

From living lab to scalable startup: a process design methodology for innovation

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Abstract

The paper introduces the DDI (Diagnosis, Design, Implementation) framework, a novel approach to help early-stage companies integrate data-driven process design. The framework was developed using a two-layer action research methodology involving direct intervention through workshops with three German startups. It connects process design to the business model, integrates the Voice of the Customer (VOC), and is flexible with various digital tools. Quantitative analysis confirmed significant waste reduction and improved performance indicators. Qualitative analysis of participant interviews demonstrated the framework's high perceived utility. The DDI framework provides a flexible methodology for startups to build scalable, customer-centric processes, closing the critical gap between traditional optimization techniques and the needs of new ventures. The paper shows how its application strengthens university–business linkages and enhances process design capabilities in early-stage startups.

Keywords: process design; methodology development; startups.

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1. INTRODUCTION

Nowadays, companies are experiencing turbulent times, from supply chain disruptions and rising costs to environmental regulations and rapid changes in the market and customer needs. Traditional companies struggle to survive in this challenging environment. Startups however must face additional difficulties, such as finding the product market fit, accessing resources, and scaling their business quickly (Mueller & Thoring, 2012; Ries, 2011). To succeed, startups must build their business on a foundation of solid processes from the very beginning. This approach supports resource efficiency and scalability by creating efficient workflows designed to prevent future bottlenecks and operational waste.

Universities can play an essential role, matching Startups with resource networks, coaching, knowledge and tech supporting companies to design business models and operations to address a real-world challenge. Unfortunately, such connections often prove inadequate. Startups accelerators and coaching tend to concentrate on product and market strategy, without the operational processes to create a scalable company. As a result, a serious gap emerges: founders become product specialists but remain inexperienced in operations. Consequently, when rapid growth occurs, companies unfortunately end up suffering workflow problems, operational bottlenecks, and various forms of waste.

To address this gap, Leipzig University established the Process Living Lab. Its purpose is to strengthen university–business linkages (UBL) by expanding the traditional triple helix model of technology transfer (university–government–industry) (Leydesdorff & Etzkowitz, 1998) into a fourth helix model. In this approach, customers are actively involved in the process, moving from passive recipients to engaged participants who test prototypes, provide feedback, and contribute to solution development (Leminen et al., 2012). The Process Living Lab not only researches processes but also co-develops solutions with SMEs and startups. Using a data-driven approach and digital tools, it designs, refines, and improves methods for process analysis, improvement, and design in collaboration with end users. This paper introduces an innovative University–Business Linkage (UBL) model

and a process design methodology developed through collaboration between academia and industry, transforming technology transfer from a simple exchange of knowledge into a co-creation process that enhances firms' capabilities. The framework offers a practical and replicable approach, particularly suited to the Latin American context. It presents the model's validation in the German setting, outlines the process design methodology and its core principles, and reports on both the validation results and the current stage of the technology.

2. THEORETICAL FRAMEWORK

Academic–industry collaboration has been studied for decades. Initially, technology transfer models and innovation were viewed as linear processes, and university–industry links were weak. However, several authors proposed different technology transfer models, ranging from Rogers et al.'s (2014) theory of the diffusion of innovations to Teece's (1986) explanation of why some companies achieve innovation but are unable to profit from it. These models paved the way for Leydesdorff & Etzkowitz (1998), the architects of the triple helix model. However, described technology transfer models are insufficient and must evolve to transfer technology faster to industry, especially in times where data, globalization, connectivity, and fast-changing customer needs create the need to strengthen the linkages between universities and industry. This motivates the creation of living labs that extend the triple helix model into a new four helix model, where the user becomes critical in technology transfer (Leminen et al., 2012). Now, universities can test prototypes with real customers outside of university facilities, and prototypes are tested in real settings, where they gather real data from customers; this model enables rapid iteration with the customer and timely feedback, ultimately reducing market risk during technology transfer.

