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Enabling Smart Service Innovation in SMEs: The bi.smart Launchpad

Research Paper

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Abstract. In the era of digital transformation, organizations are leveraging digital technologies to innovate through smart services – utilizing sensor-generated data. Despite the rich methodological knowledge available, a significant adoption gap persists in smart service innovation, particularly among small and medium-sized enterprises (SMEs) due to constraints in knowledge dissemination and resources. Addressing this challenge, we collaborated with five SMEs to develop a web application prototype, the "bi.smart Launchpad", aimed at facilitating smart service innovation projects. This paper delineates the design requirements and features instantiated in the prototype, elaborates on its architecture and implementation, and presents the results of a quantitative evaluation. Our findings demonstrate the prototype's potential to bridge the adoption gap, offering SMEs a practical and effective tool to overcome the challenges of smart service innovation.

Keywords: Smart Service Innovation, SMEs, Practitioner Methods, Prototype.

1 Introduction

Digital technologies such as cloud computing, big data, analytics, and mobile devices are creating transformative opportunities for firms to redefine market offerings and develop new business models (Chowdhury et al. 2018). This includes digital services that seamlessly integrate with existing physical products (Ulaga and Reinartz 2011; Valencia et al. 2015), such as John Deere's digital service suite that allows farmers and dealers to manage fleet data online and monitor machines remotely (Tosato 2021). These smart services rely on conventional products being transformed into smart products augmented by digital technologies, serving as boundary objects in smart service systems (Becker et al. 2013; Porter and Heppelmann 2014; Beverungen et al. 2019).

The transition from product-focused markets to integrated smart service systems is not only a technological evolution but also an economic necessity (Abramovici et al. 2018; Qi et al. 2020). Firms must shift from linear value chains to interconnected value networks to remain competitive and offer enhanced value propositions (Heinz et al.

2022a). This shift enables new revenue streams and improved customer engagement through data-driven insights and automation (Porter and Heppelmann, 2014; Beverungen et al., 2019). For example, integrating predictive maintenance services can significantly reduce machine downtime and operating costs, providing economic advantages over conventional product models (Neuhüttler et al. 2020).

Despite these benefits, the path to successful smart service innovation (SSI) is fraught with challenges (Bullinger et al. 2015; Neuhüttler and Nägele 2023). Many organizations, particularly small and medium-sized enterprises (SMEs) engaged in their core business ('brown-field innovation'), face limited digital skills, perceived risks, and complexity across business functions, as opposed to nascent entrepreneurial activities like startup incubators ('green-field innovation') (Anke et al. 2020a; Wolf et al. 2020; Heinz et al. 2022b). Specifically, the lack of established processes, roles, and methods for developing integrated smart product-service systems poses significant barriers for SMEs entering this domain (Schiller et al. 2022).

Various research streams are contributing methodological knowledge to SSI, addressing aspects such as representations of SSI outcomes (Maleki et al. 2018; Pöppelbuß and Durst 2019) and generic roles and processes for SSI projects (Jussen et al. 2019; Anke et al. 2020b; Moser and Faulhaber 2020). Despite these advances, a "last mile" gap persists in the widespread adoption and tailored applicability of SSI methods and tools (Giray and Tekinerdogan 2018; Hagen et al. 2018; Marx et al. 2020). Efforts like the DIN SPEC 33453 of the German Standards Institute (2019) aim to bridge this gap by integrating existing methodological knowledge into applicable toolboxes. However, the applied static formats fall short of the potential that digital technologies hold.

A previous review (Heinz and Anke 2023) suggests more effective ways of making methodological knowledge accessible to practitioners – which could be provided by academia (as suggested here), consultants (e.g., servicedesigntools.org), or public institutions (e.g., orghandbuch.de). Yet, scholarly efforts beyond traditional publications often face a short lifespan due to insufficient funding for maintenance and updates. To ensure practical impact, SSI researchers must address both "lost before translation" issues by aligning research with practitioner interests and "lost in translation" challenges by effectively translating academic research into SSI practice (Shapiro et al. 2007). Systematically addressing these issues requires that academia integrate and evolve practitioner-oriented artifacts, such as the DIN SPEC 33453, into dynamic research platforms, serving as practitioner-oriented repositories of formalized knowledge to support, for example, SSI efforts (Böhmann et al. 2014; Nambisan et al. 2017; Grisold et al. 2023). Such integrative resources would promote research in "Pasteur's quadrant," balancing fundamental understanding with practical considerations (Stokes 2011).

Existing approaches often fail to document the implicit design knowledge embedded in such artifacts. To address this gap, we conducted an interdisciplinary multi-year design science research project (Hevner et al. 2004) in collaboration with five SMEs, which aimed to design information systems (here: a web application) to support SSI in SMEs by eliciting design requirements (DRs) and design features (DFs). Our project systematically structured and integrated methodological knowledge for SSI, specifically targeting the usability needs of established SMEs, which often lack the resources for dedicated innovation facilitators and the capacity for extensive exploration.

