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Getting Around to It: How Design Science Researchers Set Future Work Agendas

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Abstract

Background: *There is a long tradition of writing about future work in research papers, and information systems design science research (IS DSR) is no exception. However, there is a lack of studies on (1) how IS DSR authors currently envision the next steps for their work and (2) guidelines to improve the communication of opportunities to accumulate knowledge.*

Method: *This paper contributes to this topic, building on a systematic literature review of 123 IS DSR papers published between 2018 and 2022.*

Results: *Design-oriented research requires the research team to decide which tasks to carry out immediately in building the future and which to postpone as research debt. The paper's contribution is threefold. First, we propose a research debt lifecycle to support (1) project stakeholders, (2) IS DSR community, and (3) societies looking for better futures. Second, we discuss the anatomy of future work in recent IS DSR. Finally, we suggest guidelines to manage and report the next research steps.*

Conclusion: *This paper presents a pioneering assessment of future work suggestions in the IS field, focusing on the design science research paradigm. Future work directions emerge from researchers' choices during the IS DSR process that must be continuously managed.*

Keywords: Future Work, Futures, Research Debt, Design Science Research, Report Guidelines.

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Introduction

"Future"," "silence," and "nothing" are three weird words for information systems design science research (IS DSR). Perhaps the best explanation lies with the quote from the Nobel laureate Wislawa Szymborska: "When I pronounce the word Future, the first syllable already belongs to the past. When I pronounce the word Silence, I destroy it. When I pronounce the word Nothing, I make something no non-being can hold" (Szymborska, 1998). First, IS DSR produces artifacts and design knowledge to create better futures that are measured by criteria of "validity, utility, quality, and efficacy" (Gregor & Hevner, 2013). Second, the prescriptive nature of IS DSR requires communication throughout the entire IS DSR lifecycle, which starts in the early stages of problem identification (Peffers et al., 2007; vom Brocke & Maedche, 2019). Third, at each step, design researchers produce design knowledge and create innovative artifacts for different sectors of society. Many future work directions are built during research projects; some will be selected for breaking the silence barrier, and hopefully, a few may reach the last research mile (Briggs et al., 2011).

For centuries, scientific research papers have included the authors' future plans. For example, in the fifteenth century, Coga (1666) stated, "the next time, we hope to be more exact, especially in weighing the Emittent Animal before and after the Operation." Other centenary examples of future work statements can be found in David Foster's text with the inspiring title "[w]hy academics announce plans for research that might never happen" (Foster, 2019). The author argues that research intentions or promises do not have a place in current research papers, effectively going beyond the advice by Booth (1975), who cautions that "who writes that an idea will be investigated may be warning you off 'his' territory." According to Gross et al. (2002), most scientific publications in the 20th century include a conclusion section with suggestions for future work (usually to validate and expand the claims). Therefore, research opportunities accessible to the academic community are generally more relevant. Nevertheless, the future is uncertain, and discussing it is one of the challenging duties of scientific writing.

But "do future work sections have a purpose" (Teufel, 2017)? According to this author, on the one hand, many future work sentences may be forgotten immediately after the paper is written. On the other hand, they "could also in principle be like a market for ideas, a notice board where we announce our true intentions, and where we compete with our readers" (Teufel, 2017). Our reaction to Teufel (2017) 's question is that future work sections are vital in design-oriented research. For example, by producing a market for design ideas (Teufel, 2017) that may exist in IS DSR publications. Moreover, reflecting on and communicating the next research step can help accumulate design knowledge (vom Brocke et al., 2020) and the necessary reassessment and refinement of artifacts (Hevner et al., 2004).

Design theories' prescriptive and projecting nature (Baskerville & Pries-Heje, 2019) are expected to produce differences in how future work directions are addressed. For example, there are recommendations to evaluate the developed artifacts' long-term organizational and societal impacts (Deng & Ji, 2018) that may span the boundaries of IS DSR projects. Furthermore, the different paths of knowledge creation in IS DSR projects represent a sequence of knowledge moments (Akoka et al., 2023) that require multiple reflections about the next steps of the research within IS DSR projects to ensure effective knowledge accumulation (Reining et al., 2022).

Doing futures is an essential mission for IS DSR researchers (Hovorka & Peter, 2019) and is one possible way to "be relevant to future practice" (Chiasson et al., 2018). The work presented by Pee et al. (2021) discusses how it is important to address futures in IS DSR, including the social impact of artifacts and the prescriptive and applied nature of theory, suggesting that "researchers need to be more forward-looking and future-oriented throughout the process of study" (Pee et al., 2021). On the one hand, the design offers a path to a desired

future (Simon, 1996). On the other hand, other possible paths also emerge in the form of future work opportunities. Discussing future work directions in IS DSR can contribute to producing value for society (Briggs et al., 2011). However, at each "research mile" published in scientific documents, researchers are also contributing to research debt: "all the work that we leave to our future selves" (Jarrett, 2019) and others.

Aiming to assist design researchers in building increasingly helpful future work directions, we formulated the following research objectives:

> *RO1. Understand how the opportunities for future work emerge in recent IS DSR publications;*
> *RO2. Explore a model to identify and communicate impactful opportunities for future work within the IS DSR lifecycle.*

The contributions of this paper are fourfold. First, the integrated analysis of future work directions in recent IS DSR publications describes the type of suggestions (e.g., artifact improvement, evaluation) and the context (e.g., social networks, sustainability) expected to benefit from knowledge accumulation in IS DSR. Second, a bibliometric analysis of future work directions is essential to compare one of the most prominent IS research approaches with other methods and areas of knowledge. Third, important sources of future work opportunities are revealed for each major phase of the IS DSR cycle. Fourth, this paper suggests guidelines for reporting future work opportunities in IS DSR publications, which can assist authors' decisions about research debt since the early stages of their work and reviewers in assessing future-oriented and impactful IS DSR. Our work provides a practical contribution to researchers in the Asia Pacific Region that are increasingly adopting IS DSR, as revealed by the knowledge profile published in PAJAIS, requiring more advances in research methods (Jiang et al., 2019).

We structured the rest of this paper as follows. The following section reviews IS DSR communication and the importance of future(s) in the IS debate. Afterward, we describe the systematic literature review. The results of the analysis follow. Subsequently, in the discussion, we present the research debt lifecycle in IS DSR and provide guidelines to include opportunities for future research in IS DSR publications. Finally, the paper closes with the main conclusions, implications, study limitations, and further research avenues.

Background

Communicating Design Science Research, Futures, and Future Work

Six core dimensions are important to effectively communicate IS DSR projects: problem description, input knowledge, research process, key concepts, solution description, and output knowledge (vom Brocke & Maedche, 2019). The problem identification is the first step proposed by Peffers et al. (2007) to guide DSR projects, requiring knowledge about the current state of the problem: "from observation of the problem or from suggested future research in a paper from a prior project" (Peffers et al., 2007). According to Peffers et al. (2007), the requirements follow the process, distinguishing what is feasible in the problem space. Design and development "include knowledge of theory that can be brought to bear in a solution" (Peffers et al., 2007). The work usually continues with demonstration, evaluation, and, finally, communication. At each step of the IS DSR process that must be explained (vom Brocke & Maedche, 2019), a new artifact or design theory emerges (Baskerville et al., 2018), embedded in key concepts selected by the authors.

