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Towards Phenomenon-driven Design Science Research

Jun-Patrick Raabe
Universität Hamburg, jun-patrick.raabe@uni-hamburg.de

Bettina Horlach
Universität Hamburg, bettina.horlach@uni-hamburg.de

Andreas Drechsler
Victoria University of Wellington, andreas.drechsler@vuw.ac.nz

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Full research paper

Jun-Patrick Raabe
Department of Informatics
Universität Hamburg
Hamburg, Germany
Email: jun-patrick.raabe@uni-hamburg.de

Bettina Horlach
Department of Informatics
Universität Hamburg
Hamburg, Germany
Email: bettina.horlach@uni-hamburg.de

Andreas Drechsler
School of Information Management
Victoria University of Wellington
Wellington, New Zealand
Email: andreas.drechsler@vuw.ac.nz

Abstract

We propose a research approach that extends phenomenon-driven research – which is primarily aimed at producing descriptive and explanatory knowledge about novel phenomena – with a design-oriented focus. The resulting approach aims to develop not only explanatory knowledge about novel phenomena but also prescriptive knowledge about how to face corresponding novel challenges and does so in conjunction and in a mutually reinforcing way. We illustrate our approach with two examples to understand and produce design principles for the novel phenomena of organising the IT setups in Scaled Agile organisations and Digital Innovation Units, respectively. Researchers can draw on our approach to understand novel phenomena and simultaneously produce knowledge that is also relevant to practitioners facing novel practical challenges resulting from these novel phenomena.

Keywords phenomenon-driven research, design science research

1 Introduction

VUCA (Volatility, Uncertainty, Complexity, Ambiguity) is a commonly applied moniker to the current state of the world (Bennett and Lemoine 2014) to characterise the situation that 1) novel phenomena continuously and unpredictably appear in the world, and that consequently, 2) organisations and individuals face novel and complex challenges arising from these phenomena. These novel phenomena require further investigations to understand, explain, and predict them, contributing to descriptive and explanatory knowledge or Ω-knowledge. There is also the potential to develop subsequent prescriptive or Λ-knowledge on how to respond to or even prevent the corresponding novel challenges (Gregor and Hevner 2013; Seidel and Watson 2020). Moreover, as "most management practices create their own nemesis" (Clegg et al. 2002 p. 491), new ways of coping with challenges in a VUCA world may also constitute novel phenomena themselves, potentially creating a continuous circle of trading one set of practical challenges for another, all while creating novel organisational and technological phenomena.

Phenomenon-driven research (PDR) is a well-established research approach that focuses on understanding unexpected regularities that first challenges extant knowledge and theories, and only engages in theory-building afterward (Schwarz and Stensaker 2014). PDR eschews drawing on established theories at the start of the research, as theories may serve as blinders (Holmström and Truex 2011), which may prevent a true understanding of the novel phenomenon. Surprisingly, an explicit PDR perspective – despite having a long tradition in management research (Schwarz and Stensaker 2016) – can hardly be found in IS research papers, despite IS research papers often being concerned with either understanding novel phenomena in the digital space or – in case of design science research (DSR) papers – providing solutions or other prescriptive knowledge for coping with novel challenges.

However, traditional PDR's strong focus on merely understanding novel phenomena provides little guidance on how to integrate the production of prescriptive knowledge for related challenges in an extensive research programme on a particular novel phenomenon in a VUCA world. In contrast, extant DSR literature often assumes knowledge about particular real-world challenges and underlying phenomena to start a DSR process. To address these two shortcomings, the need arises to integrate PDR and DSR into a coherent and encompassing integrated methodological approach.

To develop such an approach in this paper, we draw on extant methodological guidance in the IS DSR literature about utilising and producing both knowledge types in a mutually reinforcing way (Drechsler and Hevner 2018; Gregor and Hevner 2013; Seidel and Watson 2020). The resulting approach retains PDR's placement of novel phenomena at the centre of research interest but expands its sole focus on explanatory knowledge by integrating the production of prescriptive knowledge as one of two knowledge contribution paths. We also illustrate how this additional angle on the challenges accompanying novel phenomena can lead not only to initial solutions to those challenges but also to even deeper insights.

2 Foundations

We first introduce the two research approaches that we later integrate, PDR and DSR.