This paper presents the final artifact built to evaluate our design, the bi.smart Launchpad (available at www.bismart.info). Over the course of the project, this web application proved to be a viable tool for SSI projects in SMEs, providing a streamlined, hands-on process with prescribed activities and applicable resources tailored to SSI. The application builds on existing meta-models for method engineering and SSI-related methodologies (e.g., the DIN SPEC 33453), and it integrates interdisciplinary methodological knowledge from information systems, service design and product engineering. For example, it combines recent SSI methods (e.g., Kurtz et al. 2023) with broadly applicable frameworks such as the Business Model Canvas (Osterwalder and Pigneur 2010). Given the scope of this paper, we focus here primarily on the DRs, DFs, architecture, and implementation of the bi.smart Launchpad rather than providing a comprehensive overview of its content. We also report the results of a quantitative evaluation, reflect on the current state of the prototype, and outline further ways to extend it.

2 Design Requirements for the bi.smart Launchpad

We systematically analyzed a rich set of empirical data to understand the challenges faced by established SMEs today, based on a survey of 71 companies, as well as 24 interviews and five workshops with SMEs that focused on their needs and environment for applying methodological resources in SSI projects (Schiller et al. 2022; Paliyenko et al. 2023). Preliminary insights into these challenges were complemented by a contextual literature review to identify and formulate six distinct empirically and theoretically grounded DRs for information systems to support SSI in SMEs, each aimed at addressing key challenges faced by SMEs today. Table 1 provides an overview of the DRs that guided the design and implementation of the artifact.

Methodological knowledge support (DR1) emerged as a primary requirement, driven by the observation that SMEs often struggle with a lack of accessible, structured and comprehensive methodological knowledge, affecting the effectiveness and efficiency of innovation projects. To address this, the artifact should serve as a central resource that provides SMEs with tailored methodological support to enhance their innovation capabilities as a solid foundation for navigating the complexities of SSI.

Independence and accessibility (DR2) was identified due to SMEs' limited resources and high dependency on external consultancy to navigate innovation processes. The artifact should be designed to enable SMEs to independently access and use a comprehensive set of innovation resources to enact the right methods that suit their specific needs and context without further external dependencies. This autonomy is essential to enable SMEs to quickly adapt to and capitalize on emerging opportunities in the digital economy, thus fostering a more self-reliant innovation culture. The notion of accessibility here specifically refers to the ease of use and the ability to access and utilize the resources without specialized training or external assistance.

Scientifically rigorous content (DR3) addresses the need for reliable, effective methods based on scientific research. SMEs have highlighted the importance of confidence in the methods they use, underscoring the need for the artifact to curate and present content that adheres to rigorous scientific standards. This requirement ensures that

SMEs have access to state-of-the-art, scientifically validated methodological knowledge, thereby fostering confidence in their innovation efforts.

Open source availability (DR4) reflects the importance of knowledge sharing and collaboration in the digital age. Making the content of the web application available without royalties or similar fees invites widespread use and adaptation to individual contexts, fostering a community-driven approach to refining and expanding its utility. While this overlaps with DR2 in promoting accessibility, DR4 specifically emphasizes the availability of the artifact to a wide range of stakeholders who may be involved in SSI projects beyond SMEs themselves, and also to other researchers who seek to build on the current state of the artifact, thus democratizing access to SSI resources.

User-friendly interface (DR5) stems from the recognition that the complexity of innovation tools can inhibit their adoption. An intuitive, step-by-step interface ensures that the artifact is accessible to users with varying levels of expertise. This DR is fundamental to making the methodological resources provided accessible and manageable to a broader segment of stakeholders in SMEs. While DR2 emphasizes the accessibility of its content, DR5 focuses on designing the tool for usability and user experience.

Situational guidance and flexibility (DR6) recognizes the diversity of SSI projects and the need for adaptable methodologies. The bi.smart Launchpad aims to provide tailored guidance, allowing SMEs to adapt methodological knowledge to the specific needs of their projects. This flexibility ensures that the web application can support a wide range of innovation activities, making it a versatile tool for SMEs navigating the digital transformation landscape.

Table 1. Overview of design requirements for the bi.smart Launchpad.

Design Requirement	The bi.smart Launchpad …
DR1: Methodological Knowledge Support	… should enable SMEs to efficiently navigate smart service innovation projects by providing a comprehensive suite of tailored methodological knowledge.
DR2: Independence and Accessibility	… should allow SMEs to independently leverage the web application without external support or specialized training, enhancing accessibility and usability.
DR3: Scientifically Rigorous Content	… should incorporate methodological knowledge that adheres to stringent scientific standards, ensuring reliability and effectiveness for smart service innovation in SMEs.
DR4: Open Source Availability	… should be provided as an open-source artifact, facilitating the democratization of methodological resources.
DR5: User-Friendly Interface	… should offer an intuitive, step-by-step interface to simplify the application of methodological knowledge for users of all expertise levels.
DR6: Situational Guidance and Flexibility	… should provide situational guidance and adaptability in the application of methodological knowledge, allowing flexibility and customization to fit individual project needs and contexts.

