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Designing digital tooling for business model exploration for the Internet-of-Things

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Abstract. As digital technologies are transforming enterprises, the interest in business models is increasing. Technological disruptions like the Internet of Things (IoT) drive enterprises to redefine their business models to create and capture value, and eventually, to stay competitive. The need for business model innovation may be urgent, yet it is not always clear what to change in a business model. In these cases, business model exploration is needed. Within academia and practice, business model tools are mainly focused on formalizing single business model designs rather than facilitating systematic exploration of alternative business models. In this study, we present the design and prototype of a digital tool created to facilitate business model exploration. We use Design Science Research (DSR) as our research approach. In this paper, we present the results from the first cycle evaluation of the design and prototype.

Keywords: Business models, Design Science Research, Business model tooling, Internet of Things, Business Model Exploration, Design, Prototype

1 Introduction

New digital technologies are radically changing enterprises [1]. As technologies affect enterprises and the business environment is changing, enterprises need to reconsider, reinvent and redesign their existing business models to stay competitive [2, 3].

Business models is an emerging topic in information systems (IS) (e.g., [8, 9, 10, 11, 12, 13]. More recently, studies focus on business model tooling [4], but the potential benefits of business model tooling are still understudied [7]. Existing tooling mainly facilitates specifying and illustrating single business model designs (e.g. Business Model Canvas), rather than supporting the exploration of alternative business models in a structured way. Additionally, existing tooling is, in many cases, generic without considering digital technology innovations and disruptions.

One solution to support enterprises with radical changes is to do business model exploration. With business model exploration, enterprises can discover new business model opportunities [4]. A systematic approach to business model exploration and experimentation enables enterprises to get new business model ideas [5,6] creating competitive advantage [7,2].

In many publications, the process towards designing a business model is presented linearly. However, in practice business managers face the uncertainty of the evolving markets [14]. During business model exploration entrepreneurs are engaged in an iterative process where they create and test business models until they reach a revised, alternated, and assumed viable business model [2]. Business model exploration can be important when new opportunities require the rethinking of the business model. Defining business model exploration involves creating alternative business models, and suggesting changes, [15], conceptualizing the changes, and hence conceptualizing the business models, [2], and assessing what could happen under a range of different decision choices and alternatives [16,52]. For this study, we focus on business model exploration triggered by a technology disruption. More specifically, we focus on IoT since this is a major technology innovation that has the potential to fundamentally change business models.

Hence, the research question for this study is: what are the functionalities needed of a digital tooling to support business model exploration for businesses that face disruptive technology innovation? We use Design Science Research (DSR) as an approach for designing, prototyping and evaluating the tool.

With this paper, we aim to contribute to the business model literature by designing and testing tooling features as well as providing a step-by-step approach to the development of new business model tooling. Furthermore, we aim at a practical contribution with the development of an easy to use tool with minimum complexity, and high automation that supports enterprises with their business model exploration and innovation process.

The paper is structured as follows. In section 2 we provide a background on business models, business model innovation theory, as well as work related to IoT and business model tooling. Section 3 provides a description of the Design Science Research (DSR) approach we followed. In section 4 we discuss the design of the artifact and the main functional design principles. Section 5 gives a short description of the first version of the developed prototype. In section 6 we present the first cycle of the evaluation and the results. In section 7 we conclude with the discussion, limitations and our future steps.

2 Background

A business model is defined as the core logic of how an enterprise creates and captures value [17, 18]. Some researchers view business models as the reflection of the strategy of an enterprise [19, 20, 21]. Magretta argues that '*a good business model remains essential to every successful organization, whether it's a new venture or an established player*' [23, p. 3]. Business models should change over time in response to internal or external drivers [3].

One major external driver is a new technology. Bower and Christensen characterize a new technology as disruptive when it lacks refinement, has performance problems, disrupts an existing market or creates a new one, and eventually leads to new products [45]. For instance, one major new technology is emerging is the Internet of

Things (IoT). '*IoT is a network that connects uniquely identifiable things to the Internet. The things have sensing/actuation and potential programmability capabilities*' [24]. IoT can transform enterprises in many ways such as to deliver innovation, improve customer experiences [25], and increased cost efficiency, process agility [26] and more accurate forecasting of stock situations [27]. While the IoT is spreading, the traditional and well-known business model frameworks might not be in line with the IoT needs. Rethinking of the value creation and capture will fundamentally change the business models. However, research on IoT and business models is relatively underdeveloped [28].