Companies place a high value on their know-how. This term refers to the structured and organized knowledge that is integrated into a company's operations. This knowledge can give a company a competitive advantage, leading to success and sustainability (Tahat, 2021). It facilitates the sharing of information



and expertise, which in turn accelerates new product development (NPD) and enhances innovation. Several companies have documented success by using structured methodologies to innovate and improve their processes. Methodologies such as Lean, to eliminate waste (Spear & Bowen, 1999), Six Sigma, to achieve higher quality standards (Pande et al., 2007), and Agile Scrum (Ismayilova, 2023), to support fast iterations to improve processes and outcomes, are cases to mention in this regard.

The structured framework used to develop the methodology follows an action research model. This model integrates the researcher as part of the subject of research itself, considering every interaction as data collected (Lewin, 1946). Using this framework allows for the development of an iterative methodology that is continuously enhanced and refined based on continuous feedback. In this case, theory meets practice.

3. CONTEXT OF THE DESCRIBED RESEARCH/PRACTICE

Knowledge-intensive and technology-driven startups play a vital role in the German economy by driving innovation, opening new markets, and contributing to economic growth. The Saxony government recognizes this, and the actors within the triple helix model collaborate to promote and develop these firms. As part of these efforts, the government of Saxony has established several alliances to strengthen entrepreneurship and startup culture in the region. The

primary objective of these alliances, initiated through government-supported universities, is to strategically build networks across institutions and leverage their individual strengths, thereby creating meaningful synergies.

Thus, the Protosax program was created as part of the Startup Campus Alliance. Its primary goal is to provide spaces for creating, prototyping, and testing products and services. The program specifically supports students in testing and developing business ideas. Each participating university contributes by offering coaching services, access to labs and workshops programs focused on key areas for early-stage entrepreneurs, equipping students with knowledge and tools that ultimately foster technology transfer from academia to industry. On the other hand, students provide valuable feedback to universities, helping them improve their methods, frameworks, and technology.

The Process Living Lab at Leipzig University plays a key role in technology transfer. It researches data-based methods for process improvement, using digital tools like sensors and eye tracking to collect data. The lab then provides these services to SMEs and startups. It also fosters student research through projects that connect academia and industry. Additionally, the lab uses government resources to create international networks and promote other technology transfer models, such as hackathons and industry-academy conferences. Specifically for the Startup Campus Alliance, the Process Living Lab developed a framework (DDI) focused on process design for startups and SMEs. This methodology was developed in

response to Germany's current economic situation, particularly the shortage of skilled labor (ifo Institute, 2024). Therefore, companies are striving to make their operations more efficient and increase their output with the same resources.

3.1. Research gap

Process design is critical for organizations of all sizes. It defines the workflows, tasks, responsibilities, and resources for any given process. However, traditional techniques like Lean and Six Sigma are built for established companies with defined processes, not for startups that lack organized structures. These traditional methods typically rely on observation and non-computational analysis. But today's world of new technology, connectivity, and globalization has prompted the development of new frameworks. Modern design techniques now include computational methods, AI, and computer engineering to deliver more accurate and reliable results (Leff, 2021). Nevertheless, integrating these advanced tools creates new difficulties. Companies face challenges with specialized knowledge, data integration, security, and infrastructure (Neuer et al., 2020). These barriers make it difficult for small enterprises and early-stage startups to adopt these modern techniques. Startups face a significant gap when integrating data and digitalization into their process design. They also deal with unique challenges, such as limited resources, market volatility, and the pressure to rapidly meet customer needs (Abrantes & Furtado, 2021). Therefore, the Process Living Lab developed a new framework to close this gap. It provides early-stage startups with a set of tools to integrate digital technologies, recognizing that they often lack the infrastructure, knowledge, or resources for complex data analysis. Moreover, the developed framework is a toolset for entrepreneurs that ensures process design is directly connected to their business model. Finally, because startups prioritize innovative products and fast growth, the framework integrates the voice of the customer from the very first stage. This approach provides a deep understanding of the problem, ensuring the final processes are truly designed to meet customer needs.