Some authors proposed publication schemas to guide IS DSR communication. For example, the key contribution of Gregor and Hevner (2013) for positioning and presenting IS DSR, the

recommendations of Baskerville et al. (2018) to balance artifact and theory, or the DSR grid (vom Brocke & Maedche, 2019). Other studies focused on particular schemas of IS DSR contributions, like the design principles (Gregor et al., 2020) and their projections (Baskerville & Pries-Heje, 2019). These guidelines are advancing the quality of our field, not with rigid templates but with insightful suggestions for conducting and presenting rigorous and relevant research outcomes.

The research projects' present, future steps, and futures are intertwined into prescriptive design knowledge. Another inspiring stream of IS DSR research addresses the role of the future in IS DSR publications and how to "engage with the future" during IS DSR processes (Pee et al., 2021). These authors propose questions that authors may ask (e.g., about the impact of the artifact in the future, about the future changes affecting the artifact) for each of the steps proposed by Peffers et al. (2007), and address the critical axis of cohesion of our discipline, integrating the social and the technical realms (Sarker et al., 2019). IS DSR authors also need to analyze the past to prepare the future (Webster & Watson, 2002), which is a continuous task. For example, since the early stages of problem identification (Peffers et al., 2007), authors must evaluate how the selected problem or the reverse assumptions endure (Pee et al., 2021). The philosophical foundations of future-oriented IS research are important (Chiasson et al., 2018), and more future-oriented research is necessary in IS. However, despite the future-orientated nature of IS DSR papers (e.g., future challenges, future artifacts, creating better futures), researchers constantly make decisions that affect their next steps in IS DSR and may influence the future steps of other people (e.g., who uses the artifacts, who follows design principles, who may be inspired to build upon their knowledge). Future work opportunities presented in research papers are only the tip of the iceberg of future work directions. Nevertheless, the topic deserves particular attention because it is a key pillar of IS DSR knowledge accumulation and evolution (vom Brocke et al., 2020).

Building upon the influential contributions of communicating and building futures in IS DSR, this paper focuses on how design researchers are reporting opportunities for future work and what can be done to assist them. Considering the novelty of this study to IS DSR (and IS, in general), the following section reviews how the problem is addressed in the related fields of management and engineering.

Related Work on Future Works

One of the most influential papers in the systematization of future research directions in management was presented by Brutus et al. (2013), including articles published between 1982 and 2007. According to the authors, future work directions "are forward looking, pointing to theoretical and methodological areas where further development is required or desirable" and how they are reported changes over time. For example, Brutus et al. (2013) found an average of 1.47 directions for future research in their sample, but "49.9% of articles reported at least one in 1982, and this percentage increased to 79.5% in 2007". Although "forward looking," they are not entirely dissociated from the study's limitations, and the two main guidelines suggested by the authors are (1) to "focus on immediate and incremental opportunities (…) within a relatively short and proximal time frame" and (2) "[u]se them as a vehicle for theoretical advancement" (Brutus et al., 2013).

Zhu et al. (2019) found four main types of future work sentences. The first type – supportive, explains the role of the study for future advances. The methodologic type (2) explains the method or algorithm needing improvement. Then, there are potential influence factors (3) pointing to aspects that can influence the results. Finally, the fourth type presents future targets and goals to be achieved in the following steps. Another classification is proposed by Hu and Wan (2015). The first two types, "problem" and "method," concern (1) extending the project results/approaches, (2) using other datasets, or (3) suggesting a new research problem or approach. The type "evaluation" is mainly concerned with limitations that can be addressed

with further work (e.g., new data sources). Lastly, the type "other" is more general and includes all the other options like specific goals or targets. These contributions suggest that it is essential to understand how future steps are being reported in specific research fields.

There are a few recommendations to formulate future work sentences. For example, Teufel (2017) suggests being more specific about the goal and avoiding sentences such as "[f]uture work will examine installing models in real world applications (…)". The typical argumentation of future work sentences can be associated with the current work's shortcomings and usually closes the argumentation cycle of a research paper (Angrosh, et al., 2012). Nevertheless, many studies may not have a sequence. An analysis by Mubin, Arsalan, and Al Mahmud (2018) on Human-Computer Interaction found that nearly 50% of the selected work-in-progress papers did not have self-citations. Moreover, only roughly half of those who cited previous work could be considered actual extensions. Despite the inherent uncertainties (some authors may continue the research not using self-citations), these numbers reveal that it would be interesting to understand how researchers report their plans. Additionally, the distinctive iterative nature of design-oriented research puts future work opportunities at the top of the researchers' priorities since the early stages of the research.

At each step, design researchers select what carries to the next phase: the problem delimitation, the potential solutions to test and develop, the type of users to address, the instantiation attributes, the evaluation perspective, or the final future work directions that are, finally, selected to be communicated. Research debt is created at each step, some past debt may be eliminated, and others kept private. The quality of the few directions shared will influence the impact of IS DSR.

Systematic Literature Review Approach

This study follows a concept-centric approach (Webster & Watson, 2002) with eight steps that Okoli and Schabram (2010) suggested for IS literature reviews. Step 1 is defining the purpose, presented earlier in the Introduction. The others include defining the research protocol (step 2), (3) detailing the search, (4) screening, (5) appraising quality, (6) extracting the data, (7) performing a synthesis, and (8) writing the review.

Per the protocol, we included AISeL journal papers published between 01 January 2018 and 08 October 2022, using the keyword combination "design science" OR "design research." IS is a vibrant field of research, and future work suggestions are also expected to vary over time. Therefore, the research team focused on the last five years to spot the most recent trends in IS DSR. AISeL was selected because it is an essential database for our field and allows full text access to all papers. Additionally, we included a sample of recent ICIS completed research papers (2020 and 2021) to understand how future work opportunities are published in a leading IS conference. A total of 362 journal publications and 100 ICIS publications were obtained in the initial searches. Next, we searched the full text of each paper using the above keywords to check the suitability of the publications for our purpose. We excluded articles that were unclear about their contribution (e.g., DSR or design knowledge production) or did not follow DSR methodological guidelines (by checking the methods section). We coded all papers using the Mendeley reference management system (example provided in the appendix). We arrived at a sample of 123 papers.

In the sixth step, extracting data, we analyzed the content of each paper to find parts related to future work. To quickly locate them, we searched using keywords like "future" (116 papers), "next step" (29 papers), and "further research" (37 papers) because we aimed to identify explicit opportunities signaled by the paper authors. We refined the keywords after reading the initial papers in our sample (e.g., “new opportunities”, “directions”). Then we screened the conclusions for elements that seemed to be future work suggestions, even if the authors did

not use the selected keywords. The synthesis of studies (step 7) followed a concept-centric analysis (Webster & Watson, 2002) of the 123 papers used to write the review (step 8). The team continuously discussed the results to complete the classification of papers using a snowballing procedure: each form of future work (e.g., validate or instantiate the artifact) or research context (e.g., social networks) was included in a list, continuously incremented, and refined until all papers could be classified. A similar process was adopted by Barata et al. (2023) in the analysis of IS DSR publications.