2.1 Phenomenon-driven Research

Phenomenon-based or phenomenon-driven research is a research approach dedicated to contribute new knowledge about novel organisational as well as managerial phenomena (Schwarz and Stensaker 2016). Unlike a traditional theory-driven research path, which primarily focuses on the development, implementation, evaluation, and analysis of theoretical models, PDR starts before that by distinguishing a phenomenon from other facts and occurrences (Von Krogh et al. 2012). Its main aim is to capture, describe, and document a phenomenon and to conceptualise it so that appropriate research design development and subsequent theory building can take place. PDR classifies a phenomenon within three phases based on the significance and state of prior research (Edmondson and McManus 2007; Von Krogh et al. 2012):

1. *Embryonic (nascent) phase*: Novel phenomena must be delineated from other already known phenomena within the scientific field. As (digital) technologies motivate abrupt changes, processes, structures, and even individuals in organisations and society are also changing to counteract these external influences. These changes might become themselves novel phenomena worth studying.
2. *Growth (emergent) phase*: As a phenomenon spreads and becomes noticeably accepted as a subject for study in a research community, the emerging features and concepts of a phenomenon are captured and compared to new and extant theories.

3. *Mature phase*: In a mature state, the research on a phenomenon reaches a level of consistency where the regularities found in the previous phases become predictable, which leads to a variety of characteristics revealing the richness of a volatile phenomenon.

Table 1 summarises the five PDR activities and their corresponding knowledge contribution. Note that we changed the name of the third step (originally just 'Design') to highlight that this step is about designing research approaches for studying a novel phenomenon more in-depth, and not about designing in the DSR sense. In a nutshell, PDR provides an approach to grasp a novel phenomenon by understanding the "regularit[y] that [is] unexpected, that challenge[s] existing knowledge (including the extant theory), and that [is] relevant to scientific discourse" (Von Krogh et al. 2012, p. 278) first and only proceeds to theorizing at a later stage (Schwarz and Stensaker 2014). Such a phenomenon-driven angle is useful, as theories may serve as blinders (Holmström and Truex 2011) preventing a true understanding of a phenomenon. In other words, focusing on theories first may "prevent the reporting of rich details about interesting phenomena for which no theory yet exists" (Hambrick 2007).

Activity	Description
1. Distinguish	• demarcate the phenomenon by emphasizing peculiarities and other distinctive characteristics • define a phenomenon in terms of what it is not • identify initial instances or types of the phenomenon
2. Explore	• intensify data-gathering (through primary and secondary data) within or outside the initial conceptualisations in order to further describe and explore the boundaries of the phenomenon • produce concepts that serve as filters in further data gathering
3. Design Research Approaches	• strive to answer broad questions like "What is the nature of the phenomenon?" or "How can this phenomenon best be researched?" by following alternate research approaches • report on the phenomenon by validating observations or improving/replacing prior concepts and provide unprecedented and opportunistic insights
4. Theorise	• compare and/or demarcate the phenomenon from extant theories in the research field • utilise extant theories and refine or contribute new theories
5. Synthesise	• review and synthesise existing studies and research designs • ponder whether and how the new refined or contributed knowledge on the phenomenon connects to the extant knowledge bases • begin generalising to and contrasting with extant organisation and management theories

Table 1. PDR activities (based on Schwarz and Stensaker 2016; Von Krogh et al. 2012)

Moreover, knowledge resulting from applying theory is often not helpful to practitioners, as it does not necessarily help them to make sense of the novel phenomena they encounter or even provide prescriptive knowledge on how to deal with the corresponding novel challenges they face. Here, PDR can provide a deeper understanding of the issues and thus aid practitioners' sensemaking. Simultaneously, PDR's extant focus on describing and explaining regularities does not address the need for solutions for the novel challenges associated with the novel phenomena. Such knowledge production falls traditionally into the DSR realm, which we are going to introduce next.

2.2 Design Science Research

In the past 20 years, DSR has evolved to become a central paradigm in IS research. In a nutshell, DSR's primary goal is to contribute prescriptive or Λ-knowledge about solutions to real-world problems – in the form of design artefacts with social and/or technical components – and corresponding solution-related design knowledge (e.g., design principles or features) to the human knowledge base (Drechsler and Hevner 2018; Gregor and Hevner 2013; Hevner et al. 2004; Vom Brocke et al. 2020).

The solution design is grounded in the human knowledge base containing descriptive and explanatory knowledge (Ω-knowledge). Ω-knowledge provides knowledge about the problem space and potential regularities that may comprise suitable means to bring forth the desired ends (= the goals for the solution). Extant Λ-knowledge is a second source for knowledge informing the solution design, providing means and artefacts that previously have been evaluated to be effective in different contexts. Design efforts can draw on extant Λ-knowledge but has to adapt (or project) the knowledge into the new

application context (Vom Brocke et al. 2020). Beyond Ω and Λ-knowledge, the design researchers' creativity, experience, and insights are further sources to inform the solution design.

Over the course of a DSR project, numerous contributions can be made to both knowledge bases (Ω and Λ) and the interplay between both knowledge types in the DSR process is a crucial factor in designing a solution that is not only fit-for-purpose but also advances both types of human knowledge about the context, the problem, and the solution spaces (Drechsler and Hevner 2018; Seidel and Watson 2020; Vom Brocke et al. 2020).

