the business logic. The reader is required to apply contextual knowledge and make decisions regarding the best course of action, as stories are not imperative, may be fragmented, and can even contradict themselves (Antunes *et al.*, 2019).

The representational property is a **collection** of stories, each describing a case. Regarding the existential property, this conceptualization is mainly **ex post**, as the model retains past stories; but it is also **ex ante**, as it helps tackling complexity, thinking about how to create value, and making decisions (Haggège and Vernay, 2019).

5.6.2 Example

Storytelling identifies several differences between the example model and what was experienced by the applicants. Two important differences relate to the scope of the process itself, and the nature of the applicants. Several stories extend beyond the model. For instance, one participant was required to obtain an account to use the university intranet (i.e., there were steps that needed to be taken before “starting” the application). Several first-time applicants received very negative feedback on their applications. Two issues were identified: 1) consideration of ethical issues needed to begin much earlier in the research design; and 2) applicants needed to be aware that ethical assessment might result in changes to their research design. Again, there are steps that need to be taken before the formal start of the process, and there are connections between the process and other processes that are not obvious (the model does not consider the research design).

routines to achieve their work processes (Feldman and Pentland, 2003). A full discussion of organizational routines is outside our scope.

Regarding the types of actors, the model only supports students, academic staff and supervisors. In practice, other actors exist, such as external supervisors and researchers. The stories suggest that a refinement to the model is required.

The process starts with a completed application submitted for review. However, stories suggest that the process needed to be more supportive and flexible in the early stages. Researchers need to consider ethical issues early on. The large number of rejections reported by novice researchers indicates that researchers should be able to work on a draft application and obtain early feedback on the ethical considerations.

Overall, the model is too isolated from the wider research process, and many aspects of research design are not represented. For instance, by limiting the actor types, the model is not only lacking support in its own right, but is limiting the flexibility of researchers to collaborate with external parties.

On the other hand, stories also make it difficult to identify the compulsory administrative controls. By extending the scope and adding a variety of elements to the narrative, the administrative controls are concealed in the narrative and do not stand out as critical for accomplishing the intended goals.

5.7 Summary table

In Table 2 we summarize the implications on the flexibility-support tradeoff raised from the analysis of our example using different process conceptualizations. Based on this table, we observe that each conceptualization raises different implications, which suggests taking a more integrative approach towards characterizing the flexibility-support tradeoff.

Table 2: Summary of implications from the example

Conceptualization	Model analysis	Implications on the flexibility-support tradeoff
Imperative	<ul style="list-style-type: none"> Model does not show links to important actors Model overlooks important aspects of the wider process Model centered on administrative controls Improvisation is often necessary to complete the process, but the administrative controls cannot be violated 	Both flexibility and support are constrained by focusing on specific tasks
Instance-based	<ul style="list-style-type: none"> Model is generic and opaque Model does not address what happens with failed applications 	Support is impaired by model opaqueness. Flexibility is possible but with low support, as improvised actions are undocumented
Declarative	<ul style="list-style-type: none"> Model has only few compulsory tasks; the other tasks can be deviated Model lacks clarity about which tasks can be deviated Model lacks critical information necessary to complete the process Model does not address failed applications 	Process support depends on a variety of information. Flexibility is possible, but the level of required compliance is unclear
Actor-centric	<ul style="list-style-type: none"> Model does not show important interactions Model has excessive focus on administrative actors Applicants live the process in a wider context not reflected in the model 	Flexibility involves a variety of actors and interactions. Support is compromised by block-boxing these interactions
Patterns of action	<ul style="list-style-type: none"> Model promotes a bureaucratic procedure Process is more opportunistic than what the model implies Actors develop strategies to increase the success of completing the process 	Opportunistic behavior is an essential aspect of flexibility. Support is impaired because successful behaviors are undocumented
Process stories	<ul style="list-style-type: none"> Model limits collaboration with other parties Scope is wider than suggested by the model Connections with the wider process are not obvious in the model Roles and actors are more varied than suggested by the model More feedback is required to avoid failure 	Flexibility has a wide scope and depends on a variety of related elements. Support depends on documenting a variety of experiences

6 Comparison Chart

We now position the process conceptualizations in a comparison chart, which uses the flexibility-support tradeoff to highlight major traits (Figure 4). We use the ontology of process conceptualization and our example to justify where to position the conceptualizations in the chart. We do not claim precise positions can be set. Positions should be understood as relative, highlighting some major traits of each conceptualization.

