A Proposition for a Design Method of Service Systems*

Blagovesta Kostova[1][0000-0001-9890-5227]

[1] École polytechnique fédérale de Lausanne, 1015 Lausanne, Switzerland
blagovesta.kostova@epfl.ch

Abstract. This research is in the domain of service science and proposes a method for designing service systems. We consider three levels of design – individual, organizational, and implementation. The proposed design method links these three levels by explicit input, output, and feedback between them. We use a design science research approach to design the method. This dissertation solves a practical question – how to design businesses that fit market needs, and has a theoretical contribution as it advances service science by combining theories from three domains: cognition (opportunity recognition), business modeling, and software engineering. We use systems thinking principles to federate the above theories. We gather data and validate our concepts in three contexts – a university course, startups, and established companies. We develop the necessary constructs and models, and conceptualize the final method in three iterations.

Keywords: service design, method, opportunity recognition, business model, software engineering

1 State of Research

Service science studies complex socio-technical systems. To understand these systems, service science requires a multidisciplinary approach and a combination of methods and logic from various fields, such as computer science, psychology, design, and marketing [1]. We are interested in advancing service science by combining three research areas, namely: opportunity recognition, business modeling, and software engineering.

The desired outcome of this doctoral dissertation is a design method of service systems (**Fig. 1**) that links together three levels – an individual intuition of business, an organization of business, and an IT implementation. On the first design level, an individual, inspired by their environment, has business ideas that they believe to be valuable to a customer segment. In collaboration with other people, this individual designs the second (organizational) level to be a service system. The organizational level then feeds the third (IT implementation) level with fuzzy business needs. And the IT implementation phase yields a concrete artifact.

On each level, there are the following flows:

- Input – information received from the previous step;
- Output – processed data provided to the next level;

* Under the supervision of professor Alain Wegmann

- Feedback – meta information to guide the service designer in their work.

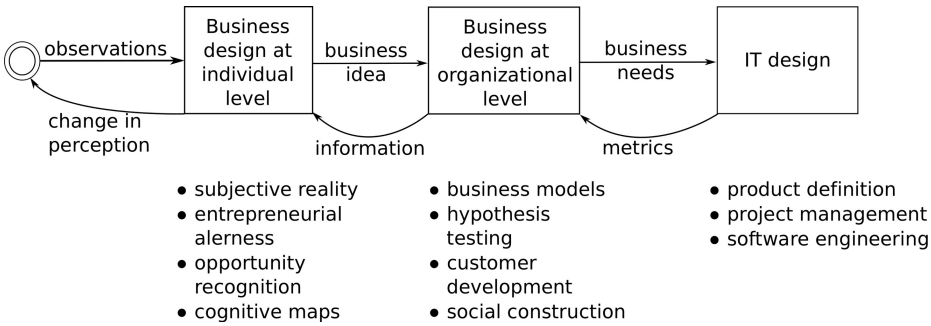

Fig. 1. Provisional service systems design method

1.1 Individual Level

The literature describes opportunity recognition (identification) as a cognitive process that consists of active or passive search, alertness, and prior knowledge [2]. Tang et al. [3] argue that the most prominent traits for opportunity identification is entrepreneurial alertness. The pattern-recognition framework [2] describes the opportunity recognition phenomenon as entrepreneurs being able to draw parallels and find similarities (i.e., patterns) in various contexts, with an alertness that surpasses active search for information. Individuals use cognitive maps to internally represent the perceived information, and these maps link together seemingly unrelated notations into opportunities [4]. The last step is a reconfiguration of elements [5], which leads to an individual's proposal for a new reality to the society, hence, social construction.

Issues: The individual's intuition about a business opportunity does not translate flawlessly to the next level, where a group of people should achieve a shared understanding.

- Input: identification of observations, which leads to a business idea;
- Output: conceptualization of the observations of the individual, first level of structuring;
- Feedback: definition of the information the individual should seek to evaluate their perception regarding the business idea.

1.2 Organizational Level

This new reality goes beyond an individual's cognitive map and into an explicit shared understanding of what the envisioned reality would be. Entrepreneurs often use business models to communicate their business proposition with others. A business model captures the most important parts of a business – the way it creates and captures value for a particular set of customers [6]. From a broad perspective, a business model is a story that explains how the enterprise works [7]. As a business model is an abstraction (it hides the complexity of implementation), the outcome of the implementation differs

from this abstract description. We need feedback on the hypotheses in order to adjust the current situation and to be able to achieve the to-be state for the organization.

Issues: On the organization level, the transition between an individual's idea (an imagined service to deliver value) to a structured definition of the service system (conceptual shared service system design) is non-trivial.

- Input: an individual's cognitive maps;
- Output: a definition of a service system that considers individual cognitive maps.
- Feedback: a definition of heuristics and of metrics to be monitored from the implementation phase.