3 Demonstration of the bi.smart Launchpad Prototype

3.1 Architecture of the bi.smart Launchpad

To address the DRs, we iteratively developed, evaluated, and refined design principles for information systems to support SSI in SMEs. We interpreted and transformed these theory-based design principles into actual artifact features, which we formalized by describing DFs. These DFs are implemented in the bi.smart Launchpad as a knowledge portal that provides decision makers and developers in SMEs with focused knowledge and tools to extend their innovation and development processes to innovate smart services and design their product with intelligent components for data collection. Figure 1 provides an overview of the overall architecture of the bi.smart Launchpad.

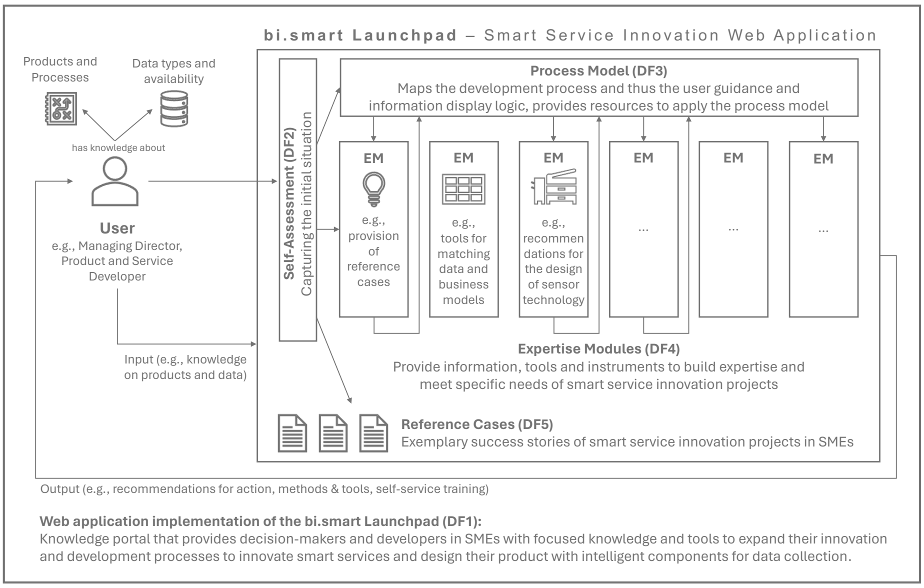

Figure 1. bi.smart Launchpad architecture.

The bi.smart Launchpad primarily focuses on SMEs that already operate in an existing core business ('brown-field innovation'), as opposed to innovation tools that target early entrepreneurial activities such as startup incubators ('green-field innovation'). Therefore, we expect the users, who are typically managing directors or product and service development teams, to already have extensive knowledge of their existing products, services, and processes, as well as what data is already available in what types and formats, which they apply as their individual input when using the bi.smart Launchpad. Through the provided methodological resources in the web application, those users can derive output for their SSI projects in the form of recommendations for action, applicable methods & tools, as well as self-service training.

The bi.smart Launchpad web application consists of multiple structural components that were individually and collectively designed to meet the above-described DRs to address key challenges that SMEs face in SSI projects. Table 2 provides an overview of these components, which serve as DFs of our protoype to address the DRs. In the next subsection, we present the set of DFs derived through our research and illustrate their implementation in the bi.smart Launchpad prototype in more detail.

Table 2. Overview of the design features of the bi.smart Launchpad.

Design Feature	DR1	DR2	DR3	DR4	DR5	DR6
DF1: Web application		X	X	X	X	
DF2: Self-assessment	X	X			X	X
DF3: Process model	X	X	X		X	X
DF4: Expertise modules	X	X	X			
DF5: Reference cases	X				X	X

3.2 Design and Implementation of the bi.smart Launchpad Prototype

The design and implementation of the bi.smart Launchpad was primarily guided by five formalized DFs to address the DRs introduced earlier. In the following, we present in detail the components of our prototype along these DFs by describing them their implementation in the bi.smart Launchpad, which can be accessed via www.bismart.info.

DF1: Wep application. Central to the design of the bi.smart Launchpad is its development as a publicly available web application that meets the requirements for independence and accessibility (DR2) and the demand for a user-friendly interface (DR5). Using Webflow, we leveraged a comprehensive library of design elements to ensure a responsive, aesthetically pleasing user experience and cross-device accessibility, which is critical for the diverse technology environments of SMEs. The application relies on a content management system to facilitate easy updates and scalability, supporting SMEs' need for a self-sufficient resource (DR2). Accessibility is prioritized by eliminating barriers such as payment or mandatory registration, in line with our goal to democratize access to innovation tools and methods (DR4). These two DRs are further addressed by deliberately providing the content in German, the first language of the primary addressees of this project, while future translations are planned. To build trust and strengthen its credibility, the application includes testimonials from industry and academic partners, as well as information on public funding (DR3). In addition, a repository of academic publications underpins the application, providing users with a foundation of rigorous scientific knowledge (DR3).

DF2: Self-assessment. The self-assessment component serves as the primary entry point for SMEs using the bi.smart Launchpad, ensuring that each SME's unique project context is thoroughly understood and appropriately supported. Through a questionnaire-based interface, SMEs can provide insight into the context of their SSI project and their organizational specifics. This ensures user-friendliness (DR5) and paves the way for customized support in future versions of the bi.smart Launchpad.