Figure 1 presents the sample distribution according to the sources and year of publication.

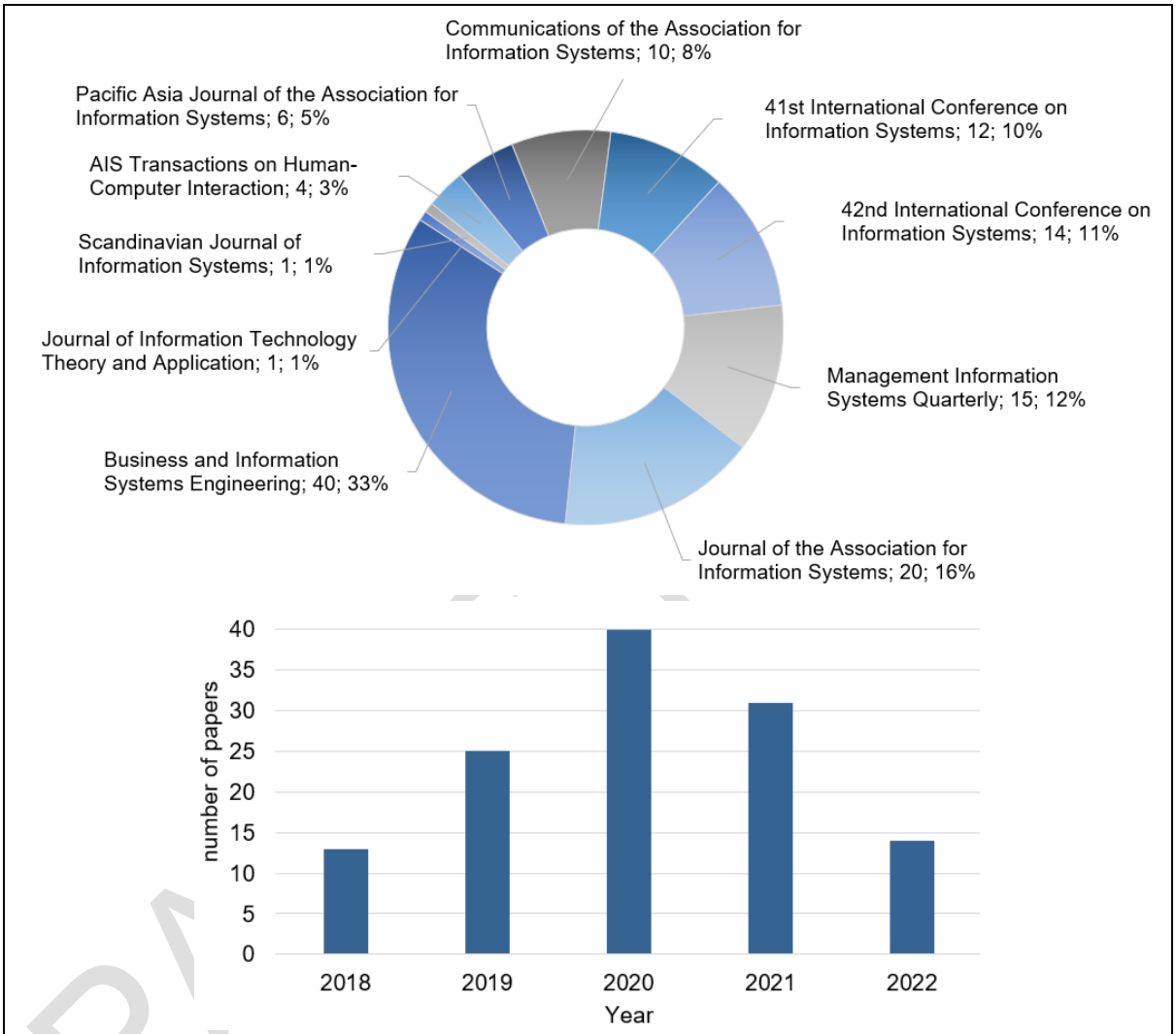

Figure 1 – Distribution of the 123 IS DSR Publications

BISE accounts for the majority of IS DSR papers, followed by JAIS, ICIS, MISQ, CAIS, and PAJAIS in the top six outlets. The past three years represent almost 70% of the papers in our sample.

Results

This section starts by describing how IS DSR authors state their suggestions for future work. Afterward, an analysis of the most important types of future work directions in IS DSR is presented. Finally, the context of future research opportunities is revealed.

The Form of Disclosing Future Work

A remarkable average of 3.7 (median 3) opportunities for future work were identified in our paper sample (reaching a total of 499). This value is more than double the findings (1.47 on average) by Brutus et al. (2013). Still, the difference must be evaluated in the light of the timeframe: we selected recent research while similar previous studies included articles published in the past decades.

Most analyzed papers (69%) present suggestions for future work that are not particular to the authors' plans. For example, "[t]herefore, it is valuable to understand the" (Adomavicius et al., 2019). An example of a study revealing the authors' intentions is "[i]n the future, we will improve our approach (…)" (Chau et al., 2020). A similar share of authors (69%) separates the study limitations and future work opportunities. For example, pointing to opportunities for future work in the discussion (Albizri, 2020; Beck et al., 2020; Eryilmaz et al., 2018; Hauser et al., 2019; Kraschewski et al., 2020; Malgonde et al., 2020; Shin et al., 2020; Simonofski et al., 2019; Ulrich, 2018), or in diverse sections like the evaluation (Bouayad et al., 2020; Graafmans et al., 2021; Hotie & Gordijn, 2019; Ptaszynski et al., 2019), contributions (Samtani et al., 2022), appendix (Abbasi et al., 2018; Storey & Park, 2022), or combining multiple sections (Chanson et al., 2019; Ostern & Riedel, 2021), such as discussion and limitations (Lins et al., 2019).

IS DSR is rich in informing the future. However, a still high number of papers (31%) are not fully exploring the potential of future work directions beyond limitations. Some of the references presented above may inspire researchers to extend their suggestions, founded on the research results, in different sections of the paper.

Creating Future Research Directions in IS DSR

Figure 2 identifies the concept-centric classification (Webster & Watson, 2002) of the analyzed IS DSR studies.

