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Need-Solution Pairing and the Role of Emerging Technology in a Public Sector Innovation Process

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NEED-SOLUTION PAIRING AND THE ROLE OF EMERGING TECHNOLOGY IN A PUBLIC SECTOR INNOVATION PROCESS

Research Paper

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Abstract

New emerging digital technologies are evolving at an unprecedented pace. These advancements create increasing expectations for public sector organizations. However, we do not yet know much about the processes of these organizations when approaching emerging technologies. Such early innovation processes are critical to reaping the benefits of emerging technologies. We conducted a case study of a Nordic government agency to explore how a potentially paradigm-changing idea involving blockchain, evolves through an innovation process. We investigated the characteristics of early innovation search processes as a public sector organization approaches emerging technologies. Our contribution shows 1) how the search focus shifts over time - focus can be more about the solution, the need or the need–solution pair, and 2) how the conceptualization of technology plays an important role in the process. The findings increase our understanding of innovation processes in the public sector.

Keywords: Public Sector Innovation, Need-Solution Pairing, Emerging Technology, Innovation Process

1 Introduction

The advancements in new digital technologies during the last few decades have had a strong influence on the public sector. There are increased expectations for the public sector to approach these novel technologies to be able to deliver public services that are more efficient, faster, and more transparent, and that respond to citizens' expectations and needs (Mergel et al., 2019). However, managing innovation in public organizations is a particularly challenging endeavor. We do not fully know how to address questions such as how public sector organizations should interpret all the promises brought by new technologies and how these organizations balance their early-stage innovation activities, as there will never be sufficient resources to jump on every new digital innovation (Norström and Lindman, 2020).

In this paper, we explore the early innovation process of public sector innovation through the lens of need-solution pairing (von Hippel and von Krogh, 2016; Nambisan et al., 2017). This process is a dynamic search of both a (business) need and a solution landscape and leaves open whether an innovation process starts with an identified problem in search of a solution or vice versa, or whether the need or problem and the solution emerge in parallel.

We investigate one selected emerging technology, blockchain, which is being approached as a potential innovation for future use by a Nordic public sector organization. Blockchain has its roots in cryptocurrency technology, but the term is now used more as an umbrella term for several types of decentralized solutions. Blockchain innovation is ongoing in many sectors, where many promises are put forward, including solving trust issues, reducing costs, and increasing integrity and privacy (Rossi et al., 2019). The technology is predicted by some to influence the public sector, or even revolutionize it (Ølnes et al., 2017; Tapscott and Tapscott, 2016). In general, governments could potentially utilize the secure, distributed, open, and inexpensive database technology to reduce cost and bureaucracy, increase efficiency, authenticate many types of persistent documents (Casino et al., 2019), prevent fraud, reduce corruption, and increase trust, auditability, resilience, better data quality, security (Ølnes et al., 2017), transparency, and accountability (Ølnes et al., 2017; Norström and Lindman, 2020).

We focus on unpacking the early innovation process involving blockchain technology and the activities that take place as the case organization attempts to understand the viability of the emerging technology for its own purposes. We pose the following research question: *What are the characteristics of early innovation search processes as a public sector organization approaches emerging technologies?*

To answer this question, we conduct an in-depth case study of a Nordic government agency with an ongoing innovation initiative involving blockchain technology. We use the conceptualization of need-solution pairing as a lens to analyze and discuss a dynamic search process in landscapes of needs and solutions. With this discussion, we contribute extended insights into early innovation processes involving emerging technologies in public sector organizations.

This paper is structured as follows: First, we review related research on public sector innovation. We then introduce the concept of need-solution pairing, after which we move on to the empirical part of our paper. There we introduce our case organization and outline the choice of our methodology and how the empirical work was carried out. We present our findings and discussion, and finally conclude by discussing the limits of our research and potential avenues for future research.

2 Related research: Public sector innovation

Before we explain the concept of need-solution pairing, which guides our analysis of the early innovation process in this paper, we will briefly go through related research on public sector innovation more in general. We look into four themes in the public sector innovation literature that are relevant to understanding early-stage innovation with an emerging technology, and the search for needs and solutions: i) stage models and complexity models of innovation; ii) maturity of technology, application, and organization; iii) process innovation and paradigm innovation; and iv) learning through engagement in innovation networks.

First, in general, innovation can be seen as both a process and an outcome (Garud et al., 2013). At the organizational level, the innovation process has traditionally been conceptualized with various forms of stage models (e.g., Rogers, 1995; Swanson and Ramiller, 2004; Kohli and Melville, 2019). The different stages range from when the organization has literally no knowledge about the technology needed or how it is applied, through learning and sensemaking, building a business case, and implementation, until the innovation is fully assimilated in the organization. According to Cinar et al. (2019), research has mainly focused on the implementation phase of the innovation process. Hence, further research is needed on the idea generation and selection phases, as well as the design and development phases. The literature on government innovation has been criticized for not sufficiently theorizing government innovation journeys (De Vries et al., 2016).