By analyzing responses and comparing them with clusters of existing cases that have been studied in more detail in previous research, the tool matches SMEs with the most relevant entry scenario to provide immediate feedback on common challenges identified (Figure 2). In its current stage of implementation, the scenarios are distinguished along three dimensions: business focus (products/services/solutions), maturity of development processes, and degree of standardization of the business. This matching is consistent with DR6 to provide situational guidance by connecting SMEs to relatable success stories (see DF5) and suggesting methodological resources tailored to the project's respective requirements. Such tailored suggestions fulfill DR1 by facilitating efficient navigation through SSI projects. In addition, the self-assessment tool enables SMEs to start their innovation journey with minimal external dependencies (DR2). Overall, this DF ensures that SMEs have a personalized, actionable plan based on their self-assessment results, promoting a guided exploration of the bi.smart Launchpad.

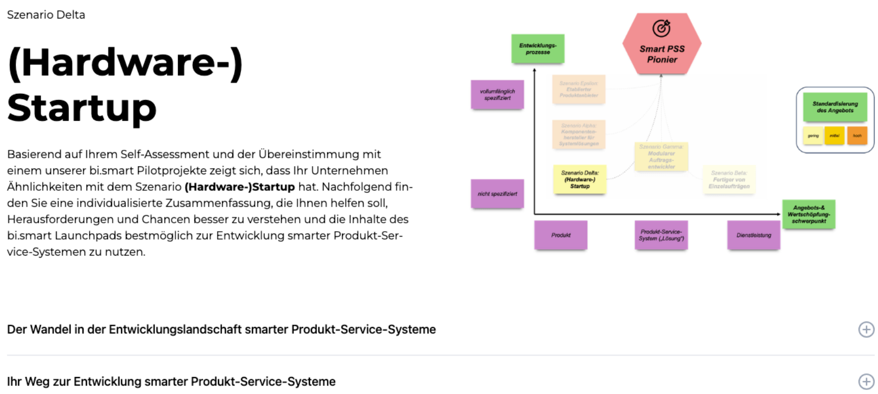

Figure 2. Excerpt of a scenario description as a self-assessment response.

DF3: Process model. The process model is a key DF of the prototype, designed to guide SMEs through integrated product and service development for SSI. This model provides a clear sequence of process steps, tasks, and methods, ensuring that SMEs can efficiently navigate the innovation process, directly addressing DR1 (methodological knowledge support). It is equipped with appropriate methods and tools, drawing on both emerging insights from the academic field of SSI and established frameworks such as the Business Model Canvas (Osterwalder and Pigneur 2010), thus meeting the standards of DR3 (scientifically rigorous content). An assembly of excerpts from the bi.smart Launchpad in Figure 3 visualizes the layered presentation of the process model – from a general overview of the process, to the overview pages of the implemented process phases, to a detailed outline of a task within the SSI process, which then link to exemplary step-by-step method description for completing one of the tasks (only a visualization of a method template is included in the figure). In total, the bi.smart Launchpad currently includes three process phases further divided into ten process steps and 39 tasks, which are supported by 58 methods with respective templates and descriptions.