The framework was developed by the Process Living Lab using an action research methodology. This

approach enabled the collection of data through direct intervention with three startups in Germany. The method facilitated the measurement of how this interaction improved the initial process design and supported continuous improvement via the canonical *plan-act-observe-reflect cycle* (Lewin, 1946). The research was structured in two distinct layers: an upper layer dedicated to the development of the framework through action research, and a lower layer for its subsequent testing. This dual-layer design was implemented to address the central research question: *how can startups integrate digital tools into their process design, and what challenges emerge during implementation?*

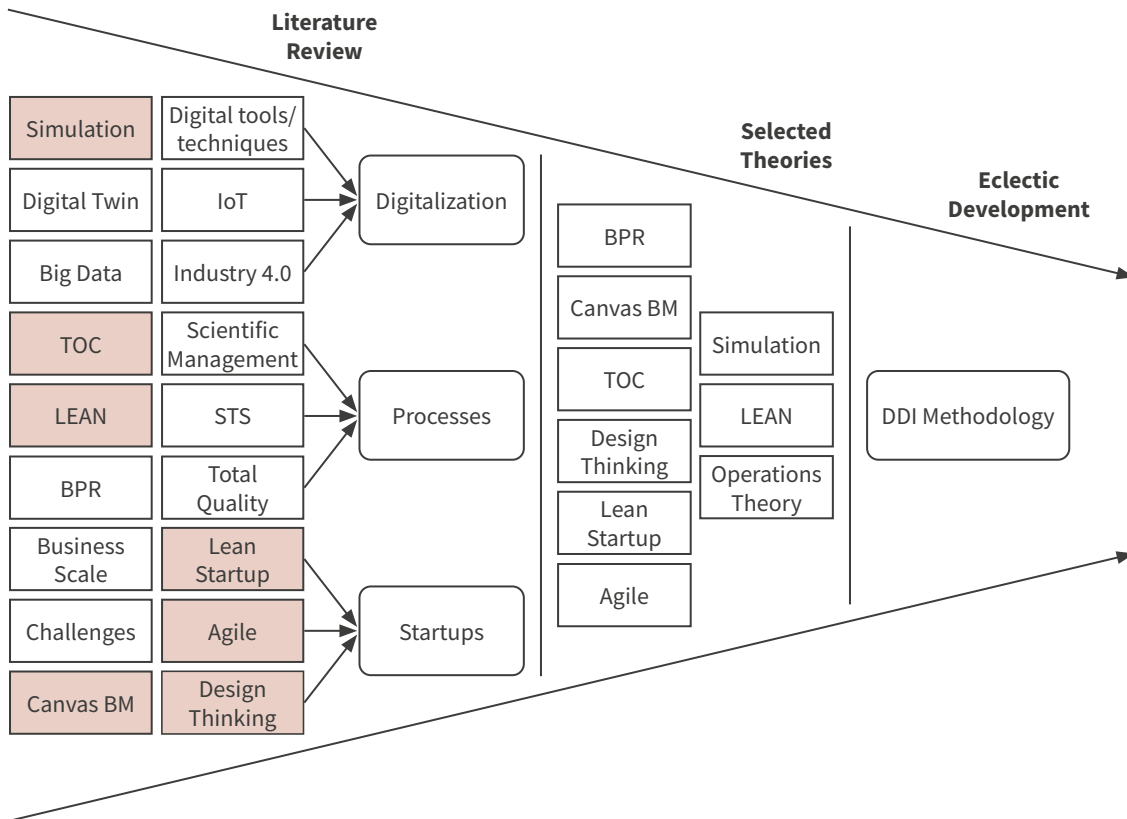
The stages of the action research cycle were executed as follows:

- *The Plan* stage focused on the development of the research methodology.
- *The Act* stage involved the implementation of the framework within the three participating startups.
- *The Observe* stage consisted of measuring the process outputs.
- *The Reflect* stage involved a detailed evaluation, where the designed process was compared against a final participant survey to assess the framework's perceived utility.