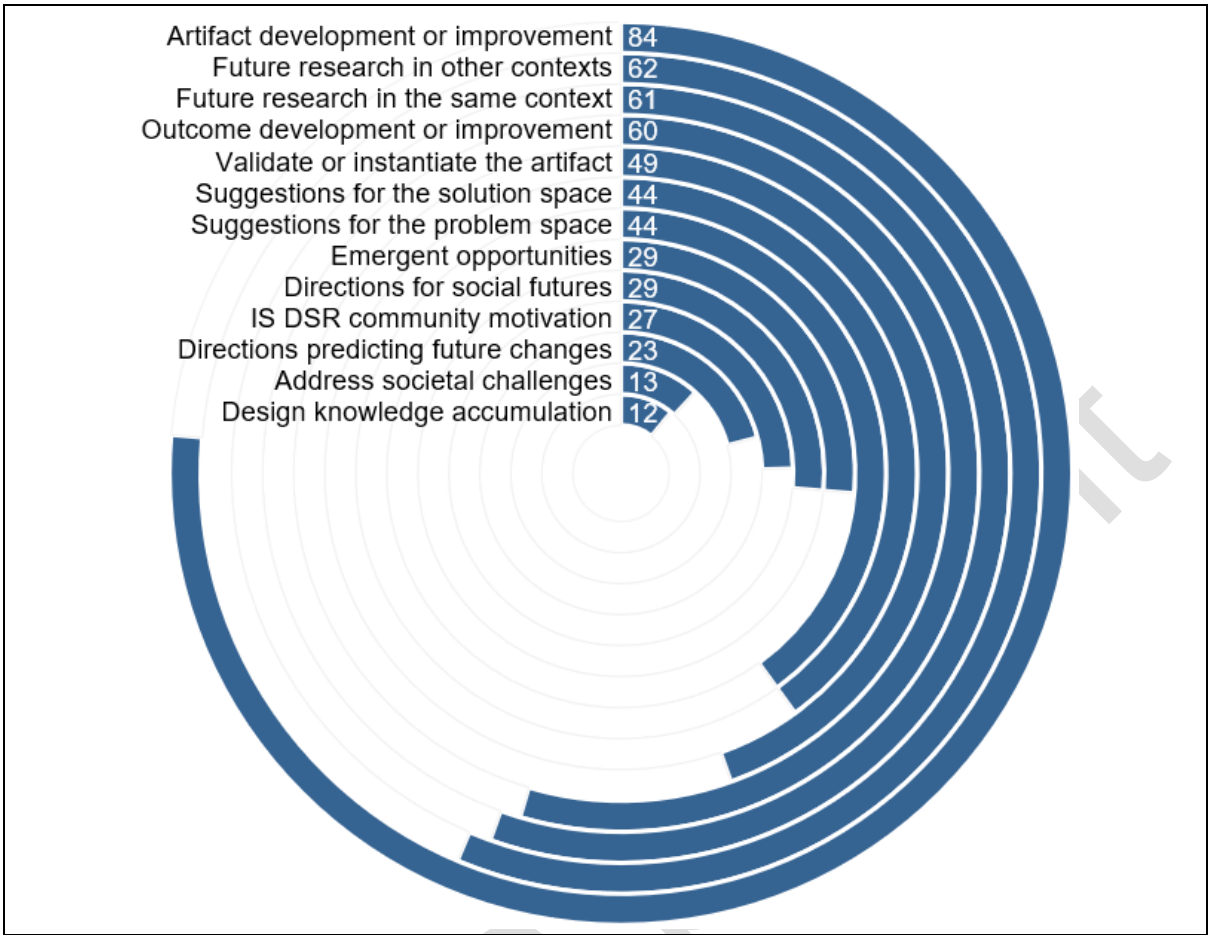

Figure 2 – The Anatomy of Future Work Directions in IS DSR (Number of Papers)

The artifact is central to building IS DSR futures. Figure 2 shows that artifact development or improvement represents the most frequent recommendation to continue the research (84 studies). For example, "a future research direction would be the augmentation of the artifact with further inference ability to calculate the absent financial concepts in a specific report" (Liu et al., 2020). The best examples recommend how it could be done "[w]henever extending the model, we recommend carefully deliberating (…)" (Linhart et al., 2020).

The context is another important distinction for further advances. Suggestions for further research in the same context as selected by the authors (61 papers, 49,6%) or extending the work to a different context (50,4% of the papers, 41% with examples) are balanced. In our sample, we found good exemplars for both. However, the most complete include (1) a good justification for the need (e.g., other contexts may have specific characteristics that could affect the results or explore the artifact more effectively), (2) examples, and, if applicable, (3) references to support the suggestion or guide researchers interested in it. We highlight the cases of Malgonde et al. (2020), Morana et al. (2019), and Linhart et al. (2020). Improving the outcomes (e.g., results, impact) follows with 48% (e.g., "research could conduct evaluations focusing on investigating potential mediating or moderating effects between the [results and…])" (Morana et al., 2019)).

To instantiate and validate the artifact in real-world settings is necessary for 40% of the papers. This need is plausible in design-oriented contributions (e.g., producing design guidelines, models, and frameworks). However, we found some situations where it was unclear why it should be done. If authors suggest putting principles into practice or testing a conceptual model in a real-world situation, the reader may ask why it was not done already. IS DSR authors could explain the benefits that the suggested artifact/design theory may reveal to

specific contexts and what could be learned from that process. Another interesting option is to suggest how other artifacts could incorporate the contribution, leading to accumulating knowledge. Merely proving that an artifact can be instantiated may not be a solid reason to motivate other researchers' decisions.

IS DSR studies include examples of the future problem space and solution space (both with 44 papers, 36%). This classification is inspired by the DSR grid proposed by vom Brocke and Maedche (2019) to communicate DSR projects. We also found their proposal interesting to guide suggestions for future work, particularly in these two dimensions. On the one hand, the future problem space may include other variables, other types of users (stating who they may be), or other sectors of the economy (stating the characteristics justifying the proposal). On the other hand, artifacts can be combined for the solution space, contributing to accumulating design knowledge or extending with additional features.

The last six concepts depicted in Figure 2 were not prevalent (below 25%), but we found them promising to the particularities of IS DSR. Several unexpected opportunities may emerge while designing artifacts. For example, see Shin et al. (2020):

> "[r]esults of the tests for the impact of time pressure on the use of recommendations contradicted what we expected based on […explain why…] could be different explanations for this […possible reasons described…] [o]ur experiments were not designed to tease out the reasons for this, but future research can explore some of these possible explanations in detail […clarify the delimitation and present the opportunity]".

Other excellent papers could be mentioned. All share similar characteristics: they (1) identify the opportunity in the discussion, (2) explain it, and (3) present the suggested sequence. This observation is consistent with other practices that we consider valuable: future work directions are essential in conclusions or future work sections but may also be discussed along with limitations or emergent issues.

Some authors look farther ahead in time. They envision how the future could/should evolve and consider the societal challenges and the role of their contribution. Some studies address sustainability issues (Kraschewski et al., 2020), making this attempt more obvious. In other cases, authors identify risks emerging from their proposals (directions predicting future changes), as in "further issue that should be covered by future work are novel attacks and weaknesses that result from displaying reputation data in visualizations or involving the user in reputation assessment" (Sänger & Pernul, 2018), or present extensions to the artifact or theory that could be interesting to address societal challenges. A separate section with implications for the future seems relevant in these cases.