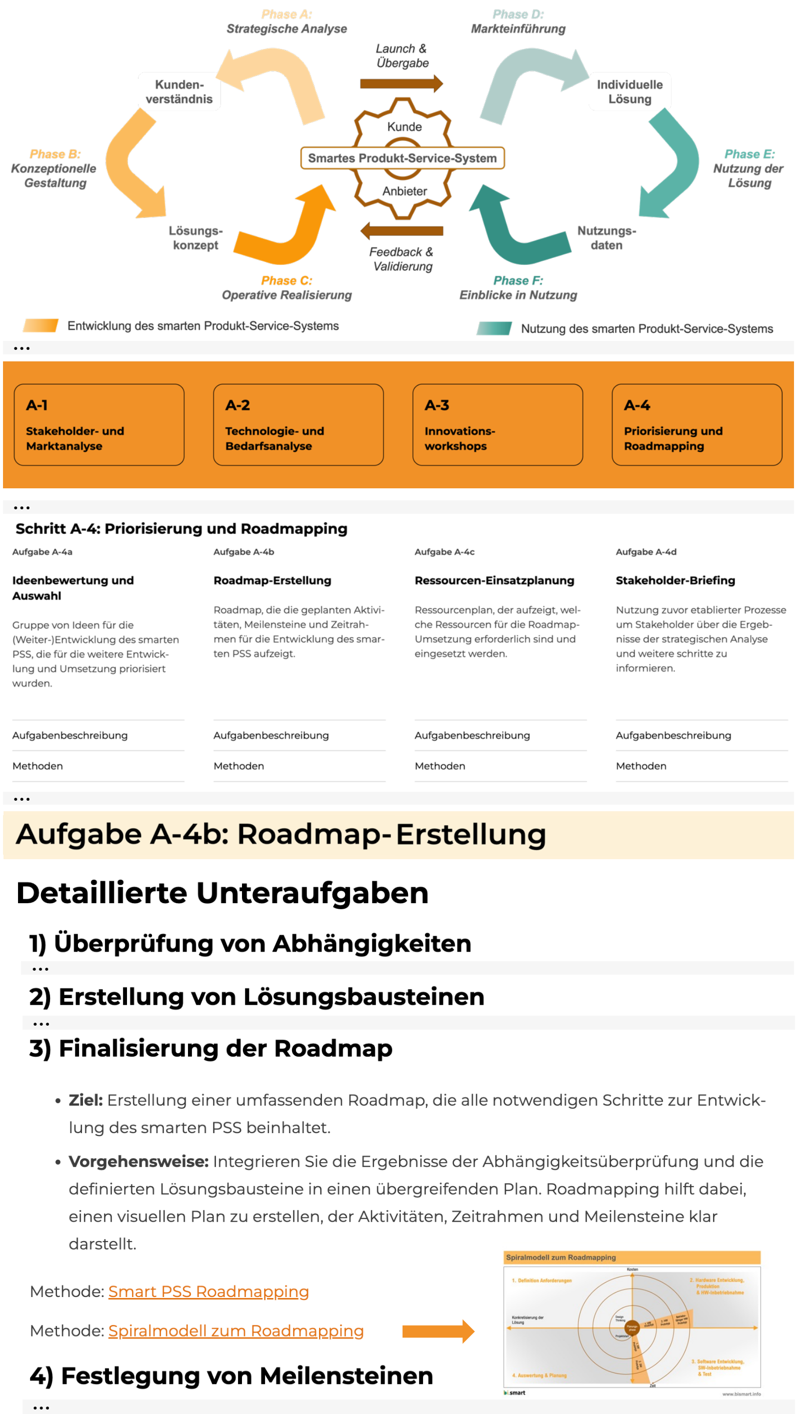

Figure 3. Overview of the different layers of resources in the process model.

Designed for independence and accessibility (DR2), the process model enables SMEs to manage their innovation projects independently without external support (DR2). Its implementation through the user-friendly interface of the bi.smart Launchpad ensures intuitive, step-by-step navigation, making complex methodological knowledge accessible and applicable (DR5). Furthermore, the adaptability of the process model to the specific needs and contexts of SME projects offers situational guidance and flexibility (DF6), providing tailored guidance and tools at key stages of the innovation process.

DF4: Expertise modules. The expertise modules within the bi.smart Launchpad serve as targeted support for SMEs navigating complex aspects of SSI, currently covering data and information management, customer (data) integration, business modeling, IIoT platforms and ecosystems, work system design, and sensor integration. These modules distill complex scientific knowledge into practical, accessible guidance by providing SMEs with a collection of tailored methodological knowledge for specific, often challenging aspects of SSI (DR1). For example, the expertise module on IIoT platforms provides an overview of different types and value constellations of data sharing platforms (Jussen et al. 2024), explains the concept of virtual sensors (Martin et al. 2021), as well as managerial approaches to foster value co-creation in IoT ecosystems (Sterk et al. 2022) among others. These modules allow SMEs to independently explore and implement new technologies and subject areas without external support (DR2) by making the latest scientific knowledge available to SMEs and translating it into practical examples. This ensures that SMEs have access to high quality, scientifically validated information, facilitating informed decision-making and innovation (DR3).

DF5: Reference cases. The reference cases in the bi.smart Launchpad provide SMEs with inspiring success stories from companies that have successfully developed smart products and services through SSI projects. These case descriptions set the context of the company and the initial challenges faced within the SSI project and then detail the project's progress, key solutions employed, and lessons learned, providing SMEs with actionable insights and practical knowledge (Figure 4). In addition, these reference cases are summarized in videos for an intuitive understanding of the project.

Figure 4. Exemplary excerpt of a reference case in the bi.smart Launchpad.

These cases contribute directly to DR1 (methodological knowledge support) by demonstrating practical applications of methodological knowledge in different contexts. The format aligns with DR5 (user-friendly interface) through engaging storytelling and visual summaries that make complex insights accessible. They also support DR6 (situational guidance and flexibility) by providing adaptable insights that SMEs can apply to their unique project needs, demonstrating how different strategies can be tailored to meet specific challenges.

4 Evaluation

Our evaluation used a structured survey to assess the bi.smart Launchpad. The survey instrument was designed to measure satisfaction with the six DRs and six evaluation criteria for the overall artifact derived from Sonnenberg and vom Brocke (2012), with responses collected on a Likert scale from 1 (poorly met) to 5 (excellently met). A total of 15 responses were collected from both researchers and practitioners with expertise in the context of smart service innovation, either from their own company context or from past and current involvement in joint research-industry SSI projects. While three participants had provided feedback at earlier stages of the project, our sampling deliberately focused on leveraging our broader network to gather unbiased feedback. The participants were introduced to our goal of supporting SSI projects in SMEs that already have a core business and asked to familiarize themselves with the structure and content of the bi.smart Launchpad in detail. They then used the survey instrument to provide quantitative feedback. In addition to the quantitative ratings, participants were able to provide comments on each rating to guide further improvement of the artifact.

