From Solution Trap to Solution Patchwork: Tensions in Digital Health in the Global Context

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Short Paper

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Abstract

This paper problematizes underlying assumptions in Design Science Research – and Information Systems Research more broadly by conceptualizing the „solution trap". The solution trap is caused by the incompatibility of co-existing solutions in complex socio-technical contexts. Information systems bring diverse cultures and theories together, causing tensions in the different institutional logics. We emphasize the need for a nuanced understanding of context unevenness and propose solution patchwork as a coordination approach to evade the solution trap. Substantiating the preliminary insights and propositions with a literature review and further empirical grounding will transition this research-in-progress to a full paper.

Keywords: Phenomenon-based Problematization, Digital Health, context-centric problem solving, design science research, medical informatics, institutional logics

Introduction

Once the COVID-19 pandemic had a hold on the world, everyone seemed to crave vaccines that would contain the spread of the virus and restore normality. The assumption was that once the vaccines were available, it would only be a matter of administering them to the population to end the pandemic. As we now know, vaccine acceptance did not turn out to be as consequential as assumed. Reasons for this lie in the mistrust of the science behind vaccines, conspiracy theories pedaled by social media's algorithms eager to increase users' engagement, lack of education, and political opportunism, to name a few causes (Troiano and Nardi 2021). In many countries, governments have struggled to counteract vaccine hesitancy. They had to put much effort into counteracting citizens, drifting away from what seemed an obvious course of action. While this discrepancy between expectations and behaviors is general and far less uncommon than it may be assumed, it can be noted that digitalization exacerbates it at the very least because it brings people, organizations, and societies across diverse contexts closer together, thus in a more direct interplay (Giddens 1986).

The divergences shown by different social groups with their values and interests (Pinch and Bijker 1984) can be explained by different institutional logics that shape orientations and behaviors (Powell and DiMaggio 2012; Scott and Davis 2015). First, this paper argues that, more often than expected, the organizational context within which people use technologies is defined by conflicting institutional logics that hinder coordination and implementation. Second, it identifies and discusses the problem of co-existing solutions - which we call the *solution trap*. The *solution trap* is a misconstruction derived from a narrow definition of problem space in engineering and DSR projects, where designers or researchers tend to specify the problem as a *lack of a solution*. Consequently, the issue here is not the lack of solutions but their abundance and mismatches.

Digital technologies hold potential to build resilience, as the COVID-19 pandemic has demonstrated. In this paper, we problematize underlying assumptions in problem-solving approaches such as Design Science Research (DSR) relying on examples of digital health in the global context. As pressing issues such as global health equity increase the need for global cooperation, we highlight the relevance of addressing the *solution trap* to facilitate coordination and implementation to overcome these global issues and build sustainable resilience.

Background

Design Science Research

The healthcare domain experiences many technological and socio-technical solutions addressing long-standing problems such as personnel shortage, treatment adherence, or limited access to medicine. Design and engineering approaches dominate the development of such solutions. In medical informatics, DSR and similar approaches are employed and claimed to be adequate for healthcare (Hevner and Wickramasinghe 2018). DSR finds its roots in the science of the artificial (Hevner et al. 2004; Simon 1996), Heideggerian philosophy (Maedche et al. 2019), and early perceptions of engineering as a way towards scientific inquiry (Nunamaker Jr et al. 1990). It is claimed to be a problem-solving approach in which stakeholders' problems are addressed by utilizing engineering solutions to address the needs of the stakeholders (Maedche et al. 2019). However, the goal of a DSR project does not end with developing an instance solution; the contribution emerges primarily from a better understanding of a class of problems and guidance for a class of solutions (Lee et al. 2015; Peffers et al. 2018). Accordingly, understanding the problem and its far-reaching consequences is claimed to be paramount in DSR (Maedche et al. 2019).