Finally, researchers may also want to motivate the IS DSR community to continue their work and contribute to accumulating knowledge. The latter can be achieved via the integration of artifacts or the extension of design principles. We found that only a minority of papers talk directly to the IS DSR community, which is not a problem, in our opinion. Still, when the research topic includes more complex settings like smart cities or smart vehicles, it seems relevant to understand how our community could continue to add value. One possibility is to separate future work opportunities for design-oriented studies and other research approaches (e.g., Lee & Ram, 2021; Poser & Bittner, 2021).

The Context of Future Work in IS DSR

Figure 3 presents the context and sub-context of future work directions in the IS DSR papers we analyzed.

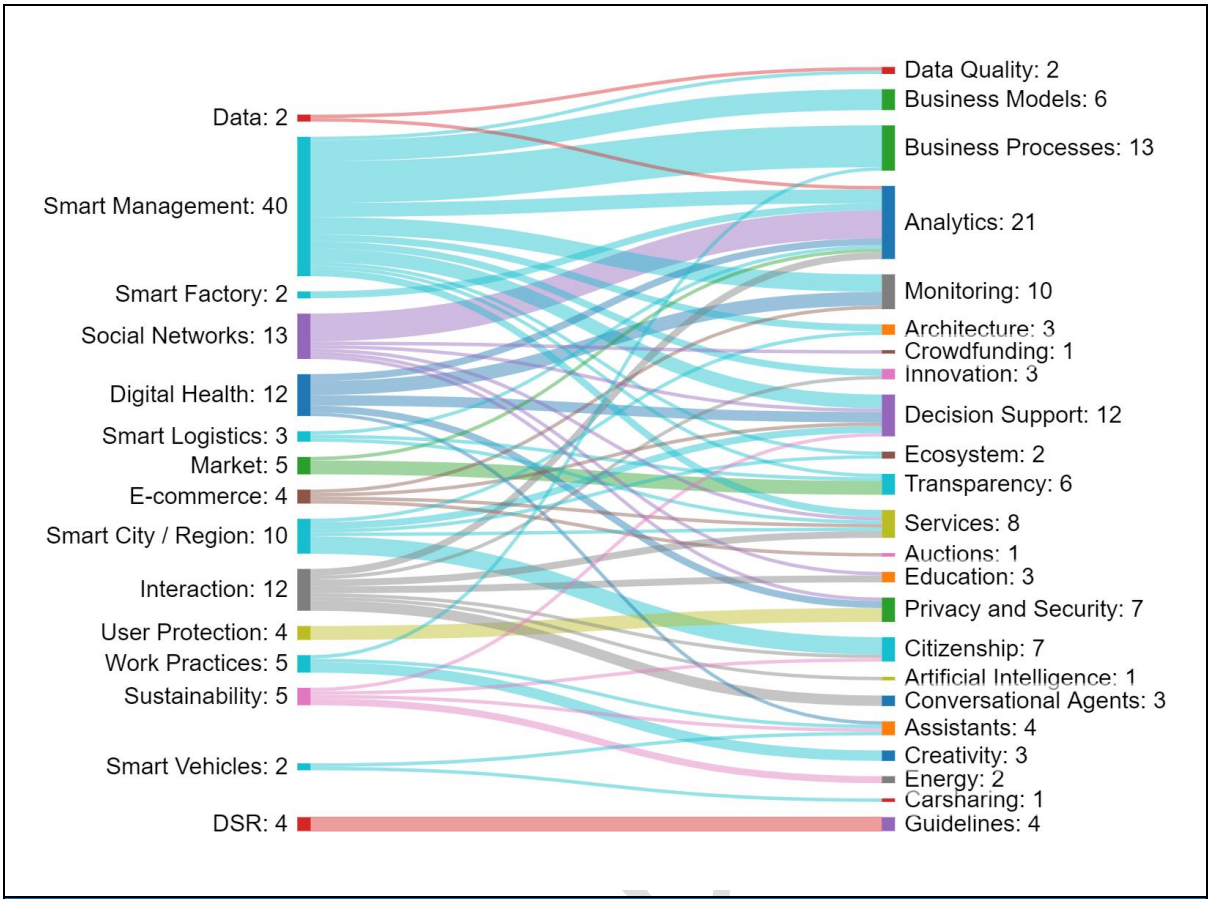

Figure 3 – Context and Sub-Context of Future Work Directions in IS DSR

We classified each paper according to the context for future work directions (15, on the left) and sub-context (on the right). We identified sub-contexts in a second round of paper review. They have synergies with the main context and are transversal to the context classification. For example, "monitoring" appears in the "digital health" context (e.g., Feldman et al., 2022; Son et al., 2020; Zhang & Ram, 2020) and in "smart management" (e.g., Sänger & Pernul, 2018). Recent IS DSR papers focus primarily on the organization (67% of the studies). Societal goals (e.g., energy conservation, e-participation in smart cities, user protection, fraud detection) are still a minority, with 27% (the remaining 6% related to research issues).

Smart management is the most popular context of IS DSR. Sub-contexts include business processes visualization, modeling, mining, and description (Del-Río-Ortega et al., 2019; Goman & Koch, 2021; Graafmans et al., 2021; Grisold et al., 2022; Pöhler et al., 2021; Schlauderer & Overhage, 2018; vom Brocke et al., 2021), digitalization (Denner et al., 2018; Jose et al., 2020), prioritization (Lehnert et al., 2018), guidance (Morana et al., 2019), enterprise systems (Demazure et al., 2021) and advanced dashboards (Toreini et al., 2022), or IS success measurement (Mayer et al., 2021) and the popular cluster of business models (Avdiji et al., 2020; Gilsing et al., 2021; Linhart et al., 2020; Pant & Yu, 2018; Simmert et al., 2019; Turetken et al., 2019). Other works address service systems (Baer et al., 2021; Beverungen et al., 2018), ecosystems (Bork et al., 2019), the potential of data and technologies for analytics (Chakraborti & Dey, 2019; Hirschlein & Dremel, 2021; Nalchigar & Yu, 2020; Nimmagadda et al., 2021), including natural language processing techniques (Bhattacherjee & De Oliveira Silveira, 2021) recommendation systems (Wang et al., 2020), architecture (Rurua et al., 2019; Widjaja & Gregory, 2020), or innovation (Ostern & Riedel, 2021; Rueckel et al., 2020), with several examples focusing on blockchain (e.g., Fridgen et al., 2021). The list of smart management studies is vast, and many intertwine more than one sub-context; for example, Evron et al. (2022) address data quality in business processes.

The emphasis on managing digital organizations is spreading to broader contexts of smart cities/regions (Bastidas et al., 2022) and smart factories (Miehle et al., 2020). For example, in emergency response (Valecha et al., 2019), community healthcare (Khanom & Miah, 2020), or rural development (Hosseini et al., 2018). Additionally, the traditional focus of policy decisions (Oberdorf et al., 2020) is being expanded to citizenship and e-participation (Becker et al., 2022; Fegert et al., 2020; Gebken et al., 2021; Ginige et al., 2020; Vogel et al., 2020).