Fulfillment of design requirements. Data synthesis revealed robust support for the DRs with an overall mean of 4.49. With a mean of 4.67, the prototype fulfills its core objective of providing methodological knowledge support (SI_DR1). The prototype's commitment to open source availability (SI_DR4) received very strong support with a mean of 4.8. Similarly, the mean score of 4.8 for scientifically rigorous content (SI_DR3) underscores the scientific foundation of the prototype's resources. Situational guidance and flexibility (SI_DR6) received a broader range of responses and a lower mean of 4.27, indicating opportunities for refinement, particularly in increasing the system's adaptability to the diverse needs of SME projects, e.g., by incorporating principles from situational method engineering (Henderson-Sellers and Ralyté 2010; Gottschalk et al. 2021). Independence and accessibility (SI_DR2) and user-friendly interface (SI_DR5) received lower scores with a mean of 4.27 and 4.13 respectively, still signaling support for our current prototype but indicating areas for improvement.

General Artifact Evaluation. The general evaluation criteria highlight the practicality of the prototype. Completeness (SI_EV1) achieved a strong mean score of 4.67, confirming the artifact's utility. Simplicity (SI_EV2) and Understandability (SI_EV3) each received positive reviews, reflected in their respective mean scores of 4.27 and 4.53. Echoing the sentiment of a user-friendly interface, Ease of Use (SI_EV4) and Elegance (SI_EV5), with slightly lower mean scores of 4.13 each, suggest potential areas for streamlining. Fidelity With Real World (SI_EV6), with a mean score of 4.4, indicates that the prototype effectively reflects the practical needs of the industry, although it suggests that additional tuning could better capture the nuances of SSI projects.

The data collected confirms the effectiveness of the bi.smart Launchpad in supporting SSI in SMEs. With high marks for its methodological support and scientific foundation, the prototype is positioned as a strong resource for its purpose. Despite its pronounced strengths, nuanced feedback – enriched by qualitative comments – points to actionable insights for iterative improvement. This includes a focus on increased adaptability and an optimized user experience, guiding the artifact's ongoing evolution.

It is important to acknowledge that our survey-based evaluation cannot fully validate the prototype's utility in practical settings through tangible economic benefits for SMEs, such as enhanced profitability or faster innovation cycles. The absence of metrics on economic success or smart service quality evolution leaves questions about its effectiveness and impact. While these economic implications are beyond this paper's scope, they are crucial for future research, which should connect the prototype's design with measurable business outcomes through longitudinal studies.

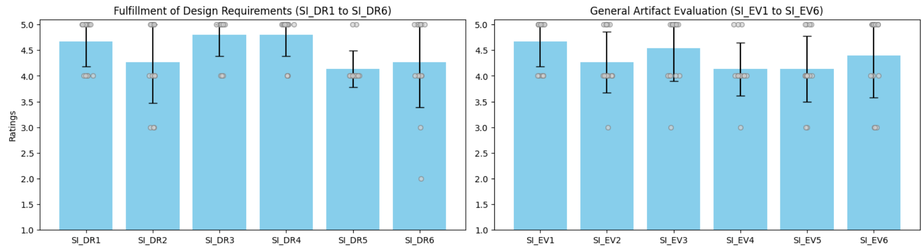

Figure 5. Evaluation results indicating mean and standard deviation (n=15).

5 Conclusion and Outlook

The demonstration of the bi.smart Launchpad prototype through the elaboration of its DFs illustrates how the artifact aims to address the key DRs identified for supporting SMEs in SSI. Each DF has been designed to ensure that SMEs are equipped with the tools, knowledge, and inspiration necessary to navigate SSI projects. Together, they enhance the usability, accessibility, and applicability of the bi.smart Launchpad, making it a valuable resource for SMEs seeking to leverage smart technologies for competitive advantage. By integrating practical tools with tailored methodological guidance and real-world success stories, the bi.smart Launchpad combines rigorous scientific knowledge with user-friendly design to foster innovation in the SME sector. Through this prototype demonstration, we not only showcase the capabilities of the bi.smart Launchpad, but also set the stage for future developments and enhancements aimed at empowering SMEs for successful SSI projects.

In considering the future trajectory of the bi.smart Launchpad, a number of extensions are being considered to enhance its capacity to facilitate SSI in the SME sector. These potential development paths build on the initial positive evaluations and foundational structure of the prototype to evolve the bi.smart Launchpad in response to the emerging needs of the SME community and the dynamic landscape of digital innovation. The planned enhancements are characterized by a focus on content expansion, enhanced user engagement, and integration of advanced technology features, while maintaining a critical balance between rich functionality and user accessibility.

First, **content expansion** within each bi.smart Launchpad component is expected to address a broader range of SSI projects. This includes incorporating materials that address specific objectives, such as sustainability initiatives or industry-specific challenges. The challenge here is to enrich the Launchpad offerings without overwhelming users, which will require further improvements in interface design and content navigation to maintain usability. Second, the platform aims to open up to scientific contributions by **introducing upload and review functionalities.** This extension aims to democratize the accumulation and dissemination of methodological knowledge by enabling broader participation in content creation and validation. Such a move towards a community-driven model not only enriches the resource base of the Launchpad, but also fosters a collaborative academic environment.