All major process models, methods, and frameworks for DSR start with understanding and formulating the problem (Hevner 2007; Kuechler and Vaishnavi 2008; Peffers et al. 2018; Sein et al. 2011). There is also an agreement that the design of an intervention or an artifact happens in parallel to learning about the problem, implying the mutual relationship between those two streams of activities. With time, the understanding of the problem and the understanding of a solution converge: the understanding and framing of the problem become more specific, and the vision of the artifact or an intervention materializes (Purao 2013). Ultimately, the proposed solution is evaluated against the project's goals, derived from the needs of stakeholders (Pries-Heje et al. 2008). Optimally, the artifact solves the problem, achieving the goals and fulfilling the needs while originating new knowledge of broader relevance.

The discourse on definitions for problems and problem spaces has intensified recently (Baskerville et al. 2018; Maedche et al. 2019; Nielsen 2020; Peffers et al. 2018; Purao 2013). It led, among others, to the notion of *problem space exploration* as a way to make a standalone contribution (Mulgund et al. 2022). Part of the discussion about understanding the problem space focuses on what constitutes a problem space and its boundaries. The literature refers to broad categories such as stakeholders (Maedche et al. 2019), organization (Nielsen 2020), and context (Herwix and Zur Heiden 2022). However, only some works try to unpack the meaning of those categories, and even then, the proposed framings remain recursive (Nielsen 2020). Nevertheless, all agree that properly exploring the problem space is necessary and needs multiple iterations to make sense of it.

Medical Informatics

Medical informatics is a relatively young, multi-disciplinary research field, which recently has expanded its scope under the broader name of "digital health". It aims to study how to improve people's health with the

support of information technology. Consequently, research strongly focuses on designing, deploying, and evaluating digital health tools. Medical informatics draws on advances in computer science, such as artificial intelligence, big data analysis, and mobile technologies, to build digital health tools addressing health issues worldwide (Haux 2010). Medical informatics has proven its relevance as a growing research field over the last decades. Recent successes can be clustered into data-centered and human-centered studies (Han et al. 2022; Staehelin, Franke, et al. 2023). In the former, for example, artificial intelligence supports clinicians in decision-making by analyzing and comparing imaging data (Hosny et al. 2018; Yu et al. 2020). In the latter, digital health tools have extended the reach of health systems in rural areas to increase health equity. For example, Miscione (2007) discusses the practices of telemedicine in the upper Amazon intended to connect citizens with clinicians across long distances. A growing body of research also studies the design of digital tools for community-based healthcare to enable lay people - so-called community health workers - to provide critical health services such as maternal care (Gilmore and McAuliffe 2013).

Medical informatics researchers apply user-centered design approaches such as DSR to design and evaluate digital health tools. As a result, they experience the challenges described in the previous section. For example, in community-based healthcare, digital tools enhance the effectiveness of Community Health workers (CHWs) to address the increasing issue of medical staff shortage by providing basic, high-quality health services to their community (Staehelin, Dolata, et al. 2023). However, they often neglect the users' preferences (Staehelin, Greve, et al. 2023). We argue that these ambiguous outcomes stem from the single problem-solving orientation inherent in medical informatics. As outlined above, design methods aim to solve a real-world problem of relevant stakeholders with new artifacts. However, these methods demonstrate context blindness that often undermines the impact of the designed artifact when deployed in the real world. How many artifacts designed and evaluated with scientific rigor following well-established theories and approaches make an actual impact for the actual user in their actual context? Not many, regretfully (Davison 2022).

EMPIRICAL ILLUSTRATIONS

In our research on digital health in the global context, we encountered multiple situations where trans-local solutions created tensions when implemented in a local context. Studying these accounts led us to the conceptualization of what we call the *solution trap*. In this section, we first introduce the *solution trap* concept and then illustrate it with two examples from our research projects. For this, we employ a socio-technical systems perspective as it emphasizes the multidirectional relation between technology, people, and their context.

The Solution Trap

The *solution trap* is a misconstruction of the problem space in engineering and DSR projects. Designers or researchers tend to perceive an application context as incomplete and specify the problem as a *lack of a solution*. For instance, difficult access to clinicians is specified in terms of a lack of personnel or adequate communication channels. Existing practice is presented as insufficient, thus demanding significant change or replacement. The reasons and origins of current practices remain uncovered. Solutions traps originated by such reductionism might lead to conflicts and undesired behaviors by the stakeholders.