Thus, DSR requires and builds upon a solid understanding about the key phenomena in the problem space and key regularities associated with these phenomena (Hevner et al. 2019). However, common DSR literature often assumes that such knowledge already exists. If it does not, such knowledge gaps need to be identified and then filled first through explanatory-oriented research (Avdiji and Winter 2019). Moreover, DSR presupposes knowledge of particular problems and challenges. When facing novel phenomena, it is often unclear, however, what the nature of these problems and challenges actually is. It is at this intersection that we see a fruitful way of integrating DSR and PDR.

3 Phenomenon-driven Design Science Research

In this section, we first outline the crucial role of phenomenon-related knowledge in DSR and then propose an integration of PDR and DSR approaches for the purpose of producing explanatory (Ω) in conjunction with prescriptive (Λ) knowledge about novel phenomena and corresponding challenges.

3.1 Phenomenon-related knowledge as inputs for DSR

Commonly, DSR and related literature states that Ω-knowledge first provides the means to observe, describe, classify, catalogue, and conceptualise real-world phenomena (Gregor and Hevner 2013; Seidel and Watson 2020). This means in particular that novel phenomena need to be observed first, then defined and described, and also distinguished from other similar phenomena. There may also be different sub-types of a phenomenon to distinguish. Armed with terminology to describe and distinguish a phenomenon, explanatory research then can start investigating regularities in order to develop pre-theoretical knowledge and ultimately, fully fledged theories.

Design science researchers can then draw on such a body of descriptive and explanatory knowledge to describe the phenomena of their interest (i.e., the problem and context) and develop suitable prescriptions (e.g., design features, artefacts) to address the problem. However, the descriptive and prescriptive constructs they use have to be compatible and coherent so that there can ideally be full traceability from the underlying descriptions over the selected documented regularities up to the chosen means or prescriptions to address the problem in its context (Vom Brocke et al. 2020). In other words, without suitable and coherent bodies of descriptive, explanatory, and predictive knowledge (in form of pre-theoretical knowledge or fully developed theories) a DSR project would lack a necessary scientific foundation available in order to diagnose the problem further and ground the corresponding prescriptions that are to be developed.

3.2 Phenomenon-related knowledge as outputs from DSR

The role of phenomenon-related knowledge in DSR is not limited to inputs to the DSR process, however. Any DSR project – and any research project in general – can, and often does, generate Ω and Λ-knowledge about novel phenomena in conjunction (Gregor and Hevner 2013; Seidel and Watson 2020).

In a knowledge production perspective, a DSR project utilises a set of knowledge from Ω and Λ in order to contribute new, refined or refutations of knowledge back to Λ (as a primary objective – e.g., artefacts or other forms of design knowledge) and Ω (as a secondary objective – e.g., new insights about individual or organisational behavioural regularities) (Drechsler and Hevner 2018). In other words, even though addressing a real-world problem on a sufficient level of fitness-for-purpose (or utility) may be the primary goal of a DSR project, learning about behavioural regularities (e.g., extending or refuting existing theories or pre-theoretical Ω-knowledge) or even uncovering new challenges that need to be addressed subsequently may well happen alongside.

Since one can assume a positive relationship between the extent of the understanding of the phenomenon itself and the related challenge on the one hand and the effectiveness of the solution on the other hand, there is a high motivation especially in the early phases of a DSR project to emphasise understanding over design, in case there is scarce Ω-knowledge available. Simultaneously, the changes resulting from implementing or instantiating a design in a real-world context may provide a trigger to learn even more from the – perhaps unexpected – changed behaviour of the real-world context.

Moreover, designing for challenges related to novel phenomena may provide opportunities to further develop the conceptual or methodological foundations of DSR. Taken even further, the output of a DSR project itself (e.g., an artefact in form of a new technology or a new management approach) that addresses a real-world problem may constitute a novel phenomenon on its own where scant knowledge exists beyond the outcomes of the initial evaluation, thus warranting further investigations.

Consequently, a DSR project aiming to address a real-world problem directly related to a novel phenomenon may contribute to all forms of Ω and Λ-knowledge the literature distinguishes (Drechsler and Hevner 2018; Gregor and Hevner 2013): 1) *knowledge about the phenomenon* itself, its context, and related novel challenges, 2) *regularities* about the phenomenon (e.g., theories or pre-theoretical knowledge), 3) design knowledge about suitable *research designs*, 4) *design knowledge* to address (parts of) the problem (e.g., design principles or features), and 5) *design entities* such as artefacts to address the problem in its entirety. Thus, any integration between PDR and DSR has to take into account the dual role of phenomenon-related knowledge as inputs to as well as outputs of DSR.

3.3 Integrating Phenomenon-driven and Design Science Research

The previous sections made in-depth cases for the important role of phenomenon-related knowledge as inputs for and outputs of DSR processes. In this section, we propose a research approach that integrates DSR and PDR for the purpose of providing a unified view of knowledge utilisation and contribution over the course of a research process that starts with the initial observation of a novel phenomenon.