The existing literature on business model tooling is mainly focused on how to design and evaluate a business model (e.g. [29,30,54]), or how an enterprise can move from an old to a new business model [31]. The existing tooling is available in different formats, such as in book [29], physical cards [32], web-based app (e.g. [33]) and mobile app (e.g. [34, 35]), printed cards (e.g. [36, 37]), computer-based (e.g. [38]) or web-based (e.g. [39]). However, to the best of our knowledge, business model tools designed for technology disruption are not widely available. More specific existing business models do not take into consideration technology disruption as a separated part of the business model design, (e.g. in business model CANVAS [29] technology is not a separate building block). Even in cases that technology is one of the basic building blocks (e.g. STOF model [11]) how business models can be affected by technology disruption is not analyzed.

Sosna et al. argue that most business models have not '*gone straight from the drawing board into the implementation […] in reality new business models rarely work the first time around since decision makers face difficulties in both exploratory and implementation stages*' [2, p. 384]. However, tools for business design, testing, and implementation are emerging, tools for systematic business model exploration are lacking, especially in relation to disruptive technology innovations.

3 Design Science Research

For this study, we follow a DSR approach because it focuses on 'producing and applying knowledge of tasks or situations in order to create effective artifacts' [40 p. 253] In other words, DSR allows us to produce innovative artifacts as an answer to unsolved problems [41, 42, 43]. For our study, we want to create an innovative artifact that can contribute to the business model tooling literature. DSR allows the creation of an artifact as a solution for the gap within the literature and practice. Therefore, we argue that DSR is the most appropriate approach to be followed for our study. Figure 1 presents our DSR approach adapted by Gregor and Hevner [44]. Alterations on their approach are made based on the identified needs of the research. The activities followed during this approach are presented below. This paper only concerns and communicates the results of the first cycle iteration (design and prototype).

For the first activity (Background), we reviewed the literature of business model ontologies, business model innovation, business model exploration and business model tooling. The purpose of this activity was to understand the main theories, and the practical problem and to realize what a potential solution to the practical problem could be.

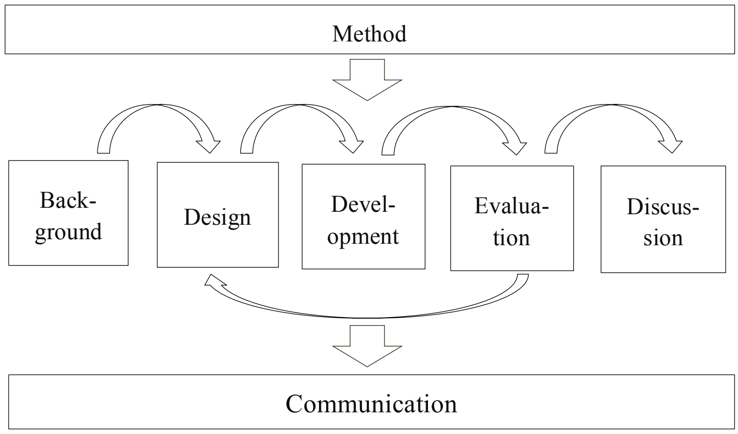

Fig. 1. The DSR approach we followed for this study (adapted by [44]).

For the second activity (Method) we reviewed potential research approaches. We realized that a potential solution to the lack of business model tooling for disruptive technologies is to design and develop a digital-based artifact. Reviewing the literature we identified some research methods that could be adopted such as the Action Design Research (ADR), Soft Systems Methodology (SSM), and DSR. However, we concluded that DSR is the most appropriate research approach for our study as it supports the creation of a theory-based artifact that contributes to the theory.

For the third activity (Design) we focused on the design of the artifact. To do so we took specific actions: Firstly, we used a Q-methodology approach (removed for review process, under review) to identify perspectives regarding the business models after a technology disruption. This study allowed us to understand how technology disruption affects existing business models design and needs. We focused on the large mobility ecosystem as we identify it as an industry with major IoT disruption where many enterprises are affected Then, we did an action research where. We investigate how business model exploration is facilitated by business model tooling and what are the gaps in the current state-of-the-art tooling in supporting business model exploration as part of the BMI process. Based on the obstacles we identify during this research we derived specific recommendations. This recommendations shaped the design principles and later the development of the prototype.