3.2. DDI methodology development

To develop the methodology, we started with a thorough literature review focused on three foundational areas: process improvement, common startup problems, and the role of digitalization in established methods. These topics were chosen because they directly address the core gap identified. Next, we used a "theory funnel" to select the most relevant theories relevant to the problem (Figure 1). Each step and activity in the methodology was then built upon a chosen theory. The result is a unique, eclectic framework called DDI: Diagnosis, Design, and Implementation.

The methodology has a strong focus on business strategy, starting with the Business Model Canvas (Osterwalder & Pigneur, 2010) to understand the startup's core activities, resources, and overall strategy. From there, we narrow the focus to a single block of the

Figure 1. Theory funnel for the development of the DDI methodology for process design

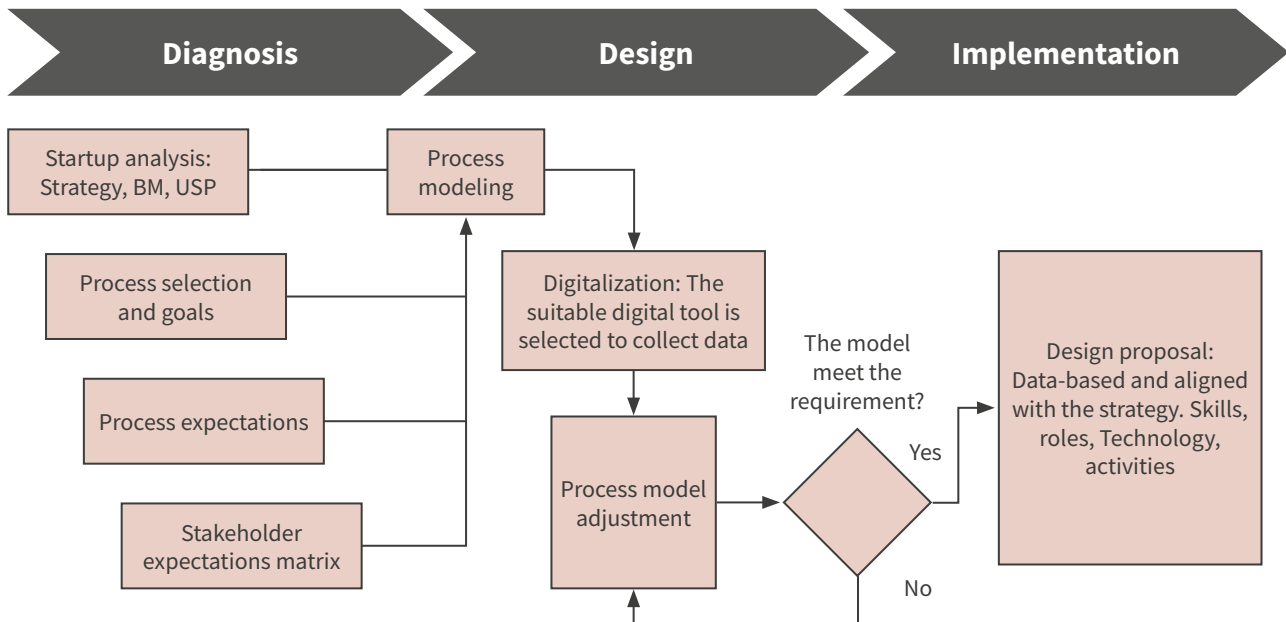
canvas to select a specific process for design, defining its boundaries, triggers, outputs, stakeholders, and the process owner. The diagnosis phase then integrates the Voice of the Customer (VOC), using a key tool we call the “matrix of expectations” to identify critical quality requirements from the customer’s perspective. Based on this analysis, we prioritize the most important criteria to ensure the final process is designed to meet customer needs (Ries, 2011). Finally, the design phase kicks off with creating a process map to serve as a blueprint, using standard tools like VSM or BPMN (Madison, 2005), depending on the process type.