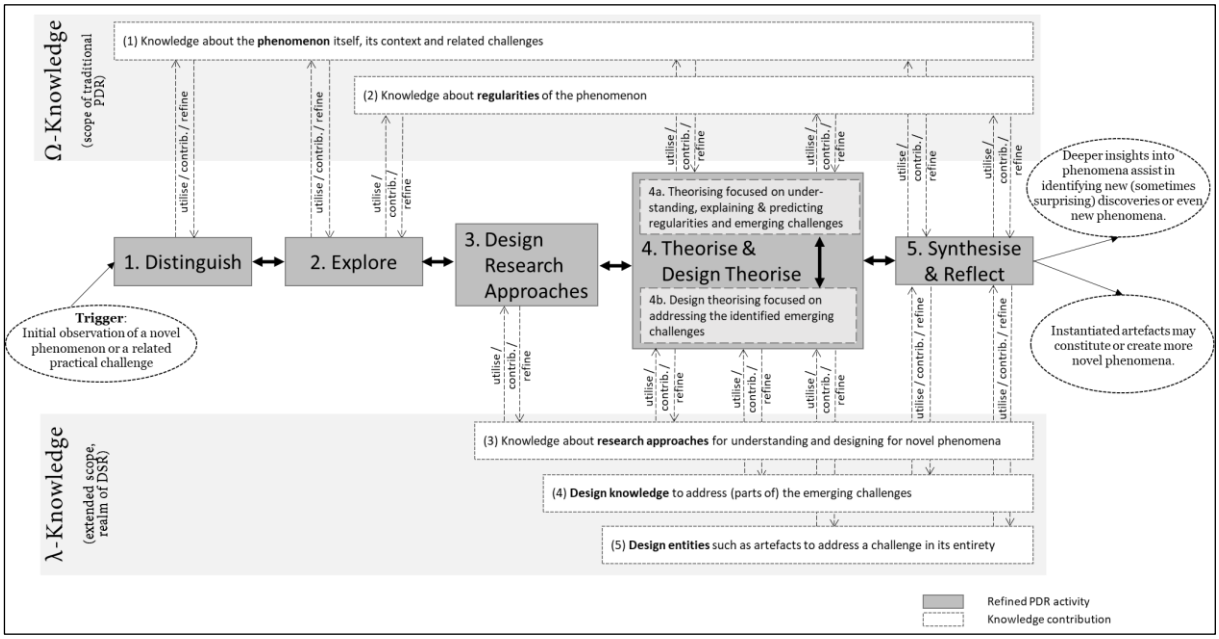

Figure 1: Integrating PDR activities with DSR knowledge types and contributions

Figure 1 contains the five enhanced activities of PDR (based on Table 1) as well as the five knowledge types a DSR project can draw on and contribute to (as summarised at the very end of the previous section). The activities are not to be understood as a waterfall-like procedure and should rather be seen as iterative blocks, as indicated by the two-sided arrows. In the following, we will introduce each activity and describe the utilised, contributed, or refined knowledge chunks (indicated by the dotted arrows) within each activity. The arrows towards each activity indicate when existing knowledge is *utilised* to produce further knowledge. The arrows towards the knowledge types indicate either a substantial novel knowledge *contribution* or a *refinement* (or refutation) of extant knowledge.

First, we extend the **initial trigger** of the PDR research process by adding a new trigger for the entire process in the form of the observation of novel practical challenges related to a novel phenomenon. The core of the "**1. Distinguish**" activity is unchanged from PDR as this phase still entails the need for differentiating a phenomenon's identity in its context from others as well as demarcating the phenomena by emphasizing peculiarities or defining what a phenomenon is not. A key extension to this first activity, however, is the explicit call to identify novel practical challenges related to the novel phenomenon. These challenges are candidates for a subsequent validation and a refinement into problems suitable to start DSR efforts to develop prescriptions as solutions. These challenges thus are further contributions to Ω-knowledge in addition to the contributions or refinements made by improving the understanding of the

phenomenon in its context. All these contributions can be made, for instance, through observations, classifications, measurements, or cataloguing (Gregor and Hevner 2013).

Likewise, the "**2. Explore**" activity is still about intensifying the process of understanding the phenomenon by questioning "whether the concepts being used allow insight into the phenomenon by distinguishing relevant data from non-relevant data" (Von Krogh et al. 2012, p. 287). By excluding non-relevant data, the phenomenon can be narrowed down further, and thus additional Ω-knowledge can be generated, which may improve our understanding about the phenomenon and the related challenges. This first sense-making step may be achieved through identifying regularities, natural laws, principles, or patterns (Gregor and Hevner 2013). Phenomenon-driven DSR projects may later iterate through the first and second activity, until a sufficient understanding about its problem, the related phenomena and their context is reached in order to be able to develop well-grounded prescriptive (design) knowledge.