Third, increased customization through the **implementation of a digital representation layer** of individual SSI projects is considered. This would allow for methodological suggestions to be more precisely tailored to the context of SSI projects (Howell et al. 2010; Gottschalk et al. 2021), based on user inputs such as self-assessment results, use case specifics, and project characteristics. The integration of functionalities such as cookies or user accounts could facilitate this personalization, although this requires careful consideration of data integrity and keeping entry barriers low. Finally, exploring the **integration of an intelligent chatbot** within the user interface could be a significant leap toward using advanced technology to assist with methodology application and documentation. This chatbot could provide situational methodological guidance based on both structured and unstructured information available, combining generative AI capabilities with the platform's research-based frameworks.

These potential avenues for extending the bi.smart Launchpad represent a balanced approach to enhancing its utility for SMEs. Each proposed extension is underpinned by the dual objectives of increasing its comprehensiveness and ensuring its continued accessibility and relevance to the target users. As the development of the bi.smart Launchpad progresses, these enhancements will be critically evaluated, guided by ongoing user feedback and the evolving needs of SSI in the SME sector.

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References

Abramovici, M., Gebus, P. and Savarino, P. 2018. Engineering smarter Produkte und Services - Plattform Industrie 4.0 Studie.

Anke, J., Ebel, M., Pöppelbuß, J. and Alt, R. 2020a. How to Tame the Tiger - Exploring the Means, Ends, and Challenges in Smart Service Systems Engineering. In: *ECIS 2020 Proceedings*.

Anke, J., Pöppelbuß, J. and Alt, R. 2020b. It takes more than two to tango: Identifying roles and patterns in multi-actor smart service innovation. *Schmalenbach Business Review* 72, pp. 599–634.

Becker, J., Beverungen, D., Knackstedt, R., Matzner, M., Müller, O. and Pöppelbuß, J. 2013. Bridging the Gap Between Manufacturing and Service Through IT-Based Boundary Objects. *IEEE Transactions on Engineering Management* 60(3), pp. 468–482.

Beverungen, D., Müller, O., Matzner, M., Mendling, J. and vom Brocke, J. 2019. Conceptualizing smart service systems. *Electronic Markets* 29(1), pp. 7–18.

Böhmann, T., Leimeister, J.M. and Möslein, K. 2014. Service systems engineering. *Business & Information Systems Engineering* 6(2), pp. 73–79.

Bullinger, H.-J., Meiren, T. and Nägele, R. 2015. Smart Services in Manufacturing Companies. In: *23rd International Conference on Production Research*. pp. 7–13.

Chowdhury, S., Haftor, D. and Pashkevich, N. 2018. Smart Product-Service Systems (Smart PSS) in Industrial Firms: A Literature Review. *Procedia CIRP* 73, pp. 26–31.

German Standards Institute. 2019. *DIN SPEC 33453:2019-09 Entwicklung digitaler Dienstleistungssysteme (Development of digital service systems)*. Berlin: Beuth.

Giray, G. and Tekinerdogan, B. 2018. Situational Method Engineering for Constructing Internet of Things Development Methods. In: *Business Modeling and Software Design (BMSD 2018)*. pp. 221–239.

Gottschalk, S., Yigitbas, E., Nowosad, A. and Engels, G. 2021. Situation-Specific Business Model Development Methods for Mobile App Developers. In: *Enterprise, Business-Process and Information Systems Modeling (BPMDS EMMSAD 2021)*. pp. 262–276.

Grisold, T., Kremser, W., Mendling, J., Recker, J., vom Brocke, J. and Wurm, B. 2023. Keeping pace with the digital age: Envisioning information systems research as a platform. *Journal of Information Technology* 38(1), pp. 60–66.

Hagen, S., Jannaber, S. and Thomas, O. 2018. Closing the gap between research and practice – A study on the usage of service engineering development methods in German enterprises. In: *Exploring Service Science*. Lecture notes in business information processing. pp. 59–71.

Heinz, D. and Anke, J. 2023. Empowering Practitioners: A Conceptual Framework for Value Co-Creation through Smart Service Innovation Methodologies. In: *ECIS 2023 Proceedings*.

Heinz, D., Benz, C., Bode, J., Hunke, F. and Satzger, G. 2022a. Exploring the Potential of Smart Service Systems: A Multi-Actor View on Affordances and Their Actualization. *SMR-Journal of Service Management Research* 6(2), pp. 132–146.

Heinz, D., Park, H.-R., Benz, C. and Satzger, G. 2022b. Innovating Smart Product-Service Systems in Manufacturing SMEs: Current Practices, Affordances, and Constraints. In: *IEEE CBI 2022 Proceedings*.

Henderson-Sellers, B. and Ralyté, J. 2010. Situational method engineering: state-of-the-art review. *Journal of Universal Computer Science* 16(3), pp. 424–478.

Hevner, A.R., March, S.T., Park, J. and Ram, S. 2004. Design Science in Information Systems Research. *MIS Quarterly* 28(1), pp. 75–79.