IS DSR addresses economic, environmental, and social aspects. We can find important contributions to e-commerce (Miah et al., 2019; Wu et al., 2019) and work practices and automation (Ciriello & Richter, 2019; Engel et al., 2021; Grund & Schelkle, 2020; Wiethof et al., 2021). Other studies focus on user protection (e.g., Lee et al., 2018), cybersecurity (Ebrahimi et al., 2022), transparency (Steenbergen & Meesters, 2021), green sensemaking (Tiilikainen et al., 2021), networks (e.g., Janiesch et al., 2020; Lipusch et al., 2020), or digital health (Eigner & Bodendorf, 2020; Fang et al., 2021; Huangfu et al., 2018; Sjöström et al., 2022; Valecha et al., 2021), with multiple variants like senior care (Zhu et al., 2021), monitoring and analytics (Yu, 2021), decision support in the supply chain (Oberdorf et al., 2021), with an interesting example of future-oriented study in this topic presented by Gand et al. (2021). Studies addressing market and competition can be found in Heinrich and Schwabe (2018); Liu et al. (2020); Siering et al. (2021); and Zhang et al. (2020).

Social networks and social media are vibrant topics in recent IS DSR publications, with several examples in top journals for users protection (Han et al., 2021), decision support (Velichety & Ram, 2021), text production (Mäkipää & Isohella, 2022), or advanced analytics proposals (e.g., Hacker & Riemer, 2021; Xie et al., 2022).

The contributions to efficient and sustainable transport, logistics, and supply chain (Berkemeier et al., 2019; Filipiak et al., 2020; Prinz et al., 2021; Strohmann et al., 2019; Zampou et al., 2022), vehicle sharing (Prinz et al., 2021), and assistants (Strohmann et al., 2019) are increasing. However, there are also examples of online reviews' sustainability (Savarimuthu et al., 2020). The future of user interactions is also emerging in conversational agents (Diederich et al., 2020; Feine et al., 2020; Janssen et al., 2021), enhanced user experience (Djamasbi & Strong, 2019; Förster et al., 2020), training (John et al., 2022), services (Niemöller et al., 2019), skills (Wambsganss et al., 2020), and government interfaces (Scholta et al., 2020). Generating (Jouck & Depaire, 2019), mining (Zschech et al., 2020), searching (Sturm & Sunyaev, 2019), and ensuring data quality are priorities for the future (Zhang et al., 2019). Finally, our sample included contributions to improve IS DSR approaches with method engineering (Goldkuhl & Karlsson, 2020), design principles (Gregor et al., 2020), or knowledge accumulation (Legner et al., 2020).

The following section discusses how authors are stating their directions for future work.

Discussion

Future work directions may appear in different parts of the paper, with different purposes. For example, a few authors use them when stating the delimitations of their work (e.g., "part A is out of the scope of this study and is also a possibility for future research"), while others present them side by side with the study limitations and "future research opportunities are often the mirror image of the stated limitations" (Brutus et al., 2013). Both options are naturally viable when authors decide to state which parts "explicitly excluded" may be included as opportunities for future research. Nevertheless, the message communicated in the conclusions is usually more visible during the initial readings of research papers (Keshav, 2007). When discussing opportunities for future work "as a consequence" of delimitations or limitations, it is suggested to add specific examples and potential references. More specific opportunities could be included in the discussion, which seems particularly interesting when

discussing particularities of the artifact deserving future attention or aspects that emerge during the research or in evaluating IS DSR. Another alternative is to use appendixes. We do not see this diversity as problematic since IS DSR has a very high standard of discussing future work opportunities.

Future work directions are continuously interacting with IS DSR. For example, using past studies to motivate the research or the insights gathered from the artifact utility to make a more profound discussion. Figure 4 presents the lifecycle of research debt.

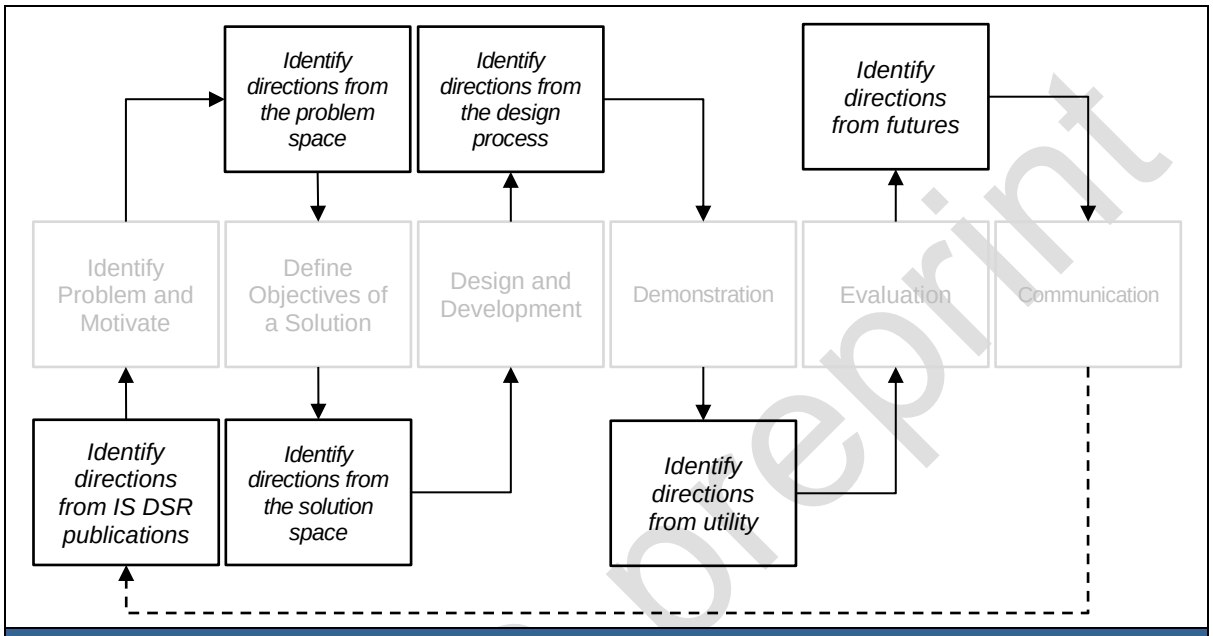

Figure 4 – Research Debt Lifecycle for IS DSR

Figure 4 presents key IS DSR steps across the middle (Peffers et al., 2007) and the different phases of changing (enriching or using) research debt. The first step suggested by Peffers et al. (2007) aims to clarify the problematic situation and explain why subsequent research efforts are necessary, motivating both researchers and the audience, before establishing what is feasible (step 2). At this stage, researchers anticipate future functionalities and architecture. Design and development of innovative artifacts represent stage 3, enabling the creation of new knowledge from the design process. The demonstration shows how the artifact performs, while the evaluation compares the outcomes with the objectives. As stated by Peffers et al. (2007), the process may have several iterations (e.g., between evaluation and step 3) before communication to different audiences (e.g., research papers, thesis, professional communities). Researchers and/or practitioners must select the most suitable project sequence for them and others at each step.