Although helpful, stage models have been complemented by conceptualizations of innovation processes as more complex and uncertain where they can unfold along many different paths (Van de Ven et al., 2008; Garud et al., 2013). In his review of 'Government Information Quarterly' articles between 1992

and 2014, Janowski (2015) explained the concept of 'digital government' as following more of an evolution-like process toward increased complexity through changes in cultures and societies. Three variables are at play here: 1) whether digitization transforms internal processes without changing them; 2) whether transformation is internal or also affecting external relationships (citizens, business, etc.); and 3) whether the transformation is dependent on the national, city, or sectoral context or if it is independent. As evolution progresses, all three variables evolve toward a more complex state. The complex and situated view of innovation breaks with earlier understandings of innovation as homogeneous—that is, involving only one dimension (Demircioglu and Audretsch 2020). This research stream has, for example, focused on actors (Tassabehji et al., 2016), barriers (Cinar et al., 2019), the evolution of digital government (Janowski 2015), adaptive governance (Janssen and van der Voort 2016), and governance networks (Ojo and Mellouli 2018). In this paper, we investigate the early innovation process of a public sector agency that involves searching for needs and solutions in a complex context in which both internal processes and the external environment are believed to be transformed.

Second, the complexity and difficulty of innovation that involves an emerging technology depends on the maturity of the technology (Lindman et al., 2020), the maturity of the business process in which the technology is intended to be applied, and the digital maturity of the organization (Holmström et al., 2021). Introducing a technology that is "new-to-the-world" to address business processes that are not yet settled is way more radical than introducing technology that is "new-to-us" to address a business process that is already stable (Hevner and Gregor, 2022). When innovating with "new-to-the-world" technologies, there is generally a vivid community discourse to engage with, one that can be an asset for knowledge but also harbors pitfalls, such as opportunistic behavior from actors who want to capitalize on the buzz (Swanson and Ramiller, 1997). As such, a dimension over which an innovation can span is the level of discontinuity it entails. On one end, we have purely incremental innovations (questioned by some as to whether they should be considered innovations), which are "only minor departures from the existing practices and are usually easier to develop and implement" (Damanpour and Schneider 2009, p. 512). On the other end are radical innovations, which are "major deviations from the organization's current programs and practices and often require recombination of more specialized and diverse ideas and information" (ibid.). Previous research on public sector innovation tends to either not reflect on this dimension or lean toward the incremental side of it (Damanpour and Schneider 2009; De Vries et al., 2016). In this paper, we investigate innovation involving blockchain technology that 1) is relatively new and 2) comes with expectations of disruption of organization and processes, indicating a high level of complexity and uncertainty.

Third, in their review of innovation types in public sector organizations, Buchheim et al. (2020) reported a lack of studies on government and paradigm innovations. The majority of the studies are instead concentrated on product/service or process innovation. Government innovation refers to changes in the institutional framework (such as privatization), whereas paradigm innovation "relates to changes in the mental framework or perspective on the issues that an organization faces" (such as wallet infrastructure, as is the case in this paper) (Buchheim et al., 2020, p. 514). As such, paradigm innovation is "substantially different from others" (p. 514), echoing Rowley et al. (2011). In terms of attention to innovation characteristics, historically, research has mainly paid attention to some aspects, such as intra-organizational service and process innovations (Buchheim et al., 2020; De Vries et al., 2016), incremental change (De Vries et al., 2016), and a closed model of innovation whose activities are only dependent on internal resources (Kankanhalli et al., 2017; Bekkers and Tummers 2018). This is also acknowledged by De Vries et al. (2016), who stated that the "literature seems to lean toward intra-organizational process innovations, which are often closely related to two major reform movements in public administration, namely NPM and e-government" (p. 154). The focus of this paper is on the early ideation phase of innovation with an emerging technology that is speculated to revolutionize the public sector infrastructure rather than a stand-alone tool for the improvement of a specific process.

Fourth, a recurring theme in the public sector innovation literature is the importance of learning through collaboration with external stakeholders in extended networks beyond organizational boundaries.

Through innovation networks, organizations form resources and capabilities unique to their innovation (Rehm et al., 2017). These networks are loosely structured and involve network governance with challenges, such as building trust and motivation and aligning views and values among the network participants (Ojo and Mellouli 2018; Bekkers and Tummers 2018). Further, Klievink et al. (2016) posited as promising an outside-in approach that uses public-private digital platforms that, if successful, can address the public sector's limited capacity to meet society's rapidly evolving challenges. Vital, however, for this to work is striking "a balance between autonomy and control, finding business models that align with public sector interests, and setting up a collaborative process" (Klievink et al., 2016, p. 78). Knowledge and continuous organizational learning about the complexity of innovation challenges have been raised as vital aspects of public sector innovation (Janssen and van der Voort 2016). In this paper, we consider our case organization's process of approaching blockchain technology as a learning process necessary to understand and conceptualize the early-stage innovation phase.