Researchers in disciplines like DSR and medical informatics aim to address problems by designing a solution (e.g., with technology) deployed in the specific context. Often, the deployment leads to a combination of established and new solutions. The combination of solutions might appear to be successful at first sight. For example, introducing information systems, such as telemedicine, extends the health system's reach to rural areas. These systems promote the biomedical approach of diagnosing and treating patients to improve healthcare. With telemedicine, doctors can diagnose patients from afar, helping them get the care they need. At second sight, we argue that these approaches can fall into the *solution trap*. Diverse stakeholders (e.g., local clinicians, SMEs, and system designers) introduce their own problem-solving approaches to solving a situation. However, a new solution inevitably interplays with existing solutions, thus risking generating new problems. So, rather than the lack of solutions, the problem is their co-existence and possible tensions arising from solutions that are only partially compatible with the context they address. This incompatibility could have two consequences: First, the recipients could reject the new intervention in favor of the established practice. They reject the intervention as the behavior intended by

the designer does not align with the context within which they live. Consequently, the new artifact is not adopted, and the intervention fails to produce the desired outcome. Alternatively, the recipients adopt the solution, and probably adjust it to align with their current behaviors. User-centered approaches such as DSR go along this direction and aim to mitigate failures by promoting the exploration of the problem space beforehand. Still, they provide little guidance on how this can be achieved in a way that considers both existing and desired practices.

A Stability Problem

A digital health project aimed to implement and study telemedicine to improve health conditions in the Peruvian Amazon. The underlying idea was that telemedicine is an effective tool to make knowledge more accessible to healthcare practitioners in rural and sparsely populated areas. This system was based on the biomedical approach to treatment: it was designed to support accurate diagnosis based on collected patient data. However, it appeared as if too many patients were diagnosed with Malaria – even in cases where symptoms and data suggested the patients would not have Malaria. This mismatch was particularly puzzling because the people making the diagnosis were trained doctors. Hence, lack of knowledge could be ruled out as the problem.

In retrospect, we found that the doctors acted to keep the health system stable. They made the diagnosis based on what was available (i.e., malaria medication) and refrained from diagnoses whose treatments may require what is not available in their context. In this illustration, malaria medication is abundant, while other medications are scarce. Availability of medicines depends on many factors, including what is assumed to be a significant public health problem, like malaria. Understandably, funding comes with expectations of use. If supply is not flexible enough, compliance with expectations and insurance of future funding implies not wasting what is available. This process contrasts with the biomedical approach, often taken for granted where biomedicine is well-established and resourced, like where this telemedicine system was designed. In such contexts, doctors assess their patient's symptoms and gather data on which they base their diagnoses. The treatment is then selected based on the diagnosis, not on contingent availability of treatments. Compared to this approach, it appears that medicine is practiced backward in the illustration above, in which resource availability circumscribes the diagnosis.

So, with the introduction of telemedicine, contrasting institutional logics collided. The designers fell into the *solution trap*, assuming the insufficient knowledge distribution in the Peruvian Amazon. However, the problem was not the lack of knowledge but rather the actual options available to actors. Established, local practices foster the stability of the healthcare system, whereas the trans-local intervention is designed around facilitating biomedicine through an information system. As a result, the *solution trap* creates a conflict of interest that can put doctors in a position where they must choose whether to make a correct diagnosis for which there might be no cure available. Favoring the healthcare system's stability over biomedical procedures may not seem ethically correct. However, it is worth noting that malaria treatments can also prevent malaria, so no damage was deliberately created, and the overall protection was increased. Doctors might be inclined to protect the overall health system for the greater good rather than just acting on each case.