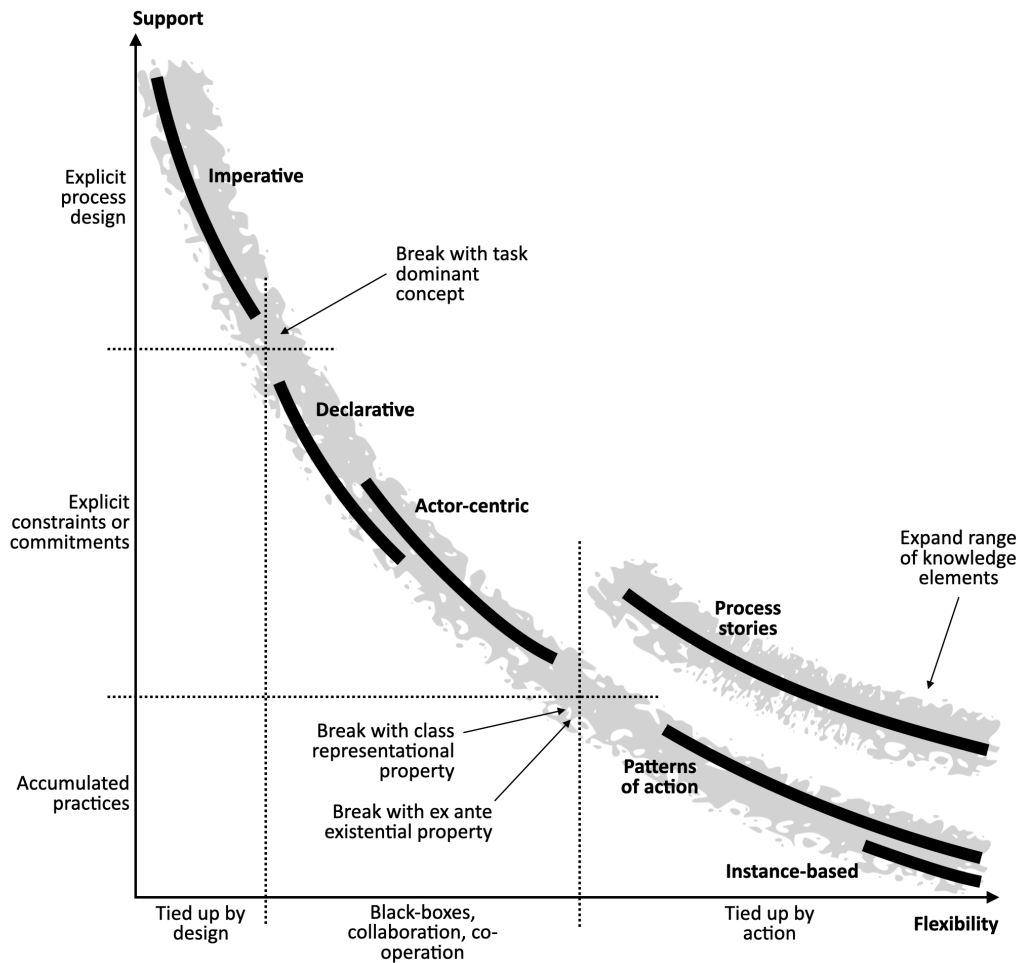


Figure 4 – Comparison chart of process conceptualizations

The imperative conceptualization offers ‘high’ support, as tasks are explicitly designed and controlled (Van der Aalst, 2013). Flexibility is ‘low’ because it is constrained by task dominance and control-flow. As illustrated by our example, a lot can happen with the process beyond tasks; and workarounds and ad hoc actions are often necessary to complete the process.