In sum, information systems (IS) research is still exploring the field of innovation as an evolution (rather than a gradual development through the lens of stage models) in complex environments and especially the early-stage innovation, innovation when both internal processes and external environment are assumed to be transformed and, when emerging technology is involved. Against this backdrop, in the next section, we outline the concept of need-solution paring as a lens through which to understand early innovation processes as an innovation space of fluidic boundaries and as a dynamic search and learning process in landscapes of both needs and solutions.

3 Theory: Need-solution pairing

To account for the emergent nature of both the needs and the solutions in innovation work, we opt to use the theory of need-solution pairs, a recent and relevant way to conceptualize innovation (Nambisan et al., 2017; von Hippel and von Krogh, 2016). This approach is informed by a long tradition of formalized approaches, including agent-based simulation models, to how organizations conduct search activities (e.g., Levinthal 1997).

Behavioral theories of organizations have historically relied heavily on models of search and learning (March and Simon, 1958). Models of organizational search can posit that organizational action is constrained by cognitive limitations (Simon, 1952) and is aimed at optimizing search strategies to find optimal solutions that balance efficiencies and innovations (Levinthal, 1997). These approaches have been criticized for overemphasizing the rational choice in innovation activity that does not consider institutional and organizational forces at play (e.g., Langlois, 1986). This seems to be a problem, especially in the public sector context, where institutional forces can be argued to have an even stronger role than in the private sector.

Need-solution pairing theory is built upon a metaphor of two distinct *landscapes* (sometimes also *spaces*): one need (or problem) landscape and one solution landscape (von Hippel and von Krogh, 2016). The need landscape represents all needs that are valid at each point in time, whereas the solution landscape represents all possible solutions that can potentially respond to the needs. Now, a need-solution pair is a link between a point in the need landscape and a point in the solution landscape. This pair is considered *viable* if, and only if, the reward associated with the need is equal to or higher than the cost of providing the solution. This theory is not constrained to a specific level of analysis; that is, it can be used for an organization, an individual, and so on.

One advantage of this theoretical lens for innovation is that it settles with previously dominant sequential views on innovation and problem-solving (Nambisan et al., 2017; von Hippel and von Krogh, 2016). Instead of viewing problem solving as searching the solution landscape for optimal solutions to a predefined problem, we can consider it as a wider search in both a solution landscape and a need landscape for viable need-solution pairs (von Hippel and von Krogh, 2016). This is particularly important, as it is becoming increasingly obvious how complicated this search is. By focusing on need-solution pairs, "predefined problem solution spaces are replaced with an innovation space of fluid

boundaries (one that reflects the flexibility of recombination afforded by digital technologies)" (Nambisan et al., 2017, p. 228).

Makkonen and Komulainen (2018) expanded this theory by drawing on both need-solution pairs and digital innovation. They put forward a framework for digital innovation that "defines digital innovation in terms of need-solution couplings and the innovation process with regard to the emergence of the need-solution couplings" (p. 1018). Makkonen and Komulainen (2018) presented the innovation process as a "multi-level coupling of needs and solutions," in which various actors are "engaged in the process for various reasons and aimed at employing the innovation and the innovation process as a solution to meet their needs" (p. 1024). Building on their theoretical contribution, Krejci and Missonier (2021) used the concept together with two others (idea management and open innovation) to develop a framework for how idea management is practiced in a digital context.

In the empirical part that follows, we take this need-solution pairing as a theoretical lens and apply it to the public sector context to study the process of innovation search and to theorize further the dynamics of search.

4 Method

We investigated how a Nordic government agency searches for viable need-solution pairs while approaching a new emerging technology, namely blockchain. We opted to follow an explorative case study approach as it fits this contemporary phenomenon (which includes emerging technology) within a real-world context, as there is a lack of theoretical grounding about a particular subject (Yin. 2003).

In terms of the level of involvement, and on a scale ranging from "neutral observer" to "action researcher" (Walsham, 2006), the first author operated within the neutral observer end of the scale at the beginning of the observation period. However, as the nature of this position often changes over time (Walsham, 2006), which is also the case in this study, there was a successive shift toward a higher level of intervention as the case study progressed. Here, we describe the case we studied, followed by a description of the data collected.

4.1 Case Description

The case studied is the innovation process at one of the Nordic government agencies. This organization was selected because it 1) offers a rare opportunity to better understand this process and 2) our research group gained excellent access to this organization. Formally, the innovation processes were primarily observed in a project organization that was to answer to a Government Commission[1] from the national government. However, the organizational set-up of these activities was to give the agency organization some leeway regarding the project's goal and ambition level. Our case study was initiated at the time of the commencement of this project (January 2022). In addition to following the unfolding of the project, data were gathered concerning various events leading up to the project. The innovation processes of our interest in this paper expanded before and beyond the formal project structure.