Future opportunities can emerge from (1) learning from research and practice, (2) the evolution of IS DSR process, (3) the research outcomes (e.g., artifact improvements that may be identified after the demonstration), (4) the expected future changes introduced by the research (e.g., the impact of IS DSR prescriptions in real-world), and (5) the reflections about more or less distant futures. First, the authors look at the opportunities the literature reveals (identify directions from IS DSR publications on the bottom-left) and/or contacts with the field. After identifying a problematic situation, authors discover the problem space (vom Brocke & Maedche, 2019) and define the research goals. Since the early stages of IS DSR, authors need to discard or postpone work that may be interesting to explore in the future. Design and development will iteratively search the solution space (vom Brocke & Maedche, 2019), and more ideas that the authors decide not to include (all models are simplified abstractions) may be added to the list, while other opportunities previously identified may be used.

Ways to identify impactful opportunities is the main contribution of the research debt lifecycle, and inspiring examples can be found in our sample for each IS DSR step. For example, the initial step (Identify problem and motivate) offers an excellent opportunity to expand previous IS DSR contributions (Rueckel et al., 2020) but also to (1) support the study motivation in the future work of previous studies, (2) explain why and how IS DSR can extend other methods (e.g., conceptual models created from a literature review that can now be demonstrated and evaluated in a real setting), or (3) differentiating the study. These arguments are usually found in the introduction and motivation sections of IS DSR publications.

Knowledge gaps emerging from the problem and solution spaces are essential, boundary-spanning sources of opportunities for future work (Avdiji & Winter, 2019). The problem space includes the research questions and the nature and rationale for artifact design (e.g., case company characteristics). In contrast, the solution space encompasses artifact versions and instantiations (Legner et al., 2020). For example, organizational-oriented studies (e.g., e-commerce, business models) may search for opportunities in improving society (e.g., transparency) or research (e.g., particularities of the DSR process). Also, societal-related IS DSR (e.g., transforming rural areas in smart cities) may reveal opportunities for more restricted contexts (e.g., business models of agri-food supply chains in smart cities). Therefore, future work opportunities may result from the continuous assessment from the early stages of the research. The list may be extensive at the end, so selecting the most relevant for useful knowledge accumulation will be necessary.

The design process includes the essential activities necessary to build artifacts and produce new knowledge. Logs play a fundamental role in documenting all the decisions made during design and development (vom Brocke & Maedche, 2019), supporting the authors' reflections about decisions made (e.g., model simplifications requiring future work) and alternatives that could inspire future research. The importance of logbooks can be found in fundamental IS DSR papers (e.g., Gregor & Hevner, 2013) and is crucial to establish a timeline of future work opportunities (and which ones remain at the end of the project). For example, an IT artifact may focus on requirements provided by the case company that may vary in other research contexts, requiring additional work impossible to execute in that process. Additionally, the research team can evaluate how the design was conducted to identify alternatives (e.g., different technologies, different participants) that may feed future work. Retrospective meetings after specific design and development stages are a possible solution to discuss research debts.

Later in the process, demonstrating a solution (e.g., artifact instantiation) opens the opportunity to identify utility improvements (Hevner et al., 2004), revealing the performance of the "artifact in use," its impact, and its requirements, like the inspiring example presented by Chanson et al. (2019) while describing their IS DSR iterations. A more comprehensive reflection about the futures (possible, preferable) may be included at the evaluation stage (for example, as presented by Graafmans et al., 2021 or Ptaszynski et al., 2019) when outcomes can be compared to current or emergent practice. Finally, the researchers must choose the most relevant directions to disclose, thus creating the publicly available research debt. Vague suggestions or mirrored limitations (Brutus et al., 2013) will diminish the value of accumulated IS DSR knowledge.

Our research also found less common but extremely helpful examples. For instance, Siering et al. (2021) highlight that the designed artifact can be incorporated into other artifacts (e.g., specific systems), explaining the benefits and motivating future research. Linhart et al. (2020) could be mentioned to illustrate several best practices suggested in this paper (e.g., justify the suggestions, and include ideas to improve the artifact) but also less usual approaches like identifying research debt while explaining the method and evaluation strategy, as in "we applied the prototype to real-world data, not in an entirely naturalistic setting. This is planned for future research" explaining their design decision in early stages of the paper, but also the

opportunities found during the evaluation stage. It is also possible to speak directly to design researchers in future work sections (Miah et al., 2019), but we found a lack of suggestions for improving IS DSR. Similar recommendations exist, for example, in action research: "[i]n the spirit of continuous improvement, action researchers should also consider how AR in general should be refined as a result of their experiences" (Davison et al., 2004). We recommend that during the stage "identify directions from the design process," design researchers also reflect on the opportunities to improve their future work and IS DSR in general.

On the one hand, priority should be given to "immediate and incremental opportunities" (Brutus et al., 2013). On the other hand, "more distant" future work may be inspired by techniques like scenario planning. The framework suggested by Tevis (2010) is a good starting point. The authors start by (1) creating a target model for a specific time frame (e.g., five years), (2) determining the necessary actions to enact the desired future, (3) studying the possible conditions of the external environment in the future, (4) identify key events that indicate the paths towards the future conditions previously identified, and (5) planning the necessary actions (Tevis, 2010). The "desired future," however, is not arbitrary. Envisioning the future should also be design-oriented and bordered by the artifact and knowledge. For example, answering what type of future the design aims to create and proposing future research opportunities to address the risks (e.g., privacy) or identify trends (e.g., population growth, climate changes) that may affect the proposals, revealing opportunities for new contributions.

Research debt is an integral part of scientific progress. It is both weird and uncertain: maybe future; maybe communicated; maybe something. Helpful future work directions require effective documentation of the research debt emerging during the process. Moreover, it is important to balance the instrumental and the humanistic visions, exploring "how the [sociotechnical] perspective may be reinterpreted while retaining its essence, and harnessed as the discipline's axis of cohesion" (Sarker et al., 2019). IS DSR is well-positioned to integrate incremental opportunities for artifact/knowledge refinements and the well-founded mid-term and long-term complex changes expected in multiple forms of organization.

Future work and futures are closely related but are not synonyms. Discussing futures can be used to motivate the research, identify opportunities for the current work, or, after completing the research, explore avenues for future work (Pee et al., 2021). Future work directions should be action-oriented, supported by the research outcomes, justified, exemplified, and useful to the academy and practice. Stating intentions (e.g., we will use more data collected in the company to improve the artifact) is not enough to create meaningful and inspiring opportunities. Answering "what I will do" is interesting. However, revealing directions to "what others could do, including me" is far more exciting. Two cases may justify a separate section for future work directions. First, if authors are discussing IS DSR futures (Barata et al., 2019; Pee et al., 2021); second, if the authors are proposing an agenda for future research or suggesting more detailed research questions that would be extensive to discuss in the discussion, limitations, or conclusion (e.g., Albizri, 2020).