4. MAIN RESULTS/REFLECTIONS

The schematic steps of this methodology are shown in Figure 2, while the relationships and outputs of each task are detailed in Table 1. The activities were applied to three selected startups, with data collected through workshops where the researcher guided the

entrepreneurs using specific questions to reach the expected outcomes. Each element was also documented to capture data that could later be used to refine and improve the methodology.

For each participating firm, two approaches to analysis were applied. First, a quantitative assessment was carried out for each process. After the process design stage, improvements were made using performance indicators such as process time and lead time, along with the identification of non-value-added (NVA) activities. Overall, waste reduction was achieved by applying the methodology. In addition, a process map was created for each case. The second level of analysis focused on qualitative data, based on final interviews with participants. These interviews were examined using qualitative content analysis to assess the perceived usefulness of the methodology. Coding categories were linked to the digital tools used in the research, and insights on perceived utility were derived from the interviews.

Figure 2. Methodology workflow

Note: Details of the order and tasks performed in designing the process using the DDI methodology.

Participants identified significant value in the DDI methodology, highlighting two main areas: a clearer understanding of their processes and actionable paths for improvement.

4.1. Key benefits

Improved Process Understanding: The most frequently cited benefit was workflow visualization. Participants consistently noted how the methodology helped them map out their current processes, making them more objective and aware. As one participant stated, “...I believe it made me more conscious of time and movements...” Another added, “...Seeing the workflow visualized in diagrams made it easier to understand...”

Structured Guidance for Improvement: The diagnostic phase was seen as a critical first step. Participants also valued the inductive questioning and expert facilitation during the workshops. This was summarized by one participant who said, “The guidance provided helped identify points for improvement that would have been overlooked otherwise.”

4.2. Challenges identified

Despite the benefits, participants also noted several challenges:

- *Dependency on Experts:* A primary concern was the reliance on expert intervention to guide tool usage and interpret data, which some felt could slow down implementation and make it harder to sustain improvements independently.
- *Complexity of Digital Tools:* Experiences with digital tools were mixed. Key issues included a lack of familiarity and technical limitations in virtual settings that affected collaboration.
- *Online Workshop Limitations:* Conducting workshops entirely online was a notable challenge. As one participant observed, “Not being able to conduct the process in person made it difficult to identify certain steps.”

5. CONCLUSION

This research presents a successful model for technology transfer, initiated and driven by a university lab. First, the Process Living Lab at Leipzig University

Table 1. *Structure of the diagnosis, design, and implementation methodology*

Phase	Activity	Outputs
Diagnosis	Understanding the startup	USP Business model Resources: human, finance Business strategy, constraints, Growth stage
Diagnosis	Process selection and goal definition	Process to be designed Inputs and expected output of the process Responsible (process owner)
Diagnosis	Define goals and expectations	List of expectations Identify common interest
Diagnosis	Expectation Matrix	Prioritize expectations Expectative matrix
Design	Quantify expectations	Feasible expectations
Design	Process modeling	Process model workflow Parameters for simulation
Design	Digitalization: data collection and transformation	Data results from model simulation. Data visualization. Insights from the data (bottlenecks, process times, total output)
Implementation	Process design proposal	A compilation of information collected from the workshops, containing a simulated process, a list of resources, and activities.

Note: This table shows the detailed tasks and outputs of each activity in the methodology. These tasks were applied via structured workshops.

used academic research to identify a real-world problem and develop a tailored framework for startups. Second, it transferred this technology by applying the methodology directly, enhancing the capabilities of three selected startups. This approach strengthens university-business linkages by developing solutions tested with real customers, effectively extending the triple helix to a four-helix model that also incorporates citizens.

The model's success is amplified by another critical element: the government's active participation. Thanks to resources from the Alliance for Enhancing Entrepreneurship, Innovation, and Startups, the framework is currently being tested in six additional deep-tech startups in Saxony. This proves that university-government partnerships can effectively integrate with

industry, in the form of startups, to enhance business capabilities across the region.

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