The idea behind the "**3. Design Research Approaches**" activity is also still the same: the experimentation with alternative research approaches (Von Krogh et al. 2012), which may lead to new knowledge about research approaches for understanding a phenomenon. As with the previous two activities, we extend this phase to cover design-oriented research as well. Such an integrated perspective on understanding and designing tends to increase a research project's overall contribution and impact potential (Seidel and Watson 2020), and is also well in-line with the more journey-like nature of DSR (Vom Brocke et al. 2020). As knowledge about suitable research methodologies and methods is part of Λ-knowledge (Drechsler and Hevner 2018), the arrow towards that knowledge base indicates the standalone contribution potential of this third activity, beyond its purpose to set the stage for activity 4.

The most substantial change to traditional PDR that we propose takes place in the "**4. Theorise and Design Theorise**" activity, which is now split into two sub-activities. 4a corresponds to the established recommendations in PDR to theorise focused on understanding, explaining & predicting regularities (Von Krogh et al. 2012) , but extended to include emerging challenges (cf. "1. Distinguish" above) of the novel phenomenon. The new sub-activity 4b is the DSR counterpart to 4a and focuses on design theorising focused on addressing the previously identified emerging challenges. While 4a's primary focus is on utilisation, contribution, and refinement of Ω-knowledge, 4b utilises, contributes, or refines Λ-knowledge. In both cases, pre-theoretical knowledge is equally valued as (and will almost always be a necessary prerequisite for the development of) fully-fledged theories or artefacts. Pre-theoretical Ω-knowledge allows to gain a better understanding of the phenomenon and its challenges whereas pre-theoretical Λ-knowledge can provide building blocks (e.g., design principles) for future more coherent approaches (e.g. artefacts) to solve parts of or even entire emerging challenges. Note that 4a and 4b are not to be seen as clearly distinguishable research activities or even an either/or choice. Most research will be conducive to produce both types of knowledge to varying extents, and it will be mostly down to the researchers' mindset about their primary direction of inquiry. Moreover, claiming fitness (or utility) for produced Λ-knowledge depends on a solid foundation of Ω--knowledge that meets certain standards of truth (Gregor and Hevner 2013; Seidel and Watson 2020).

As with the previous activity, we also extended the scope of the final activity "**5. Synthesise & Reflect**". The fifth activity still entails reconciling the newly generated knowledge with established wisdom, assessing the extent of the contribution, and identifying potential future research avenues, or future iterations on the same research questions. Synthesizing also lowers the risk of knowledge being scattered, and thus avoids isolated contributions to the human knowledge bases (Von Krogh et al. 2012). However, especially contributed Λ-knowledge requires a more nuanced reflection on the nature and extent of contribution made beyond its fitness-for-purpose (or utility) to address a given problem (vom Brocke et al. 2020). As contexts in DSR can be quite specific in nature, design knowledge that was assessed as fit-for-purpose usually can only claim fitness for the respective application context. Applying this design knowledge to other contexts means *projecting* this knowledge into those contexts, and – unlike as for Ω-knowledge – it is not just about generalisability, but more nuanced considerations of *projectability*. A third criterion – and one that is applicable to both Ω and Λ-knowledge – is the *confidence* with which the claims to truth / fitness and generalisability / projectability can be made. For research in the space of novel phenomena, we would expect it to be natural to start with claims of low confidence for one's initial knowledge contributions and then use these claims for subsequent cycles through the PDR (and DSR) activities to refine the previously contributed knowledge and thus improve the level of confidence.

Lastly, deeper insights into a phenomenon may assist in identifying other (and sometimes surprising) new phenomena and related challenges. Moreover, instantiated artefacts may constitute or even create novel phenomena on their own – thus highlighting the cyclical nature of the integrated PDR/DSR approach. In the interest of parsimony, we omitted the cyclical arrows from Figure 1, however.

4 Example 1: Meta-Requirements and Design Principles for Organising the IT setups in Scaled Agile Organisations

In this section, we illustrate the application of the research approach shown in Figure 1 in the context of a research programme on the novel phenomenon of Scaled Agile organisations (Horlach 2021). In a nutshell, Scaled Agile organisations either have split the IT function (and parts of the business organization) into agile and traditional service delivery following a bi-modal approach, or have 'agilised' the IT function or even the whole enterprise. Scaled Agile organisations apply Agile principles and methods beyond software development in order to meet the needs of strategic agility – comprising speed to market, customer centricity, and continuous innovativeness – for their (mostly digital) products and services. Often, the result is a formation of semi-autonomous product / service teams (SAP/ST) – which blur or even eliminate the traditional distinction between 'business' and 'IT' – in these organisations.