Our contribution advances the field of schemas to guide IS DSR with examples of relevant future work directions and decision touchpoints within IS DSR projects. Nevertheless, some suggestions may be transferable to other research approaches. For example, action researchers are also interested in close collaboration with practitioners in their cyclic interventions and joint reflections. Our research debt lifecycle can be used to guide the principle of learning through reflection, where researchers focus on "how future studies should be planned and executed [… and] practitioners will focus on how the application of both theory and tools in this problem context may be relevant to future work in similar problem contexts" (Davison et al., 2004).

Conclusion

We presented a systematic literature review of IS DSR papers to understand how future work opportunities have been expressed. Departing from that, we proposed the research debt lifecycle to assist IS DSR authors in identifying relevant future work directions.

IS DSR is prescriptive in nature, balancing artifact and theory (Baskerville et al., 2018). Transforming the future is a priority in our field (Chiasson et al., 2018; Pee et al., 2021) and is constantly being changed (Hovorka & Peter, 2019) by our artifacts and design principles. Therefore, evaluating how we envision and write the future opportunities for our contributions is critical.

The directions for future work included in 123 recent IS DSR papers were evaluated according to thirteen concepts. Both the form and substance of future work were considered. We concluded that design researchers are shaping the future of organizational management and expanding their focus to cities, supply chains, and societal concerns.

The future challenges are on the agenda of IS DSR, but there are also opportunities to improve disclosing the futures. First, mirroring limitations is a narrow perspective. We suggest instead justifying and providing examples for work avenues. Second, authors may envision future transformations caused by the artifact or by the society, influencing artifact use, to expand their suggestions for future work. Third, design researchers may seek opportunities to integrate their contributions, increasing design knowledge accumulation. Fourth, future work in artifact validation needs to be better explained, clarifying how other researchers can explore research debt in subsequent inquiries.

There are important limitations that must be stated. First, the restriction of the sample to more recent IS papers. Second, our review protocol may raise uncertainties in the process because we did not read all papers in full. We searched for specific keywords to focus the analysis, but the classification of papers is subject to interpretation, having some subjectivity attached. Third, our study reveals forms of disclosing future work directions and their content but does not prove that these are the only possible forms. Fourth, we have presented the evolution of research debt according to the IS DSR steps proposed by Peffers et al. (2007); other IS DSR approaches exist. Finally, this is the first study about future work directions published in IS DSR publications. Therefore, our contribution identifies important stages of future work creation, reveals examples, and initial guidelines to state more useful directions to our field, avoiding more obvious or vague statements about "adopt in practice" or "improve by other colleagues." However, it misses details about the opportunities for specific artifacts (e.g., a list of suggestions for smart city advances).

There are also important directions for the future. First, as design researchers, we highlight the opportunity raised by the last limitation. Identifying a typology of future work directions in different stages, contexts, or types of IS DSR projects would be interesting. One possibility would be to extract the justifications made by the authors to pass future work to the following steps, evaluating the priorities made, for example, for the problem space and the solution space of smart vehicles. This analysis would better show how IS DSR aims to change research priorities. The second opportunity emerges from the process used in this paper. Our "human evaluation" has advantages (e.g., reasoning about each future work opportunity found, using different words, and linking to the aim of each paper) but also limits the sample size. Natural language techniques are promising (Teufel, 2017) to identify patterns for future work or other topics like study limitations, DSR methods adopted, and characteristics of specific types of artifacts (e.g., business process models). Perhaps the best approach could mix both types of analysis. Third, creating more specific studies of knowledge accumulation in IS DSR would be interesting. For example, evaluating the sequence of research-in-progress papers, following the example of Mubin et al. (2018), but also recognizing the success factors for work

progression. This analysis could provide a better picture of the volatility of futures in some areas of research. Some may have higher risks (e.g., areas unrelated to smart management and organizations), and future work could provide guidelines to assist researchers in managing future instability. Additionally, it was important to conduct the same study but using exclusively research-in-progress papers to identify future work patterns more particular to the authors' plans. Fourth, our work only scratches the surface of future work directions in quality assessment. Some good examples we found can be helpful to researchers, but more detailed suggestions about argumentation can be interesting to add. Another example includes recommendations to create future work directions logs in IS DSR projects. Fifth, other research approaches like grounded theory or action research can also accumulate opportunities for future work during the entire process, opening opportunities for more studies not restricted to IS DSR. Finally, our contribution modestly aims to accumulate knowledge in integrating futures in IS research: self-reported futures that deserve to be created (1) during and (2) after IS DSR. Other authors may want to explore the issues of validity or generalizability of future work contributions.

What we decide to build in our research is as important as what we decide not (yet) to build. We hope this paper may inspire researchers to create future work directions that make the best of research debt.

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Appendix A: Paper Classification Example

We have made a snowball classification: read the first paper and extracted the relevant concepts (e.g., future research in other contexts), and iteratively added more concepts as they appear in the list. When necessary, the process restarted from the first paper. For example, when we decided to classify if the paper presented specific examples of future work contexts when including the context and sub-context to improve each paper presentation, and when we made a classification with three more wide-ranging types of future contributions presented at the end of the discussion (organizational, societal, research).

Each paper was classified according to the example presented in Table 1.

Table 1 – Example of Paper Classification

Paper: Morana, S., Kroenung, J., Maedche, A., & Schacht, S. (2019). Designing process guidance systems. *Journal of the Association for Information Systems*, *20*(5), 499–535.		
Regions of interest: R1:"The investigation of potential mediating or moderating effects (…)"; R2: "Future research should provide (…)"; R3: Avenues for Future Research [Section]		
Organizational	**Context:** Smart Management	**Sub-context:** Business Processes
State authors plan (uses words like "we will", "our next steps is to…") [ ]; Includes opportunities near the limitations [X]; Future research in the same context [X] – with examples [X]; Future research in other contexts [X], with examples [X]; Outcome development or improvement [X], with examples [X]; Justification of the proposals: 1 (Not clear); 2 (Justifies); 3 (State-of-the-art) [3]; Future work presented in different parts of the paper [X], where: designing, discussing limitations, future work; Artifact development or improvement [ ]; States opportunities for knowledge accumulation [ ]; Envisage societal challenges [ ]; Suggestions for the solution space [X]; Suggestions for the problem space [X]; Directions for social futures [X]; Emergent opportunities [X]; Directions predicting future changes [ ]; Validate or instantiate the artifact [X]; IS DSR community motivation [X]; Number of relevant sentences: 9		
General comments: Presents opportunities in different zones of the paper. Link to study delimitations. Extensive discussion of limitations and related opportunities. Separate section for future work highlighting the most relevant (five).		

Notes: A "Region of interest" identifies sentences that captured the research team's attention for detailed analysis. Some papers presented more than one region of interest. The majority of papers did not present a section exclusively for future work opportunities. All papers were classified as organizational (e.g., improving managers' decisions), societal (e.g., addresses cities, wider contexts), or research (more specific to improving research), and by context and sub-context. We screened selected parts of the introduction or discussion to understand the proposals made by the authors (when the suggestions were more specific).

About the Authors

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