An Accountability Problem

As part of an international project to implement information systems to support public health, the leading group was engaged in the transition from a legacy system to open-source software. The new software promised to cut dependency on software vendors and reduce costs while at the same time improving local capacity to adapt to the variety of contexts of implementation. This effort was complemented by standardizing datasets, which meant that all local teams were expected to use a FOSS DBMS and a compatible data model. In one of these deployment locations, the local health commissioner was eager to see data, but often, the timeframes he allowed to produce reports were too short for the local team to follow the technical guidelines to use FOSS and standard data models. So, the local team used to import data in Excel, which they were more familiar with, to create reports and visualizations on time.

This departure from standards can be explained by contradicting local and trans-local institutional logics leading to the *solution trap*. The local team engages in established practices (i.e., using Excel for reporting) that align with their institutional logic. They can better meet the demands of local health needs and provide reports in due time. The intervention (i.e., standardized datasets) comes with a trans-local institutional logic that favors standardization to facilitate decision-making on a national level and even increase scalability internationally. Further, the intervention requires the local team to adapt its practices to move

from the established practices to new ones without immediate upside for them. So, the local team avoids standards to the extent that they imply a misalignment with their institutional logics. The misalignment forces them to decide between mutually exclusive solutions. They chose the established practice because of their direct accountability to the local health commissioner over their vague accountability to the leading technology focused academic group informed by the notion of global scalability. As a result, the solution tension generated a technical debt from which it was later difficult to recover.

The Relevance of Solution Traps

In the most disparate situations of life, everyone happened to see that someone was doing something based on their knowledge of outcomes rather than on being consequential on their premises. Therefore, our illustrations above hint at a general, yet often overlooked issue: targets of technological designs, as much as of public health interventions are not void recipients of solutions. Rather the opposite, they deal with several co-existing solutions for their problems. Consequently, new interventions add more options in an already crowded solution space. Adding without thinking about removing complicates problems rather than solving them. We call these kinds of situations *solution traps*, and we find them particularly important to problematize from the perspective of disciplines like DSR and Medical Informatics, which commonly assume the consequential behaviors that our examples above problematize (Chatterjee and Davison 2021; Sandberg and Alvesson 2011). We mainly focus on their single problem-solving orientation, reducing the targets to mere recipients of their plans and designs. This orientation results in context blindness as a product of reductionism to control the complexity of the problem space.

Looking at this kind of incompatibilities more closely, it becomes apparent that the reason seldom lies in a divergence in motivation, values, or aims. Instead of the start and endpoint, the tension arises from the different prospected journeys (i.e., different solution approaches). Often, the underlying assumption of stakeholders is that their solutions are easily transferable across different contexts. This assumption, in combination with an attempt to reduce complexity, leads to inadequate consideration of established institutional logics and embedded technologies. Consequently, interventions are designed to change or replace existing behaviors and artifacts, even if they may undermine their stability and accountability lines due to existing interrelated practices of all sorts. The friction of different institutional logics leads to the observation of tensions illustrated above, which lie deeper than typical organizational change problems (e.g., resistance). The *solution trap* highlights a misalignment of institutional logics for existing and intended behaviors. The *solution trap* cannot be escaped by designing an artifact that simply promises to improve the existing behaviors without understanding what keeps them in place. Would patients be better off if the personnel in both illustrations acted according to trans-local logics? We cannot say for sure.

In a nutshell, instead of spotting gaps in the literature, we engage in the phenomenon-based problematization of empirical observations (Chatterjee and Davison 2021; Monteiro et al. 2022) to identify *solution traps* that are common, yet largely overlooked, especially when it comes to "getting things done". Even though these situations frequently escape the mandate and scope of designers, they may undermine their work. Thus, they are worth consideration. Our illustrations should not be read as rare and extreme cases. Their peculiar global contexts highlight rather than divert attention from quite common *solution traps*. We have proposed a different angle that highlights the role of organizational contexts in providing different solutions, thus hindering possible coordination.