The broad challenge that initially guided this research programme was the question of how to effectively organise the IT set-up in Scaled Agile organisations, as many well-known challenges arising from gaps between business and IT do not apply in these organisational set-ups anymore. The same applies to corresponding management approaches to address these challenges such as IT governance, IT project portfolio management, business-IT alignment, or enterprise architecture. Instead, new management challenges arise within and between the SAP/ST.

Since there was very little knowledge at the start of the research programme about the Scaled Agile phenomenon and the corresponding more specific challenges of organising the IT set-up, an overall research approach was needed that could give sufficient guidance to develop suitable research designs to investigate both angles further. The approach shown in Figure 1 proved suitable to give this guidance and led to the insights and contributions summarised below in Tables 4 and 5. The tables are sorted by Figure 1's five phases and the five knowledge contribution types (2 in Ω and 3 in Λ). We further distinguish where we drew on (= *utilised*) extant knowledge, *refined* extant knowledge, and *contributed* novel knowledge without clear precursors in the knowledge bases.

PDR activity	Selected Ω-knowledge contributions & type
1. Distinguish	*Phenomena (utilised & refined)*: Scaled Agile organisations (bi-modal agile and traditional as well as uni-modal agile), Scaled Agile management frameworks Phenomena (*contributed*): business organisations partially or solely comprised of SAP/ST teams instead of a functional organisation with traditional hierarchies, Scaled Agile governance and business-IT alignment mechanisms
	Context (utilised & refined): organisations with digital products / services, strategic agility, business-IT alignment, IT governance
	Challenges (contributed): internal coordination within and between SAP/ST, coordination between SAP/ST and traditional IT / business units, strategic coordination between the SAP/ST and the organisational leadership
2. Explore	*Regularities (contributed)*: bi-modal IT as one instance of co-existence between SAP/ST and a traditional IT function, main areas of action for establishing a bi-modal IT organisation, five archetypes of bi-modal IT organisations
	Context (utilised & refined): organisations with digital products / services in business / service / digital platform ecosystems, enterprise architecture
	Challenges (refined / contributed): integrating an ecosystem perspective to SAP/ST management and the whole organisation, resource allocation to SAP/ST by the organisational leadership, measuring the business value contribution of SAP/ST and their products / services, handling architectural dependencies

Table 4: Sample phenomenon-driven contributions in PDR phases 1 and 2 for Scaled Agile organisations

Tables 4 and 5 show an evolution from general phenomena (e.g., Scaled Agile organisations and frameworks) and challenges to additional phenomena (e.g., bi-modal IT) and challenges (e.g., value and ecosystem concerns) which were discovered across the first two steps. Afterwards, a research approach was configured that proved to be suitable to produce descriptive as well as prescriptive knowledge through appropriate coding of interview and focus group data. Subsequently, integrated and mutual reinforcing theorising and design theorising about descriptive as well as prescriptive knowledge about the main topics raised in the interviews and focus groups (portfolio management, enterprise architecture, and organisational set-up, alignment & governance) took place. In the end, an overarching regularity (or pattern) of organising for fluidity and change instead of organising for stability was uncovered in the context of organisations with digital products and services in their business ecosystems

who were striving for strategic agility. Moreover, a set of seven paradoxes emerged that are specific to Scaled Agile environments with SAP/STs and supplant management challenges and paradoxes in traditional functional organisations. We assess the level of confidence for the resulting prescriptive knowledge as medium to high. The main limitation here is that in the scope of the research programme no re-application of the contributed design knowledge in the design of actual artefacts (i.e., solutions to challenges in specific organisations) had taken place.

PDR activity	Selected Ω-knowledge contributions & type	Selected Λ-knowledge contributions & type
3. Design Research Approaches	N/A	Explorative qualitative interviews & focus groups with organisational stakeholders, additional interviews with external consultants, field visits of selected case organisations, grounded theory-inspired coding to develop descriptive as well as prescriptive knowledge.
4. Theorise & Design Theorise	*Regularities (contributed / refined):* three types of SAP/STs in organisations, IT governance in Scaled Agile frameworks, reconceptualization of enterprise architecture, business-IT alignment, and IT governance for organisations with SAP/STs *Context* (*refined*): Scaled Agile organisations in digital business ecosystems	*Design knowledge (contributed):* meta-requirements and design principles for portfolio management, enterprise architecture management, alignment, and governance in organisations with SAP/STs
5. Synthesise & Reflect	*Regularities (contributed)*: adopting strategic agility leads to organising for fluidity and change instead of organising for stability *Emerging challenges (contributed)*: seven paradoxes (four on the team level, three on the organisational level) that Scaled Agile organisations with SAP/STs may have to cope with	*Patterns across the contributed design knowledge:* organisations shall strive for external continuous value and customer-orientation as well as internal continuous adaptability, innovation and synergies *Design knowledge fitness*: ascertained through expert interviews, focus groups and field visits *Design knowledge projectability*: limited to organisations with SAP/STs in digital business ecosystems *Design knowledge confidence*: medium to high based on # of interviews, extent of regularities, and theoretical saturation achieved.