1.3 Implementation Level

The implementation level calls for an alignment between business and IT. Zachman [8] introduces an information-systems architecture that is foundational to the field of enterprise and service-oriented architecture. Weigand et al. [9] argue that to achieve alignment in enterprise architecture, we need to adopt a service perspective. IT-business alignment can be based on a transformation of values. For example, value-based software engineering recognizes the need for market justification information and communication technology (ICT) infrastructure [10]. This value-based view over software engineering serves as grounds for service-oriented modeling methods such as SEAM (Systemic Enterprise Architecture Methodology). SEAM is a family of methods for strategic thinking, business / IT alignment, and requirements engineering. SEAM is based on software engineering and on systems thinking philosophical principles [11].

Issues: On the implementation level, we need to define a desired input that corresponds to concrete business needs and is implementable (i.e., minimizing uncertainty). By tracing the business value, we need to be able to justify the software requirements. In addition, we need to be able to supply relevant metrics to the organization level in order to test business hypotheses.

- Input: mapping between the business needs and service requirements.
- Output: service that delivers a concrete IT artifact to service adopters.
- Feedback: data from the interaction to feed the feedback loops in the previous level.

1.4 Current Research

One existing research project in our area of research is on the alignment of human-centered service systems with corresponding business models [12]. This project focuses on designing principles in order to facilitate this alignment. It is a research project in its early stages; it has been presented as a research-in-progress. The goal of the project is to implement service innovations and their corresponding business models. The design principles guide service designers towards which actions to take. So far, two principles have been stated: define scenarios, and define scale and scope of the innovation. The validation of the principles is ongoing. The project does not consider IT implementation. In addition, it features few details on the individual's cognition.

Hypothesis-testing entrepreneurship is based on the approach called Lean Startup [13]. It is a practice-oriented approach towards entrepreneurship. The presented work

is a case that is summarized in [14]. This approach describes steps for achieving a product-market fit. Yet, the details on information and value exchange are minimal. The method is well-recognized in the industry but could be extended by data collection, analysis, and validation.

The current state of SEAM, the method for enterprise and service-oriented architecture, developed in our laboratory, includes models for analyzing and designing service-adopter motivation and the value-based alignment of hierarchical service systems. Our project uses SEAM to design service systems that connect the organizational and implementation levels, with a focus on value transformation between the levels. Potentially, we could extend SEAM to the individual designer's level and add explicit feedback mechanisms between levels.

2 State of Research Work Performed by Student

Our research involves three contexts: (1) on an individual level within a business design class for computer science students; (2) within the context of a collaborating startup, where we observe the transition from an individual level to an organizational level and to initial implementation; (3) within the context of an established company and implementation in a structured context:

- Teaching (individual): We describe our teaching approach that is based on experiential learning, systems thinking and service-dominant logic. Using repetition, we explain to our students how to recognize principles and patterns that exist in practice and how to apply the same principles and patterns in different contexts. During the 2017 semester, we collected data with two questionnaires. The project was presented as a research-in-progress at ISPIM 2017 [15]. We test our hypotheses about how individuals perceive business opportunities, how they structure their business ideas, and how they begin to model businesses.
- Startups (from individual to organization): We investigate how startups structures their business hypotheses, make decision-making process explicit, and evolve from an unstructured organization into a structured one. Our primary goal is to trace value exchange between elements in a business model, hence to design service systems based on value transformation. In this startup context, we collect data on how multiple individuals share their perceptions, form a shared view of the business idea, and shape the business needs into IT requirements.
- Industry (organization and implementation): We investigate the opportunity-recognition process within established companies. We collected data from a field project (four days of participation in requirements specifications workshops for a customer-relationship management system). We observe how a structured organization formalizes their business needs for new services.

3 Research Methodology: Design Science Research

The research methodology is based on design science research. "Design science […] creates and evaluates IT artifacts intended to solve identified organizational problems"

[16]. By designing an artifact, we solve a practical problem and contribute to the knowledge base. "Artifacts are defined as constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices), and instantiations (implemented and prototype systems)" [16].