“Received wisdom” for increasing flexibility advises modelers to specify (Ezekiel *et al.*, 2019; Ploesser *et al.*, 2010; Reichert, 2018; Reichert and Weber, 2012). However, this strategy requires analyzing a wide range of possibilities, which over complicates modeling, and still may not be exhaustive. Furthermore, the strategy increases model complexity, which makes models more difficult to change and thus less flexible (Reichert, 2018). Another strategy is to decrease model granularity, leaving blank parts in the model (Schonenberg *et al.*, 2008; Van der Aalst, 2013). This is what happened in our example, where the model was defined around administrative tasks, thus ignoring the wider research process. However, this strategy makes process models less relevant and usable for organizations, as it takes knowledge out of the model. Informal rules and interactions were concealed by the model. If these were essential to realize the business goals, then the model was incomplete. Similarly, the focus on administration, rather than the needs of researchers, made the model less relevant. Finally, another strategy consists in violating the control-flow contract by allowing ad hoc interventions during the process execution (Reichert, 2018; Reichert and Weber, 2012). This strategy increases flexibility but dramatically decreases support, because ad hoc interventions are done outside the model.

These limitations suggest that, overall, the imperative conceptualization affords high support and low flexibility. Any increments in flexibility are accompanied by decreased support, as support is explicit by design.

In contrast to the imperative conceptualization, the instance-based conceptualization seems ultimately flexible. After all, a process model defined ex post always fits reality. For this reason, we place this conceptualization at the ‘high’ end of flexibility. However, instances are challenging for support. They provide fragmented views over business activities and deal with the specific rather than the generic. In our example, we had a story reporting the unique experience of an applicant external to the university. The story narrated the challenges dealing with a system that was not conceived for such type of applicant, which resulted in many improvised actions. Such actions were loose and unconventional. Operating this way makes it difficult to

promoting best practices and improving performance (Lukyanenko *et al.*, 2019). Therefore, the extreme flexibility brought by this conceptualization pushes support to the ‘low’ end.

The declarative conceptualization shifts the flexibility-support tradeoff away from the extremes towards the middle of the chart. Support is promoted because specific task dependencies can be defined using constraints. Flexibility is also promoted by constraints, as actions that do not violate the constraints are possible. Therefore, depending on the extent of defined constraints, modelers may confer more or less flexibility to the process, while conversely conferring more or less support. These decisions may involve an appreciation of process variability and autonomy and expertise of actors (Marin *et al.*, 2016). In our example, stories highlighted the need to retain control over a small set of compulsory tasks. However, just using constraints would provide weak support for understanding the wider relationships between the application process and the wider process.

Another way to move the flexibility-support tradeoff to the middle of the chart is to change the dominant concept from task to actor. This empowers actors to autonomously decide what to do when the operational context changes (Fleischmann *et al.*, 2012). In our example, after receiving a rejection, some applicants decided to contact other actors (colleagues, supervisors, and even the head of the committee) looking for help.

The actor-centric conceptualization also gives more freedom to collaborate. In our example, applicants external to the institution delegated the application to internal colleagues. Furthermore, commitments may be assigned to groups instead of individuals, which allows the process to become a co-operative endeavor (Fleischmann *et al.*, 2012). In our example, students and supervisors often co-operated as a team. Many aspects of co-operative performance (e.g., who is responsible for what) were invisible to the ethics committee.

A comparison between actor-centric and declarative conceptualizations is difficult because both offer a range of tradeoffs. As noted earlier, constraints can be more or less extensive. Similarly, actor-centric interactions and commitments can vary in granularity. Nevertheless, we suggest that the actor-centric conceptualization covers a range that potentially offers more flexibility and less support than the declarative conceptualization (Figure 4). The main reason is that the focus on actors (human or not) can more accurately represent the lived experience of many organizations, which often delegate autonomy and require collaboration and co-operation. In our example, there were collaborative and co-operative behaviors that were invisible but instrumental to move the process forward.

We now move to the patterns of action conceptualization. A fundamental impact on the flexibility-support tradeoff is the change in contract, which is socially constructed. This type of contract allows new actions and patterns of action to continuously emerge. Our example could be conceived this way, where new application patterns would emerge as new types of applicants and applications arise. Therefore, flexibility is more tied up to action than design, which justifies positioning this conceptualization in the ‘high’ range of flexibility.