Table 5: Sample phenomenon-driven contributions in PDR phases 3 to 5 for Scaled Agile organisations

Among these contributions, we would like to highlight the seven paradoxes for Scaled Agile organisations (Horlach and Drechsler 2020) which arose towards the end of the research programme out of a deeper problematisation of the previously identified challenges. A sole focus on the Scaled Agile organisations phenomenon in the original PDR spirit – i.e., without an explicit attention on understanding and addressing the corresponding emergent challenges – would likely not have enabled us to achieve the necessary level of insight to outline the paradoxes.

5 Example 2: Meta-requirements and Design Principles for Positioning Digital Innovation Units (DIUs) in Incumbent Firms

Analogous to the example discussed in the previous section, we now demonstrate the proposed research approach in another research programme in the context of the phenomenon of positioning DIUs in firms for fostering their (digital) innovation capacity (Raabe et al. 2020a, 2020b, 2021). Again, little was known about the phenomenon of DIUs and specifics of related challenges for organisations at the start of the research programme, and the research approach shown in Figure 1 proved again suitable to guide subsequent investigations, leading to the insights summarised in Tables 6 and 7 below.

In short, DIUs represent dedicated organizational agile units that work across firm boundaries and strive to foster digital innovation activities in incumbent firms. Many DIUs are currently established or in the process of being established in numerous firms, but (design) knowledge about these agile units and their integration is still scarce. In addition, the large number of established DIUs is accompanied by many multifaceted challenges described in press that need to be tackled. With this in mind, the researchers in

this project analysed DIUs in-depth and defined generic meta-requirements as well as design principles for DIUs to address a firm's (digital) innovation capacity. The meta-requirements and design principles are considered a kind of abstract blueprint for establishing DIUs in firms in the long term. Tables 6 and 7 summarise key findings from this research programme, again sorted by the five phases and five knowledge contribution types of Figure 1.

PDR activity	Selected Ω-knowledge contributions & type
1. Distinguish	*Phenomena (utilised & refined)*: Agile innovation units, (digital) innovation management approaches and frameworks *Phenomena* (*contributed*): definition and differentiation of DIU archetypes and their embedding in incumbent firms
	Context (utilised): digital products and service innovations, agility
	Challenges (contributed): rejection of digital innovations in firms, tensions between DIUs and other business units, complex handover scenarios of digital innovations
2. Explore	*Regularities (refined & contributed)*: status quo of addressed digital trends and types within DIUs
	Context (utilised & refined): digital innovation management (including digital products, services, processes, and business models), DIUs as an instance of a bimodal IT archetype
	Challenges (refined / contributed): visualizing a shift from an intra-organizational towards an inter-organizational ecosystem perspective, different terms or labels for DIUs with various tasks & activities

Table 6: Sample phenomenon-driven contributions in PDR phases 1 and 2 for DIUs

PDR activity	Selected Ω-knowledge contributions & type	Selected Λ-knowledge contributions & type
3. Design Research Approaches	N/A	Explorative qualitative interviews with organisational stakeholders, additional interviews with external consultants; social media submission analysis, qualitative meta-analysis with inductive/deductive coding techniques to create descriptive as well as prescriptive knowledge
4. Theorise & Design Theorise	*Regularities (refined):* Prerequisites for a successful DIU foundation *Context (refined*): digital innovation management, digital innovation ecosystems, DIUs as an extension of a bimodal IT archetype, focused on exploration (ambidexterity)	*Design knowledge (contributed)*: Meta-requirements and design principles for DIUs, best/good practices for setting up DIUs focused on digital product innovations, taxonomy for digital accelerators/incubators, dynamic capabilities needed or realized in DIUs
5. Synthesise & Reflect	*Regularities (contributed)*: Various objectives and tasks lead to a two-fold approach for DIUs to focus on: a firm's problem-based selection of digital innovations vs. a digital innovation-driven change of the firm	*Patterns across the contributed design knowledge:* pathways/blueprint for establishing and positioning DIUs in firms *Design knowledge fitness:* ascertained through expert interviews *Design knowledge projectability:* industry-independent but limited to large incumbent firms with legacy IT functions / information systems *Design knowledge confidence:* medium based on # of interviews, the understanding of the phenomenon, and the extent of regularities