The idea developed in the project (VeriBus) is about finding new ways of providing services to the customers of the agency that are companies by adopting blockchain technology that would allow for information ownership closer to the individual company, higher information integrity, and increasing potential for cross-border information flows. Ownership closer to each company would also mean having more power to choose with whom to share information. A typical scenario is that two companies engage in a business in which they need to develop trust. One company might need to present some kind of certificate or other type of verification issued by a third party, such as a government agency. The

[1] The government can issue Government Commissions to government agencies to investigate various issues. This may, for example, be about contributing with the basis for the government's decisions or implementing efforts that support the government's policy.

VeriBus service provides an infrastructure for downloading digital verifications issued by a third party (an issuer), through which the verifying actor can prove the authenticity of the verifications (essentially powered by cryptographic functions).

The most obvious work leading up to the observed project was a proof-of-concept activity that spanned from March to September 2021. This activity started with an event following the so-called design sprint methodology, originally developed by Google, in which the idea is to quickly evaluate hypothetical ideas together with users in a few days. The result from the design sprint was a promising idea that the agency decided to turn into a proof of concept. In September, the proof of concept was communicated and demonstrated externally to receive as much input as possible. Following this was communication with the government, which ended up commissioning the agency to develop it further. Figure 1 depicts the relationship between these activities.

Even though the idea now in focus in our case was developed during the proof-of-concept activity in 2021, more high-level ideas related to what is now being explored in the observed project can be traced back to around 2020, and even before that. During the last few years, the agency has introduced a novel vision, that could be characterised as disruptive, for the future role of the agency. These ideas were highly influential when one of the strategists, now part of the project, started to formulate thoughts that eventually led to the design sprint in March 2021.

As mentioned earlier, the project runs as a Government Commission but with the possibility of aiming for a higher ambition level, which the agency did. For example, whereas the assignment only required that the ideas be tested conceptually, the ambition of the project set up by the agency was to reach a level of technical maturity that allowed for quality assurance testing in which a scaled solution was reachable in a reasonably short period of time.

A core project team was formed consisting of a range of technical and legal experts as well as system matter experts within the domain of the agency. A project leader with experience in innovation projects in government agencies was contracted. After some initial planning meetings, a project methodology was formed using agile methods. This was run in three-week sprints, with a backlog and sprint log handled in the project management tool JIRA, and a structured set of meetings with clear objectives along each sprint. In addition, the planning is supported by objectives for each quarter, which are broken down from the overall project goals. There is also a clear ambition to frequently network with actors outside the agency. For this purpose, a set of reference groups was formed, for example, one representing the customers and one for discussions on technology matters.

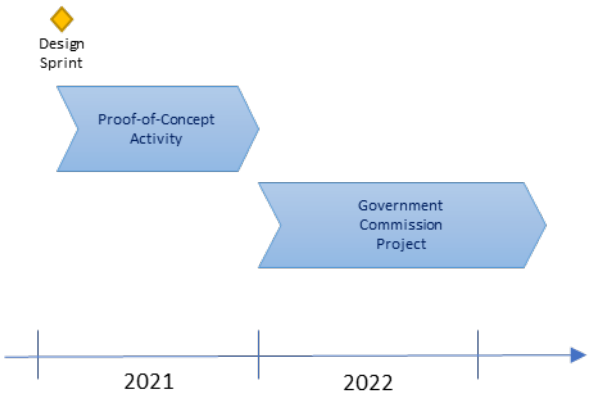

Figure 1. VeriBus development phases

4.2 Data collection

The data primarily consisted of meeting observations, field notes, and semi-structured interviews (see Table 1 about data collection and Table 2 about the interviews below). All respondents were either project members or had a strong relationship with the project. As a cross-functional and cross-disciplinary project, the respondents belonged to a variety of roles. The role of each respondent is not presented for anonymity reasons. The roles are *director-general*, *strategist*, *digital strategist*, *innovation leader*, *IT chief architect*, *IT architect*, *legal unit manager*, *business developer*, and *project leader*.

Data type	Quantity
Observed meetings	72 (approx. 100 hrs.)
Full day visits	7
Interviews	10

Table 1. Data collection

Respondent #	Length of interview
R1	68 min
R2	58 min
R3	73 min
R4	31 min
R5	66 min
R6	59 min
R7	49 min
R8	50 min
R9	55 min
R10	55 min
	Total: 9 h 24 min

Table 22. Interviews

Most of the meetings were online meetings. Attending all meetings held with the entire project team provides a constant (at least weakly) sampling of the state regarding the team's search in the solution space, the need space, and the pairing of the two. The interviews are a way of obtaining thicker data on aspects worth pursuing. Tape recording was the default option, although it was relaxed if needed to get access to a respondent. The interviews were transcribed. As for meeting attendances, focused note-taking served as the main collection method, but this was supported by tape-recordings to allow for going back to themes considered valuable for analysis. Field notes were taken on a need basis, primarily in connection to the days when data was collected on site, as that opened for informal discussions outside of the meeting room. Other forms of data, such as internal documents and publicly available media content, were also used to supplement the meetings and interview data.