Solution patchwork

DSR methods help designers to learn from the users' practices. Existing approaches in DSR provide valuable tools for designers at the micro level. However, the artifact may not achieve the intended transformation if it is not adapted to the socio-technical context. Practice research provides the tools to grasp the users' practices, so it serves as a starting point to understand the underlying institutional logics. However, institutional logic is often hidden and unreflected, therefore, difficult to elicit. By exposing users to the designer's conceptualization of their behaviors and logic, users could be prompted to reflect on their behaviors and reason about their institutional logic.

Against this backdrop, we propose *solution patchwork* as a coordination approach to avoid the *solution trap*. The Cambridge dictionary defines patchwork as a "cloth consisting of smaller pieces of differently patterned cloth that are sewn together." It is a type of needlework where pieces of cloth form a coherent

pattern. Similarly, designers need to integrate the local and the trans-local aspects (which may not match the micro and macro levels) when designing, deploying, and adjusting an artifact. When adding a new piece to the patchwork, a tailor must make decisions about the material and color of the patch and the best stitching technique to add it to its neighboring pieces. Likewise, designers face similar considerations. The patchwork combines established practices and artifacts - digital or analog. Like seams keep the individual patches together to build a patchwork, institutional logics need to link practices, structures, and norms to form an institution such as the health system in the Peruvian Amazon. Consequently, a designer must understand the institutional logics within their problem space to judge the intended intervention. Only then can they ensure the compatibility of their new patch with the overall patchwork. A new patch might seem to fit well at first but disrupts the overall pattern. *Solution patchwork* emphasizes blending new artifacts with existing practices rather than designing to fill a gap or replace a dysfunctional practice. This means that designers need to step back from the patchwork every now and then to see the bigger picture. They might find empty spaces or overlapping patches or discover that they damaged a patch by attaching another one. Further, we argue that designers need to step back to avoid oversimplifications often used to deal with the complexity of their design problems. Moreover, designers must constantly move between the micro and macro levels to create a coherent patchwork. Instead of designing to fill a void or improve the situation with a better solution, designing for institutional logics has three consequences:

1) The designer's goal should be to add to an overall functional patchwork. The awareness of institutional logics allows them to better position their artifacts in the socio-technical context for which they are designing. It becomes apparent that their focus should shift from designing for individual practices to designing for the broader contexts (including institutional logics) for a successful transformation.

2) Designers should carefully select where they attach their new patch. By understanding the current institutional logic (i.e., diagnose malaria because of the availability of remedy), designers can anticipate how their artifact could create friction with the context. They must find entry points that complement rather than compete with existing practices. In our illustration, the availability of medication might have guided the diagnosis. A possible entry point could be to improve the availability of other medications, allowing the doctors to provide better care.

3) Designers should consider the fit between their patch and the patchwork. The patchwork analogy might suggest that anything can be stitched together. However, combining colors and fabric types is central to the overall result. While we do not question the rigor of biomedicine and IS research, we highlight the need for contextual adaptation of trans-local solutions. For example, biomedicine often stands in stark contrast to traditional medicine. People predominantly exposed to traditional medicine could be skeptical of biomedicine or even reject it altogether. Instead of replacing local health practices, embedding biomedicine in these practices could increase its acceptance. Similarly, theoretical concepts such as empowerment are based on specific cultural features. Recent studies report counterintuitive outcomes when transferred to other contexts (Staehelin, Greve, et al. 2023).

DISCUSSION

As we have argued so far, the root cause for the *solution trap* often is not the misalignment of motivation, values, and aims of the stakeholders. Instead, it is an incompatibility of co-existing solutions that causes tension. These solutions are rooted in the complexity of contexts that IS brings together by combining diverse cultures, expertise, and theories. This paper highlights the importance of considering the role of the socio-technical contexts in generating co-existing solutions rather than just producing or receiving them. Understanding the co-existence of solutions in complex contexts has two main implications:

First, there is a need for a more nuanced understanding of context unevenness (exacerbated, when not originated, by IT). Orlikowski (2002) highlights how the mutual adjustments of agents and structures are not a spontaneous blending process. Instead, it depends on how uneven powers at play favor some arrangements over others. Such a nuanced understanding of digital transformations offers the basis for a more sensible approach to guide practitioners from plan to practice. However, this broad and deep understanding is frequently lacking, at least in publications (Purao 2013). It appears that publications focus more on the solution rather than reflecting on how the understanding of a specific problem space evolved in the process and whether the final problem framing was adequate or relevant to the stakeholders. This reflects the predominant focus on solutions and, in some cases, an oversimplistic understanding of the

stakeholder's needs and organizational problems to be addressed. The study of existing practices, their origin, and values receive little attention in publication outlets (compared to other fields such as *computer-supported cooperative work*). Due to such issues, artifacts proposed in DSR projects find limited application in practice, reducing the overall real-world impact of DSR (vom Brocke et al. 2022). Structures, practices, and technologies emerge in dialectic processes in a specific socio-technical context (Bijker 1997; Dolata and Schwabe 2023). Each context is characterized by a complex interplay of actors, technologies, and artifacts. Stakeholders' needs and practices are driven by dialectic processes in organizations and society (Scollon 2001). Sadly, designers frequently abstract from this aspect. Instead, a problem is frequently specified negatively, such as *insufficient adherence to treatment*, *lack of health literacy*, or *missing resources*. This might create the illusion of a *void* to be filled with a solution, leading to a disregard for the status quo and its underlying institutional logic.

Secondly, we propose *solution patchwork* as a coordination approach to help navigate these complexities. The tension between co-existing solutions often arises from their origin. While local practices often emerge bottom-up, new interventions are implemented top-down due to their engineered single-focus task. In DSR and Medical Informatics, an innovation imperative exists that values novelty over incremental improvement. While DSR literature recommends attention to the context (e.g., focusing on practical relevance (Hevner 2007), we would argue that the preferences of the research community drag the attention away from the specificity of a context. *Solution patchwork* aims to harmonize both sides to enable the design of artifacts for their actual contexts of use. We see our proposal aligned with well-established approaches to bottom-up innovation, such as Jugaad and Bricolage. The former originates in India, where people practice Jugaad as a way "to make the most of what they have" (Radjou et al. 2012). The latter stems from the French anthropologist Lévi-Strauss and describes how people rely on combinations and continuous recombination of practices and resources to address their needs (Johnson 2012). Jugaad and Bricolage describe how people tap into the available resources and adapt their behavior, continuously evolving to improve their situation. In other words, they adjust their surroundings harmoniously with their practices and resources. S*olution patchwork* draws on this notion of (re-)combination of resources following relevant institutional logics. It highlights the need for cohesiveness in the socio-technical system and positions institutional logic as the seams that hold the institution together. We propose *solution patchwork* as an approach that bundles the chaotic innovative power of Jugaad and Bricolage in a way that enables designing for the complexity of the real world.

In this paper, we highlight a persisting problem in DSR - and possibly information systems research more broadly. Researchers and designers tend to reduce the complexity of the problem space. There might be reasons for this, including the aim to make projects manageable, the results publishable, and solutions innovative. This reduction allows them to build on well-established theories and approaches to make sense of their surroundings, design an intervention, and study its effects. Assuming a void in the target context allows researchers and designers to focus on their core competence: design and evaluate interventions based on their worldview. A growing body of research addresses bias in the design of information systems, criticizing that a small group of designers (especially from Silicon Valley) forces their worldview on the rest of the world (Avle and Lindtner 2016; Lazem et al. 2022). Similarly, theories are affected by the context from which they stem, leading to a call for context adaptation (Davison 2021; Davison and Martinsons 2016). However, we still lack effective approaches to help put IS into practice across globally spread and uneven contexts. Future research could substantiate the *solution patchwork* approach in two ways. First, a broader empirical grounding in a larger number of case studies from digital health and beyond would enhance generalizability. Second, a comparison of the *solution patchwork* to other problem-solving approaches would strengthen validity. This would further highlight how this context-centric approach differs from problem-, solution, or system-centric approaches, to name a few.

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