We regard moving the existential property to a combination of *ex ante* and *ex post* as essential to reexamine support. Support comes from the continuous accumulation of knowledge about the process, where the model holds collective history. In our example, we found stories reporting practices and events not considered in the model, which enriched process history. However, this conceptualization may result in process models that accommodate an indistinctively large collection of variations, where every action sequence is possible. In our example, the process could end up with the head of the ethics committee collaborating in the applications instead of vetting them. The consequence is that patterns of action may end up offering less support than expected, which explains why we position this conceptualization in the ‘low’ range of support.

Moving to our last conceptualization, process stories, we position it in the ‘top’ range of flexibility (Figure 4). As with patterns of action, the contract based on narrative is socially constructed, as actors can interpret the situation and decide what to do next. The process is more tied up by action than design. However, we see the combination of narrative contract and collection representational property as potentially more supportive than the combination of patterns of action and network representational property. This is because the collection of process stories can define a more ‘visible’ context for exercising flexibility, highlighting which cases are relevant, and thus compelling actors to follow them. Furthermore, process stories let human actors analyze prior cases using diverse knowledge elements. In our example, the collection of stories characterized the process beyond the ethics application, to consider the broader scope of research, where ethical concerns do not pertain to an autonomous process, but instead are interwoven with the research itself. After all, the overarching goal is to ensure the ethics of the research. For these reasons, we position process stories in a new flexibility-support band, which indicates this conceptualization has some potential for increased support when compared to patterns of action (Figure 4). In particular, process stories can capture the often ‘invisible’ context of unique cases. For instance, the collection of stories in our example highlighted the frustration of applicants that repeatedly had their applications rejected; and identified strategies for coping with these situations, such as copying successful applications and asking the head of the ethics committee for help.

Taking a broad view over the comparison chart, we distinguish three clusters. One cluster promotes support over flexibility. This cluster has one single entry, the imperative conceptualization. Even though a variety of options exist in this conceptualization to increase flexibility, they are tied up by design. Another cluster is situated in the middle of the chart (declarative and actor-centric conceptualizations), thus offering a

better balance between flexibility and support. Reaching this cluster requires a break point: steering away from the task dominance. Interestingly, the conceptualizations in this cluster offer better flexibility-support tradeoffs and a wider range of options for balancing flexibility and support. The final cluster promotes flexibility over support (instance-based, patterns of action, and process stories). This cluster requires breaking away with class-based, ex ante models. These conceptualizations are tied up by action instead of design, and support is based on accumulated practice. We also find that process stories offer options to increase support while sustaining flexibility, which result from using a wide range of knowledge elements.

7 Discussion

Having discussed the implications of different process conceptualizations on the flexibility-support tradeoff, we now draw some theoretical and practical implications from the study.

7.1 Hybridization of process conceptualizations and impact on IT systems

From our analysis, it seems beyond dispute that a variety of conceptualizations affords more support-flexibility tradeoffs than a single one. By selecting a specific conceptualization, we constrain our understanding of the process, what type of process model we develop, and what flexibility-support tradeoffs we can achieve.

Therefore, we should think about processes in hybrid ways. We observe that such hybridization challenges the notion of task as the central concept of process conceptualization. This may be related to the consideration that tasks may not only be enablers, they may also be constrainters when modeling processes (Biazzo, 2000). Tasks bind process models to explicit and detailed business activities, while other dominant concepts leave space for a diversity of options. Therefore, we suggest that process conceptualization should be seen as an arena where tasks and other concepts (actors, constraints, patterns, stories) constantly fight for dominance.

In this arena, we observe interesting combinations of ex ante and ex post attributes. While the ex ante attribute facilitates the control and automation of process execution (Van der Aalst, 2013), the ex post attribute facilitates realism and change. The mixture of these features allows a diversity of choices between process modeling and execution. We also observe interesting combinations of class and instance attributes. Classes seem too constraining. Classes avoid dealing with a miscellany of cases but constrain them to a generic model. However, process models can emerge and morph over time shaped by instances (Weiss *et al.*, 2020). Finally, we also notice interesting alternatives to control-flow. The most challenging alternatives are patterns of action and process stories, as process executions essentially depend on social practices. Actors can deviate and interpret the process according to their own contexts and motivations.