We used an analytical approach to iterate between empirical data and theory (Alvesson and Sköldberg, 2017). Data were collected through semi-structured interviews. The coding process is visualized in Figure 2. Round 1 shows coding that was entirely driven by empirical data. Round 2 shows themes that successively emerged during the case study, informed by round 1 codes and concepts in the public sector innovation literature. At an early stage in the case study, the first themes that emerged were the need, solution, and pairing themes. As the project that was formally observed was already in place, and as it had become clear that the project goal was to present a conceptual solution to address certain needs

using a certain technology, these codes became relevant. As the data collection and analysis progressed, additional themes emerged, namely work methods, technology, and learning.

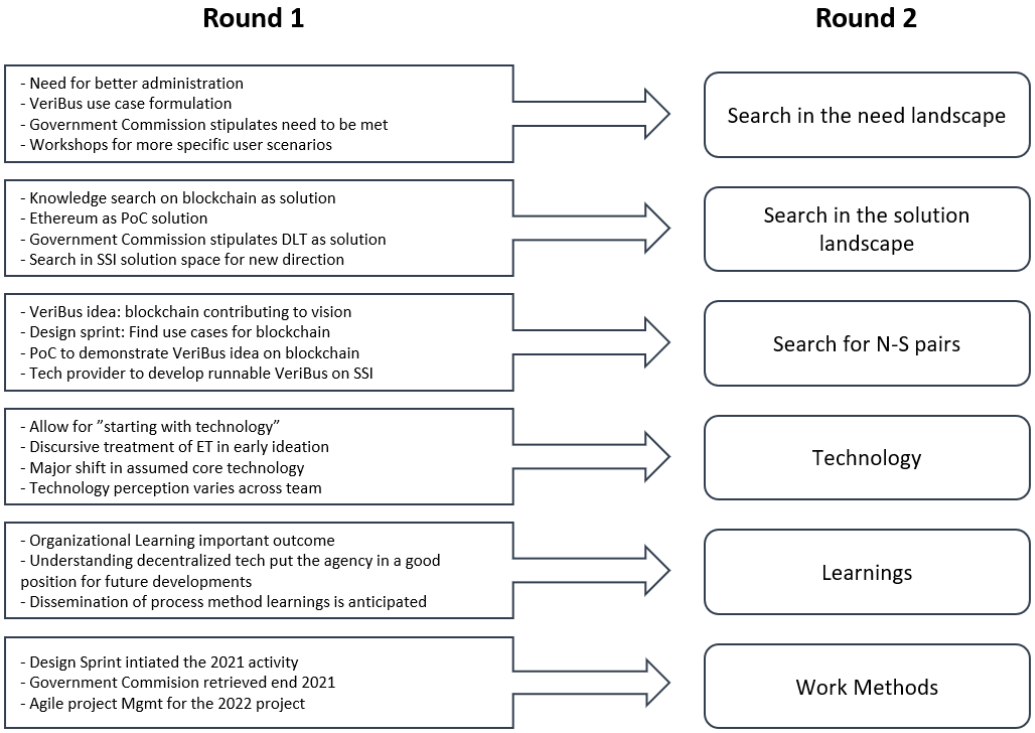

Figure 2. Coding scheme

5 Findings

In this section, we illustrate how the innovation process of the case agency emerges over time through specific project methods and through different approaches to, and conceptualizations of, technology and innovation. Based on our analysis, we unpack the innovation process and outline four themes that describe and explain the process. The themes include: 1) what work methods the team used and why, 2) how the team members searched landscapes of needs and solutions and how they paired the two, 3) the role that technology played in the innovation process, and 4) the team members' view of an innovation process as a learning process.

5.1 Work methods

The VeriBus idea was developed through phases with different types of methods. The organizational initiation was a design sprint in early 2021, in which VeriBus was the idea chosen for further refinement. The design sprint methodology had not been used at the agency before, and it was considered successful. *"It's really really good because it has... This is a way for us as an agency to think out of the box, because we are inclined to often think traditionally"* (R1). In 2021, there was a phase in which a runnable proof of concept (PoC) was developed. This phase was handled as an activity within everyday line management at the digitalization and innovation unit with no explicit project methods. The development of the proof of concept was outsourced to a smaller technology provider to meet the goal of a ready proof of concept by the end of the year, according to one of the strategists.

In relation to the presentation of the proof of concept, at the end of 2021, discussions with the relevant government ministry led to the issuance of a Government Commission to develop further a conceptual test together with an environment monitoring report. This was an important step, as it both legitimized

and secured further development of the idea. *"It makes a huge difference if you have a Government Commission or not. If we have a Government Commission, we cannot be de-prioritized, if not, we can be de-prioritized, for example in our portfolio management. And it also opens doors for us when we want to talk to other agencies"* (R3).

