

PROCESS ANALYTICS, PROCESS ANALYTICS, AND WHY WE NEED (A THEORY OF) PROCESS SCIENCE

TREO Paper

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Abstract

Process Science (PS) aims to integrate diverse process-focused disciplines to address complex real-world problems. To facilitate the further development of PS, it is crucial to clarify its role as a field of research. This paper contributes to this discourse by extending a view of PS as infradisciplinary knowledge that provides the foundations for successful interdisciplinary analyses of procedural phenomena. From this view, a key task for PS is to develop methodological foundations that support the construction of shared terminology within PS projects, which may form the basis for a theory of PS.

Keywords: Process Science, Theory of Science, Interdisciplinary Research.

1 Why We Need Process Science

The inaugural editorial of the *Process Science* journal defines Process Science (PS) as “the interdisciplinary study of socio-technical processes over time” (vom Brocke et al., 2024, p. 5). This is quite precise about the object of PS but leaves ambiguity about its role. Contrasting the explicitly stated interdisciplinarity, the aim “to create knowledge that has instrumental value in solving real-world problems” (vom Brocke et al., 2024, p. 11) resembles that of a purposive-rational, technical discipline (Lorenzen, 1974; Lyytinen and Hirschheim, 1988), and “looking beyond single disciplines” (vom Brocke et al., 2024, p. 10) – taken literally – implies transdisciplinarity (Gethmann et al., 2015). These are not fundamental flaws of PS, but simply evidence that the nascent field of PS has not yet had the time to develop a mature methodology and identity.

Addressing this ambiguity and progressing the development of PS with respect to these fundamental concerns is crucial to improve its success and legitimacy as a field. First, a field identity is necessary to allow meaningful judgments about legitimacy (Lyytinen & King, 2006). Additionally, PS’s goal to solve real-world problems only supports its legitimacy if there is reasonable confidence that it can indeed be realized successfully (Lorenzen, 1974). As interdisciplinary projects are often highly complex and face a variety of challenges, this success is anything but guaranteed (Gethmann et al., 2015). While this should not surprise anyone with interdisciplinary experience, it emphasizes the need for strategies to address these challenges and support the success of interdisciplinary work (Lorenzen, 1974).

Potentially, this is a role that could be fulfilled by PS. From this view, PS would be understood as infradisciplinary knowledge (Lorenzen, 1974), i.e., as a general PS that provides the methodological

foundations for the special process-related disciplines, which thereby helps in forming the common ground for interdisciplinary inquiry into processes. Below, we exemplify why deeper inquiry into this view might be worthwhile to advance the discourse on the methodology, identity, and legitimacy of PS. We then consider the implications of this view for PS and potential avenues for future research.

2 Why We Need a Theory of Process Science

An elementary challenge of interdisciplinary work is the divergence of terminology, which can severely hamper success because it gives rise to misunderstandings (Lorenzen, 1974) and produces uncertainty about how to assess the validity of claims (Gethmann et al., 2015). We exemplify how this manifests in PS based on the experiences of the authors of this paper in planning and conducting interdisciplinary, process-focused work. We discussed a sample of fundamental PS terms from the perspective of three disciplines, i.e., (i) process mining, (ii) animal behavior research, and (iii) control engineering (Table 1). Despite using similar terms and often identical labels (e.g., “process analytics” for both process mining and control engineering) the meaning of even basic terminology differs substantially.

Term	Process Mining (BPM)	Animal Science (Ethology)	Control Engineering
Process	Activities executed collectively towards a common purpose	Sequence of behaviors, not necessarily oriented towards a complex purpose	Dynamical process with inputs, states, and outputs
Activity	Discrete steps of a process that take time to execute	Overall level/intensity of active behavior for one or more animals	<i>Not commonly used</i>
Behavior	Dependencies between activities, e.g., parallelism	Reaction of animals to internal and external stimulus	Changes in system in response to changes in the inputs or environment/faults
Event	Occurrences of things that are instantaneous	Occurrence of a specific behavior segment	Things that trigger drastic changes in system behavior

Table 1. Key terms of PS across process mining, ethology, and control engineering.

These divergences are more than mere inconveniences. Because of their severe impact on the success of interdisciplinary projects, their pervasiveness in PS practice emphasizes that language is a critical concern for PS. This includes questions about which “process languages” (vom Brocke et al., 2024, p. 4) are most appropriate to describe and explain a process. Crucially, however, this language-critical perspective extends to a much more fundamental level. Ultimately, the (methodological) conventions that regulate how the validity of claims is assessed are constituted by and through the use of highly specialized languages in each discipline (Gethmann et al., 2015). Since PS concerns interdisciplinary work, it cannot rely on the conventions (and terminology) of a single discipline to substantiate its results.

This also cannot be solved by a universal, standardized PS terminology. Due to the high diversity of methods and underlying assumptions across the many disciplines encompassed by PS (Brocke 2024, cf. Lyytinen & King 2006), any terminology that would be general enough to cover all related disciplines would be too unspecific to drive any substantive cooperation; and any terminology specific enough to be useful in application would inevitably conflict with disciplinary conventions. This raises the need to discursively negotiate the notion of validity for (almost) any unique project, an essential part of which is the construction of a shared terminology (Lorenzen, 1974). From the view of PS as infradisciplinary knowledge, this entails that providing methods and techniques to systematically construct a common language is a premier purpose for what we envision to become a theory of PS.

Crucially, this is not to say that language construction is the only concern for such a theory. Still, while there are many other challenges to address subsequently, securing language is initially the only meaningful concern, given that other challenges can be addressed successfully only after a common terminology has been sufficiently secured, as a common language is a necessary prerequisite to hold any discourse about the nature of other problems and the validity of claims at all.

3 How to Construct a Theory of Process Science

Finally, we evaluate the implications of this view for the methodological development of PS. Once again, this requires showing that we have the means to ensure a reasonable chance of success for this approach to benefit PS (Lorenzen, 1974). While the general argument presented above can be seen as first support for this, it is by no means a conclusive proof. Given the inherently pragmatic orientation of PS (vom Brocke et al., 2024), the proof for the viability and usefulness of this view lies in its application.

The theory of science developed within methodical constructivism appears promising for this purpose, as it aligns with a pragmatic orientation, adopts a language-critical stance, and mitigates the proliferation of conflicting terminologies by grounding abstract concepts in shared lifeworld practices and abilities (Hesse, 1980). There are well-developed procedures for the construction of terminology through stepwise abstraction from practical abilities (Janich, 2014; Kamlah & Lorenzen, 1974). Additionally, this can draw on an ample amount of work providing elementary terminology as a starting point for project-specific language construction, e.g., for logic (Kamlah & Lorenzen, 1974), action theory (Janich, 2014) or the concept of information (Janich, 2018) – which are directly relevant to PS.

This infradisciplinary view implies three tasks for future research: (i) identifying common frictions in existing interdisciplinary PS projects to understand which terminology needs securing, (ii) producing a first theory of PS by adapting techniques for methodical language construction, and (iii) iteratively testing and revising this theory. Going forward, we intend to test this approach in ongoing projects – for example, by systematically reconstructing the concept of ‘behavior’ to bridge the communicative gap between process mining and ethology. Furthermore, we invite the PS community to discuss not just what PS studies, but how it can first be made to speak a common language.

4 Acknowledgements

The project ProcessPig is funded by the European Union within the framework of the European Innovation Partnership (EIP-AGRI) and the state program rural areas of the state SH (LPLR).

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