In this arena, the flexibility-support tradeoff operates as a governance mechanism (Röglinger *et al.*, 2022), which helps dynamically aligning process concepts and attributes to the dynamic needs of the organization. As different tradeoffs are required by the organization, business processes should be dynamically reconfigured to embrace the most adequate conceptualizations. IT systems should be required to support hybrid conceptualizations and operate with the range of options and under the governance mechanisms suggested by our chart.

7.2 Impact of hybridization on process modeling

Most modelers will be aware that process models and the processes they represent can exist within a range of states: emerging, un-designing, re-designing, exploring, fading, diverging, converging, etc. Our approach and ontology provide the necessary conceptual scaffolding for accommodating different states, and different abstractions. At this stage, the main role of our analysis is identifying options and ranges. New modeling notations and processes are needed to support these conceptualizations.

7.3 Impact of hybridization on the business process discourse

Some discussions about process support and flexibility often highlight the “predominance of the technical aspects” (Klun and Trkman, 2018, p. 788). Opposed to this predominance, we also find a strong but siloed sociotechnical discourse (Grisold *et al.*, 2020). We regard these discourses as complementary. Our study interconnects the two discourses in the context of process science, which is particularly attentive to understanding and influencing change (Vom Brocke, Van der Aalst, *et al.*, 2021).

As noted above, we regard the flexibility-support tradeoff as a governance mechanism that interconnects the technical and sociotechnical discourses. An essential aspect of this discourse is the set of concepts and attributes brought by the ontology of process conceptualization. Based on this foundation, researchers may consider how to advance organizations and IT systems in order to understand the required tradeoffs, associated conditions, and sociotechnical options.

8 Conclusions

In this paper, we articulate three contributions. A major contribution is the analysis of a set of process conceptualization using an ontology with four properties: dominant concept, contract, and existential and representational properties. These properties help characterizing the main differences between conceptualizations. They can be used to integrate any future, new approaches, and may prove salient for other areas of process theory, for example, general systems theory.

Our second contribution is a detailed analysis of the flexibility-support tradeoff. We find it significant that, of the six conceptualizations, three increase flexibility by intervening on the existential property. Playing with this property, flexibility comes from retrofitting into the model what has happened with the process. Processes do not need to be fully modeled in advance, provided ex post insights can be captured and made part of the model.

Our final contribution is a chart aligning the different tradeoffs brought by each conceptualization. The chart is not intended to be definitive or complete; it essentially highlights the diversity of features and options available.

The extent of covered viewpoints makes this study unique in the process management field. It provides a contribution towards a more multidisciplinary discussion of business processes integrating different conceptualizations. We specifically avoided situating the discussion as the divide between the purely technical and the purely sociotechnical viewpoints. Instead, we focus on the intersections and interconnections.

This study also provides conceptual scaffolding necessary to explore new hybrid approaches to the flexibility-support tradeoff. The integration of classes and instances, ex ante and ex post representations, and various types of contracts, bring interesting possibilities for technological developments. We would like to see IT systems supporting multiple conceptualizations for the same process; and supporting dynamic changes regarding what conceptualization is adopted. We also suggest that, when processes fail, the realization of conceptual breakdowns may benefit awareness, mitigation and compensation.

We also see our study as a call for greater research attention to storytelling methods for codifying process knowledge. These methods offer many advantages. Process stories are easy to capture, can be crowdsourced and do not require modeling expertise (Antunes *et al.*, 2019). They can capture and retain rich process knowledge. Even if other process models end up being developed, the additional knowledge captured by process stories should be retained and made available, supporting process analysis and design. Process stories can also be used for diagnosing issues with existing processes.

This study has also some limitations. We do not claim that the list of selected conceptualizations provides a complete account of the phenomenon. Even though we cover a range of views, we recognize that other may also be relevant. We acknowledge the formal and economical domains were not sufficiently addressed by this study. We do not relate our chart with a detailed, systematic account of theories and methods developed in the literature in the scope of each conceptualization. We also do not relate the chart to concrete technical solutions to increase flexibility and support. Another limitation is that, even though the chart articulates a set of constructs relating process flexibility and support, it still lacks causal explanations.

Regarding future research avenues, we consider evaluating the extent the proposed chart reflects organizational strategies. The chart could also be adapted for practice to assess and map the organization's goals regarding the flexibility-support tradeoff, and to guide decisions as to which process conceptualizations should be adopted.

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