To handle this request from the ministry, a 15-month project was set up and an external project leader was contracted. In terms of project methodology for this phase, an agile approach was chosen with 3-week sprints. The recurrent meetings consisted of a briefing meeting every week plus sprint meetings every sprint (sprint planning week one and sprint planning plus retrospect week three). To control the progress and stay tuned with the overall objectives of the project (i.e., the Government Commission), quarterly targets were elaborated early in the project.

The staffing of the project was cross-functional and cross-organizational. Adjustments to the group were made during the project as a way to meet changing project needs. For example, after a number of sprints, an increasing need for service design competence was identified; hence, two additional members were recruited internally. *"These workshops, where we talked about the fact that we might need to add competence to the group [...] back then we realized that we would probably need UX competence or business architect competence*" (R2).

5.2 Searching for needs and solutions

Many ideas and thoughts evolved among the people involved at the government agency over the course of the last few years. In this section, we explicate these dynamics through the *need-solution pairing* lens, which separates the search into three types: search in the need space, search in the solution space, and search for viable need-solution pairs.

In 2018, during the period that followed the recruitment of the current director-general, a revamping of the agency's vision was carried out. The resulting vision stated a change in how business information will flow in the future. *"A society where data flows freely and creates benefit in society or creates value"* (R6).

An analysis was carried out to prepare for work on the government's vision. They analyzed the needs of their customers and found a required need for better administration as a consequence of digitalization of the agency´s services. *"We saw that digitalization put demands not only on the products or services that were produced, but also that the administrative simplification that we can contribute with also needs to be digitalized in a different way"* (R6). On a high level, ideas about solutions that could viably be paired with these needs were also expressed. *"We don't intend to just simplify, but we see that in the new world, you don't need to be in full contact with the authorities. Instead, we can remove the interaction [...] retrieve information instead of reporting, of course according to the law or consent. And we're talking about having a distributed storage"* (R6).

Regarding the search in the solution space, blockchain as a technology had been discussed for some time in the organization. For example, already in 2018, two of the IT architects in the IT department put together two presentations (one technical and one business-oriented) to inform the agency of the peculiarities of this technology.

In 2020, one of the strategists formed the first sketches of the VeriBus idea. *"But the idea was something that I had brought with me since the autumn before this particular one and then we used the design sprint to sort of cook things together as a group"* (R1). According to this respondent, the idea emerged by matching the general affordances commonly associated with blockchain technology (decentralized treatment of information, trust between actors without involving intermediaries, and information integrity) with the subset of the agency's new mission dealing with the *sharing* of information. The initial sensemaking of the digital strategist is categorized here as a high-level search for a viable need-solution pair.

In early 2021, a design sprint was planned around blockchain technology. The persons involved in planning the design sprint were initially puzzled by this technology-driven approach but managed to reformulate the design sprint with the help of earlier experiences in innovation. "*Oh, my god. A design sprint.. And blockchain [...] Well I thought, but that doesn't work starting from blockchain [...] you have a technology here well without any definition regarding concrete solutions, needs and challenges"* (R5). So, with blockchain technology presented and the ideas and promises with such decentralized approaches discussed, the design sprint was carried out with the aim of finding a new innovative use case that could leverage this new technology.

The proof-of-concept activity that followed the design sprint and ended in a live video presentation in October 2021 involved finding a solution based on blockchain technology that could be used to present the need to be solved in an executable application. The intention was to involve an external network of stakeholders in a conversation about the proposed need to be solved. The solution was contracted to a technical provider that already had a blockchain-powered platform for document management. By adding document metadata to a permissionless blockchain (Ethereum), the authenticity of a verification document can be validated by an actor who needs to trust a company. The proof of concept also worked as a communication tool to seek funding and legitimacy for the continuation project. As a result, a Government Commission with a 15-month delivery time was issued, stating that the agency was to deliver a type of service (in line with the VeriBus idea but more vaguely defined) using distributed ledger (DLT) technology. From a technology perspective, DLT covers a somewhat larger set of technologies than blockchain, even though the terms are often used interchangeably in common discourse.

As it turned out, in the project that was set up to deliver on the Government Commission, the search for a technical solution resulted in a substantive change of attention within the solution landscape. It was concluded that to meet the intended need, a technology related to, but essentially not the same as, blockchain had a better match. *"But as the concept of digital wallets came into play and that it could be what is actually the foundation and around which we then build, we tapped into it quite heavily and for me it felt very good"* (R1). Hence, during the early phase of the project, this technology (SSI technology consisting of digital wallets and verifiable credentials) was further investigated (i.e., local search in the solution landscape). With a more clearly defined technology base, the project then changed its focus to developing more specific user scenarios (search in the need landscape).

With well-defined user scenarios, and with a chosen technology setup, the agency once again contracted a technology provider to carry out the development of a runnable application. This would be used to demonstrate the conceptual solution required by the Government Commission. Thus, at that time, there was a match between the solution landscape and the need landscape. Regarding the viability of the pairing, no deeper analysis was carried out to pinpoint *how* the chosen solution was viable for the chosen need or *whether* other solutions could potentially meet the chosen need at a lower cost.