Table 7: Sample phenomenon-driven contributions in PDR phases 3 to 5 for DIUs

Tables 6 and 7 show the emergence of the embryonic phenomenon of DIUs in incumbent firms. In the first two steps, the researchers distinguished various archetypes of DIUs (e.g., incubators or trend screening units) as well as multifaceted challenges that may lead to failure of DIUs (e.g., conflicts between Chief Information Officers and Chief Digital Officers). Subsequently, a research approach was configured and refined to produce Ω and Λ-knowledge through appropriate coding of interview data. Analogous to example 1, integrated and mutual reinforcing (design) theorising about the main aspects raised in the interviews (digital innovation management, business-IT alignment, bimodal IT function, and organisational design) took place afterwards. Subsequently, overarching pathways and principles for establishing and positioning DIUs in incumbent firms were uncovered. These can assist firms to innovate by fast-integrating digital products, services, processes, and business models. We assess the level of confidence for the resulting prescriptive knowledge as medium, mainly because in the scope of the research programme, equivalent to example 1, no re-application of the contributed design knowledge in the design of actual artefacts (i.e., establishing DIUs in a real scenario setting) had taken place.

6 Discussion and Conclusion

In this paper, we extend phenomenon-driven research (PDR) by integrating it with design science research (DSR). While the main five PDR activities stayed the same, each activity gained an additional perspective on 1) either understanding novel practical challenges associated with the novel phenomena PDR is concerned with or 2) contribute prescriptive or design knowledge about how to address these challenges. Such knowledge can encompass entire solutions or just design requirements and corresponding principles that are already effective in specific practical contexts and are now codified in an abstracted way to be potentially applicable to other contexts. Other ways of deriving prescriptive knowledge can be more traditional DSR work that draws on the gained understanding of regularities and potential other extant design knowledge for other contexts and produces novel artefacts to address the identified challenges.

The integrated nature of our proposed extension to traditional PDR thus opens up the potential for PDR to contribute prescriptive knowledge to the human knowledge bases in addition to 'just' descriptive, explanatory, and predictive knowledge. Our extension thus enhances the knowledge contribution potential of any PDR endeavour following our integrated approach. On the DSR side, our research approach starts before one might be even aware of specific problems and challenges associated with a novel phenomenon and allows a seamless pivoting towards design-oriented research once such challenges are identified. In the terms of Figure 1, a traditional DSR approach would start with step 3.

Researchers undertaking PDR or DSR will most likely be already aware that increasing knowledge about emerging phenomena and solution to extant challenges will almost always be a knowledge journey, and we recommend taking an even more open mind throughout and actively searching for additional unplanned research opportunities for either research mode, even if it means switching the primary directions of inquiry from explanatory to design-oriented directions or vice versa. Ultimately, an integrative perspective on the production of descriptive as well as prescriptive knowledge about novel phenomena promises to have synergies that result in higher overall contribution potential than a sole focus on either knowledge type (Seidel and Watson 2020). For instance, such deeper insights in our first example enabled us to derive seven potential paradoxes that Scaled Agile organisations face.

A second benefit of our approach goes beyond knowledge contribution and concerns the practical impact of research. Practitioners in a VUCA world face many unprecedented challenges. Sometimes these challenges are created by forces outside their control, but sometimes they are created by the practitioners themselves when experimenting with novel management approaches (such as applying Scaled Agile approaches or establishing DIUs) – especially as "most management practices create their own nemesis" (Clegg et al. 2002 p. 491). Simultaneously, if effective, these novel approaches may be the source of competitive advantages and the practitioners on their own may be reluctant to widely share their unique solutions. In contrast, neutral researchers are uniquely positioned to capture these first-movers' deeds and experiences (effective and ineffective). Researchers can further – and potentially across several organisations – distil the essence of effective and ineffective approaches and disseminate this practical knowledge in aggregated form back to interested practitioners, along with a refined understanding of the phenomena and challenges themselves. The promise of anonymity and otherwise lack of traceability, combined with the potential to receive useful insights and recommendations about latent or extant novel challenges may be a powerful motivation for practitioners to take part in PDR studies, especially those studies that can advertise to develop both descriptive and prescriptive knowledge right from the start. By following our proposed approach, researchers can thus achieve both relevant and interesting academic knowledge contributions as well as a notable impact in practice. Researchers also may have an easier time recruiting first-mover practitioners as participants in their research studies in the process.

Future research on our proposed approach can shed additional light on the interplay between descriptive and prescriptive knowledge when (design) theorising novel phenomena, or on other potential synergies between understanding and design-oriented research activities in such a context. Moreover, analysing published IS papers on novel phenomena and related challenges through the lens of our approach can shed light on gaps that extant research has left unexplored, or problematise the result of an (oftentimes) single focus on either explanatory or prescriptive knowledge contributions. Furthermore, there are other design, action, or impact-oriented research approaches such as Canonical Action Research or Action Design Research. Since these also have an integrated perspective on understanding and designing, it appears promising to explore their connections to our extended PDR approach as well. Lastly, future research is more than welcome to apply and refine the approach themselves while contributing all forms of knowledge about novel phenomena to the knowledge bases.

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