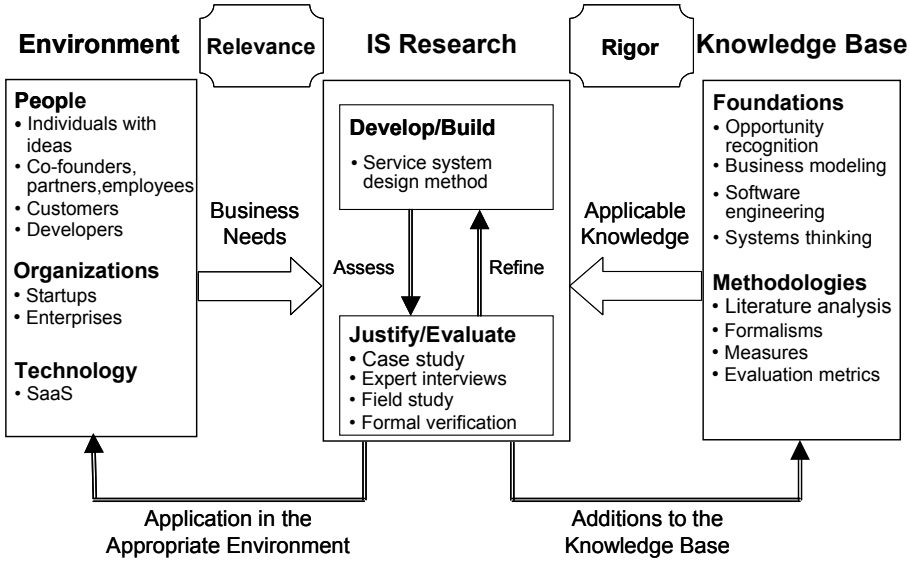

Fig. 2. Research design based on [16]

In our case (**Fig. 2**), the practical problem is that startups struggle to design businesses and corresponding software solutions. Our artifact is a method for designing service systems. To build a method, first, we need to identify constructs and models, which are going to correspond to inputs, outputs, and feedbacks between the levels (individual, organization, implementation), and to evaluate their relevance. We perform a literature analysis to identify what already exists, and conduct field studies to understand what is in use. We evaluate them with expert interviews and case studies. Second, we design the artifact (a service design method) by using the previously identified set. The build phase is based on literature analysis and field studies. We evaluate to what extent the proposed method solves the practical problem with expert interviews, case studies, and formal verification of models. This concludes the application in the appropriate environment. Third, we contribute to the knowledge base. The evaluation criteria on the theoretical contribution come from the knowledge base methodologies.

4 Doctoral Project Timeline

We follow an iterative approach. There will be three iterations, for each academic year, and a final thesis writing period after the last iteration.

Table 1. Doctoral project timeline

Objective	Iteration 1	Iteration 2	Iteration 3
Constructs and models design	Sep - Nov 2017	Sep - Oct 2018	Sep 2019
Constructs and models evaluation	Dec 2017 - Feb 2018	Nov 2018–Feb 2019	Oct – Dec 2019
Method design	Mar – May 2018	Mar – Apr 2019	Jan – Feb 2020
Method evaluation	Jun – Aug 2018	May – Aug 2019	Feb – Apr 2020

References

1. Maglio, P.P.: Editorial—Service Science 2.0, (2013).
2. Baron, R.A.: Opportunity Recognition as Pattern Recognition: How Entrepreneurs "Connect the Dots" to Identify New Business Opportunities. Acad. Manag. Perspect. 20, 104–119 (2006).
3. Tang, J., Kacmar, K.M.M., Busenitz, L.: Entrepreneurial alertness in the pursuit of new opportunities. J. Bus. Ventur. 27, 77–94 (2012).
4. Weick, K.E.: Cartographic myths in organizations. Mapp. Strateg. thought. 1–10 (1990).
5. Gaglio, C.M., Katz, J.A.: The Psychological Basis of Opportunity Identification: Entrepreneurial Alertness. Small Bus. Econ. 16, 95–111 (2001).
6. Chesbrough, H.: Business model innovation: Opportunities and barriers. Long Range Plann. 43, 354–363 (2010).
7. Magretta, J.: Why Business " B Models Matter. Harv. Bus. Rev. 3–8 (2002).
8. Zachman, J.A.: A Framework for Information Systems Architecture. IBM Systmes J. 26, 454–470 (1987).
9. Weigand, H., Johannesson, P., Andersson, B., Bergholtz, M.: Value-based service modeling and design: Toward a unified view of services. In: International Conference on Advanced Information Systems Engineering. pp. 410–424. Springer (2009).
10. Boehm, B.: Value-based software engineering. ACM SIGSOFT Softw. Eng. Notes. 28, 3 (2003).
11. Wegmann, A.: On the systemic enterprise architecture methodology (SEAM). In: International Conference on Enterprise Information Systems (2003).
12. Kleinschmidt, S., Burkhard, B., Hess, M., Peters, C., Leimeister, J.M.: Towards design principles for aligning human-centered service systems and corresponding business models. Proc. 37th Int. Conf. Inf. Syst. 1–11 (2016).
13. Eisenmann, T.R., Ries, E., Dillard, S.: Hypothesis-Driven Entrepreneurship: The Lean Startup. (2012).
14. Reis, E.: The lean startup. New York Crown Bus. (2011).
15. Kostova, B., Tapandjieva, G., Wegmann, A.: Teaching Business Design at an Engineering School–Principles/Patterns/Practice. In: ISPIM Innovation Symposium. p. 1. The International Society for Professional Innovation Management (ISPIM) (2017).
16. Hevner, A.R., March, S.T., Park, J., Ram, S.: Design Science in Information Systems Research. Des. Sci. IS Res. MIS Q. 28, 75–105 (2004).