From a technical perspective, the new SSI-based solution focused on verifiable credentials—digital objects stored locally in so-called digital wallets—instead of blockchain as the technology for securing authenticity. Hence, in the new solution, all verification metadata were stored in the company's local wallet, and authenticity was secured through cryptography. The only data structures that needed to be accessible globally were 1) identities (public keys) of verification issuers and 2) verifiable credential schemas. These data structures are typically stored in a global registry, which can be a blockchain network. In the developed solution, a permissioned blockchain was used.

5.3 The role of technology in the innovation process

Technology played an important role in the innovation process. The early drafts of VeriBus emerged as a hypothesis that parts of the expressed vision of the agency could be realized with support of blockchain technology, according to one of the strategists. It was the affordances discussed regarding this technology that matched well with the part of the vision that dealt with the flow of information in ecosystems and with enhanced trust between actors in the ecosystem.

With this hypothesis as a trigger, the design sprint was used to trigger ideas related to blockchain affordances among the participants, coming from various parts of the agency. Five concrete ideas were sketched, among which VeriBus was one, and it turned out that VeriBus had the best potential to realize further as a proof of concept. In 2021, this was developed with blockchain as part of the technical solution.

When the proof of concept was demonstrated and a new phase in the refinement of the VeriBus idea started, the entire technical architecture was replaced. Insights from a technical expert in the project team showed that the core technology that would best serve the need was instead digital wallets and verifiable credentials. This technology is broadly considered part of a decentralized stack of decentralized technologies, and it is indeed often proposed with blockchain as a supporting part of the architecture. However, the core technology was not based on blockchain, and blockchain technology was not essential for it to work. *"Blockchains are still there [...], not being an absolute must have, but it is there"* (R1).

Alternatively, the role of the technology in this process could be perceived through the various ways it had or had not influenced the different team members. Even though the initial idea had been triggered and powered by new technologies, technology was far from the central issue in project meetings. There was a range of attitudes—from skepticism and conviction to indifference—in relating to the underlying technology, strongly dependent on the team role. *"In general, my point is that blockchain is rarely the only solution. And maybe sometimes not even in the best solution"* (R9). *"I haven't actually [read up on technical details] and there are probably a couple of different reasons for that. One is that I'm actually not that interested in the technology itself."* (R10).

5.4 Learning as a complementary innovation outcome

In conceptualizing the innovation process, the respondents talked about innovation not only in terms of needs and solutions but also as an effort to learn and develop new mindsets and new technology and applications. Even though the project related to the Government Commission had clear project goals (involving a conceptual test), it was also viewed as a learning process. There was a mindful attitude regarding whether the outcome of the project would later result in an implemented solution. Further, the project participants stressed that the most important outcome of the process was a higher understanding of the involved decentralized technologies, so that the agency was much more prepared for them. For example, there was ongoing work at the European Union level regarding these technologies, and one potential avenue is the future implementation of these technologies in public administration throughout Europe. Projects such as our case make the government more prepared regarding this technology and its potential applications.

Respondents also highlighted how this project was a successful way of learning how to manage a visionary innovation and spread those learnings to other agencies and organizations. This type of approach was proposed internally by the team, as well as externally by collaborating organizations. Success indicators mentioned by respondents included cross-functional team setup, agile methodology, management support, and open-minded attitude, that is, openness to various views, openness to let go of earlier assumptions, etc. (communication material between the agency and the government-owned company).

This project also helped to relax some of the existing structures and inertia regarding how organizations previously assessed emerging innovations.

6 Discussion: Shifting landscapes and the role of emerging technology in the public sector innovation process

Innovation processes in the public sector are uncertain and complex (Demircioglu and Audretsch 2020; Van de Ven et al., 2008; Garud et al., 2013). The uncertainty increases with the level of immaturity of

the technology involved (Hevner and Gregor, 2022) and with the level of discontinuity the innovation entails (Damanpour and Schneider, 2009). Complexity means that multiple dimensions are involved in the innovation; for example, organizations struggle to tackle internal and external ambiguity (Janssen and van der Voort 2016) and collaboration with multiple stakeholders to respond to heterogeneous needs and desires and to build trust (Ojo and Mellouli 2018; Bekkers and Tummers 2018). There has previously been a focus in research on the implementation phase of the innovation process, while the early idea generation and selection phases have been neglected (De Vries et al., 2016). There is also a need to further understand paradigmatically changing ideas (Buchheim et al., 2020) and how they are approached and developed through an innovation process. In this paper, we give an example of an innovation process that is both uncertain and complex, and that is based on a potentially paradigmatically shifting idea related to the uncertainty of the emerging technology involved. We conceptualize the process as an "idea and selection phase" rather than an implementation phase; hence, we contribute to early public sector innovation process research and practice.