Howell, D., Windahl, C. and Seidel, R. 2010. A project contingency framework based on uncertainty and its consequences. *International Journal of Project Management* 28(3), pp. 256–264.
Jussen, I., Fassnacht, M., Schweihoff, J.C. and Möller, F. 2024. Reaching for the Stars: Exploring Value Constellations in Inter-Organizational Data Sharing. In: *ECIS 2024 Proceedings*.
Jussen, P., Kuntz, J., Senderek, R. and Moser, B. 2019. Smart service engineering. *Procedia CIRP* 83, pp. 384–388.
Kurtz, J., Zinke-Wehlmann, C., Lugmair, N., Schymanietz, M. and Roth, A. 2023. Characterising smart service systems – Revealing the smart value. *SMR-Journal of Service Management Research* 7(2), pp. 112–128.
Maleki, E., Belkadi, F. and Bernard, A. 2018. A Meta-model for Product-Service System based on Systems Engineering approach. *Procedia CIRP* 73, pp. 39–44.
Martin, D., Kühl, N. and Satzger, G. 2021. Virtual Sensors. *Business & Information Systems Engineering* 63(3), pp. 315–323.
Marx, E., Pauli, T., Fielt, E. and Matzer, M. 2020. From services to smart services: Can service engineering methods get smarter as well? In: *Wirtschaftsinformatik 2020 Proceedings*.
Moser, B. and Faulhaber, M. 2020. Smart Service Engineering. In: *Smart Service Management*. Cham: Springer International Publishing, pp. 45–61.
Nambisan, S., Lyytinen, K., Majchrzak, A. and Song, M. 2017. Digital Innovation Management: Reinventing Innovation Management Research in a Digital World. *MIS Quarterly* 41(1), pp. 223–238.
Neuhüttler, J., Kett, H., Frings, S., Falkner, J., Ganz, W. and Urmetzer, F. 2020. Artificial Intelligence as Driver for Business Model Innovation in Smart Service Systems. In: *11th International Conference on Applied Human Factors and Ergonomics (AHFE 2020)*. Available at: http://dx.doi.org/10.1007/978-3-030-51057-2_30.
Neuhüttler, J. and Nägele, R. 2023. The role of Data and AI during development of Smart Services. In: *14th International Conference on Applied Human Factors and Ergonomics (AHFE 2023)*.
Osterwalder, A. and Pigneur, Y. 2010. *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. John Wiley & Sons.
Paliyenko, Y., Heinz, D., Schiller, C., Tüzün, G.-J., Roth, D. and Kreimeyer, M. 2023. Requirements for a smart product-service system development framework. *Proceedings of the Design Society* 3, pp. 3085–3094.
Pöppelbuß, J. and Durst, C. 2019. Smart Service Canvas – A tool for analyzing and designing smart product-service systems. *Procedia CIRP* 83, pp. 324–329.
Porter, M.E. and Heppelmann, J.E. 2014. How smart, connected products are transforming competition. *Harvard business review* 92(11), pp. 64–88.
Qi, Y., Mao, Z., Zhang, M. and Guo, H. 2020. Manufacturing practices and servitization: The role of mass customization and product innovation capabilities. *International Journal of Production Economics* 228, p. 107747.
Schiller, C., Friedrich, M. and Buchart, S. 2022. Dissemination of smart product-service systems in the corporate world. In: *13th International Conference on Applied Human Factors and Ergonomics (AHFE 2022)*.
Shapiro, D.L., Kirkman, B.L. and Courtney, H.G. 2007. Perceived causes and solutions of the translation problem in management research. *Academy of Management journal* 50(2), pp. 249–266.
Sonnenberg, C. and vom Brocke, J. 2012. Evaluation Patterns for Design Science Research Artefacts. In: *Practical Aspects of Design Science*. Springer Berlin Heidelberg, pp. 71–83.
Sterk, F., Heinz, D., Peukert, C., Fleuchaus, F., Kölbel, T. and Weinhardt, C. 2022. Fostering Value Co-Creation in Incumbent Firms: The Case of Bosch's IoT Ecosystem Landscape. In: *ICIS 2022 Proceedings*.

Stokes, D.E. 2011. *Pasteur's Quadrant: Basic Science and Technological Innovation*. Brookings Institution Press.

Tosato, G. 2021. Enabling the dealer network to deliver smart services. In: *Managing Industrial Services*. Cham: Springer International Publishing, pp. 173–183.

Ulaga, W. and Reinartz, W.J. 2011. Hybrid Offerings: How Manufacturing Firms Combine Goods and Services Successfully. *Journal of marketing* 75(6), pp. 5–23.

Valencia, A., Mugge, R., Schoormans, J.P.L. and Schifferstein, H.N.J. 2015. The design of smart product-service systems (PSSs): An exploration of design characteristics. *International Journal of Design* 9(1), pp. 13–28.

Wolf, V., Franke, A., Bartelheimer, C. and Beverungen, D. 2020. Establishing Smart Service Systems is a Challenge: A Case Study on Pitfalls and Implications. In: *Wirtschaftsinformatik 2020 Proceedings*. pp. 103–119.