In the discussion below, we show that public sector innovation with emerging technologies—such as blockchain—challenges existing theory on innovation processes in the public sector. We contribute to need-solution pairing literature by 1) showing how the innovation search shifts between the different landscapes (need, solution, pairs) and 2) by explaining how the conceptualization of technology shifts over time in early innovation processes and what role these different conceptualizations play in how the innovation process proceeds.

6.1 Shifting landscapes

The search for a need–solution pair can be performed in the need landscape or the solution landscape, or it can be focused on the actual pairings, thus evaluating the viability of a pairing (Nambisan et al., 2017; von Hippel and von Krogh, 2016). As pointed out by von Hippel and von Krogh (2016), when searching a landscape, the search is necessarily performed within a *section* of the landscape, as the richness of information contained in landscapes often makes it impractical to search more widely.

A reflection on the search in need, solution, and pairing landscapes in our case revealed that the search focus shifted back and forth between the landscapes over time. Thus, even though the need side (use cases), solution side (technology), and pairing (rationale for using the solution for the need) were logically interlinked, there was a tendency to progress in each of these quite independently. As our findings show, most of the progression was made in one area at the time. Starting with the design sprint event, use cases were searched that could benefit from the affordances of blockchain technology. Following this was a half-year activity in which a technical application was developed to showcase the idea. Further, this resulted in the Government Commission project, which increased the details of the landscape search. The project started with a detailed search regarding technology choices, and after some months, it shifted into detailing use cases. Hence, the focus shifted between the landscapes over time. Our findings also show that landscapes shifted with regard to which section of each landscape was chosen for localized search. These shifts can be both in size and relative position (i.e., adjacent sections). An example of a shift in size occurred when DLT was defined in the Government Commission (i.e., the section corresponding to DLT was pointed out). This was an expansion of the section earlier used for the search, namely the section corresponding to blockchain technology. The section shifted in relative position when digital wallet and verifiable credential technologies (SSI technology) were chosen as foundational instead of blockchain; that is, the search in blockchain section shifted to the adjacent section of digital wallets. It was considered adjacent because all the technologies were part of a set of technologies belonging to the same decentralized technology vision, but as technical architectures, they were different.

From these results, we draw the conclusion that to move about with innovation related to emerging digital technologies, there is a need to keep a relaxed relation to the need and solution landscapes. As these technologies are ambiguous and uncertain by nature (Rotolo et al., 2015), too narrow-minded thinking leads to a high risk of innovation dead-ends.

In addition to the shifting nature of landscape search in the innovation process, we noted that thorough detailing of the tentative pairs that emerged connecting the need and solution landscapes was scarce. The pairings were kept at either a high level (e.g., statements that the affordances discussed for blockchain technology were relevant for meeting the needs expressed in the vision) or as individual convictions that the developed conceptual solutions made sense in meeting the needs of future users. This approach brings both opportunities and risks. Opportunities include not getting stuck in details, which can allow for faster progression, and risks may involve failing to evaluate the linkage between solution and needs in detail, which might result in the development of solutions that no one wants.

6.2 Role of emerging technology

Need-solution pairing is a concept that allows for many different paths in the search for an innovation. A solution can be sought for a need, but a solution can also trigger the formulation of a need, etc. However, among practitioners, the idea of letting a technology drive the process is usually thought of as a bad practice, which also surfaced in our data. Nevertheless, the participants accepted, and some even encouraged, this throughout the development of the idea. First, the design sprint was set up with the question of how blockchain can transform the agency. The rationale was that the idea of blockchain helped unlock people's minds in trying to visualize future ways of organizing. Second, the Government Commission issued to the agency states that DLT was to be used in the development of the service. These examples show that an emerging technology may take on the role of an *idea trigger*. However, the risks that follow when focusing on technology still need to be addressed.

Another angle in reflecting on the technology was ambiguous interpretations among stakeholders in the organization. Naturally, IT professionals put effort into understanding the technical details and interpreting the possible affordances from this position. More strategic stakeholders, however, departed in their interpretations more from the commonly discussed affordances; in the case of blockchain, this would be promises of increased trust, increased information integrity, and decentralized information management. Consequently, there was strong ambiguity regarding what blockchain technology meant to the different stakeholders. In its broadest sense, we observed that blockchain referred more to a *technology vision* (powered by visionary ideas on more decentralization) rather than a technology.

7 Conclusion, limitations, and future research

This paper aims to investigate the characteristics of early innovation search processes as a public sector organization approaches emerging technologies. First, our findings show that search focus changes between solution, need, or need-solution pairing over time. Second, the conceptualization of technology plays an essential role in this process. Given the ambiguity of emerging technologies, not only regarding their technical details but also their potential affordances, it is imperative with continuous learning while innovating with these technologies.

Single-case study designs have limitations, and future research is needed to strengthen the presented findings. It may also be beneficial to reflect on how to manage an innovation process with emerging technologies, especially the appropriate project methodologies. In our study, most decisions related to the choice of project methodology did not follow an organizational template. Instead, they depended on the individuals responsible for the task. This question calls for further research on methodological choices in these types of innovation processes.

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