In activity 4 (Development), we develop an interactive prototype. Initially a paper-based navigation plan was designed. Then, we convert it to a software-based, clickable artifact.

For our fifth activity (Evaluation) we evaluate the developed prototype to draw conclusions regarding the satisfactory or unsatisfactory functionality of the artifact [43].

In the sixth activity (Discussion), we interpret the results.

For the seventh and last activity (Communication), we communicate some conclusions, the contribution to the scientific community [41]. In this publication, we communicate the used research approach and the results from the first evaluation cycle of the developed prototype. Feedback from the communication together with feedback from the evaluation activity will be used in our future studies as inputs for the next iteration and improvements of the study and the artifact.

4 Design

In this DSR activity, we focus on the creation of the design principles (DPx) we want to test and that will inform the artifact development. (Section 5 Development). To formulate the design propositions we follow the structure given by [55]: '*Provide the system with [material property—in terms of form and function] in order for users to [activity of user/group of users—in terms of action], given that [boundary conditions—user group's characteristics or implementation settings]'* ([22], p. 4045).

Entrepreneurs are often not only unaware of the concept of business model but also even that they have a business model. Even enterprises that invest in new ideas often have little ability to do business model innovation incorporating these changes [47, 48]. Entrepreneurs that are unaware of business model concepts and ontologies are likely to struggle to identify and revise their business models in a systematic way. At the same time, recent studies have identified so-called patterns of business model designs, which reoccur [53,54]. Hence, we suggest preloading a business model canvas sheet with common patterns as opposed to the common 'fill-the-blank' approach of existing business model tools templates (e.g. business model canvas). Hence, the first principle for designing our prototype is:

DP1: *Using pre-filled business model templates facilitates the user's understanding of the components of the current business model given a specific business case.*

Generating ideas on how to change different business model components is important for business model exploration [14, 49]. However, when there is technology disruption, such as with the IoT, scholars argue that they do not have a holistic view on which aspects of the business model will be affected [50]. We argue that a solution that solves that problem is the use of solution based business model patterns. Thus, the second design principle on which we based we based the design for the prototype is:

DP2: *Using templates with solution-based patterns improves idea-generation on how to change different components of the current business model, given a specific technology disruption.*

Making a decision about whether adapting the components in the business model is a prerequisite to business model implementation. A deliberate evaluation of intended business model changes helps to avoid investments in unfruitful paths [46]. However, existing business model tooling focuses mainly on designing or re-designing new business models but they do not offer opportunities for assessing the changes before they get implemented [51]. Studies suggest that a way to do this is by using assessment methods (e.g. critical success factors, key performance indicators) to assess the feasibility of the generated ideas and potential changes [38, 51, 10]. However, busi-ness model assessment tooling is not widely available. Such assessment requires ‘a clear and structured description of the business model’ [38]. That might not be possi-ble in the case of the reshape of a business model due to a digital disruption. We ar-gue that assessing and understanding the feasibility of a business model change, is a prerequisite to decision-making about business model adaptation and thus, to consider when doing business model exploration. Hence, the third design principle for the prototype is:

DP3: *Using a tool with assessment features improves user’s decision making about whether to adapt components in the business model, given that the users have already identified potential changes on the current business model.*

While our contribution is focused on the three design principles, we need to have non-functional requirements too in order to have a user-friendly prototype that can be evaluated. In our previous study, we identify eight non-functional characteristics that business model tooling should have (i.e., have a structure, stimulate the user, be adaptive to the abilities of the users, have low barriers, be simple, provide specific results, be enjoyable, and easy interface [4].

The three developed principles together with the non-functional requirements allowed as getting an understanding on how the artifact should be. In the next activity we present the prototype as it was derived from the above principles and functionalities.

5 Development

For the development of the prototype, we used the commonly used program Microsoft Excel. We choose this program as it allows us to facilitate and implement the design principles described in section 4 (Design). We created the prototype based on the identified design principles and the functional and not functional requirements in a three-step approach. Each of the steps reflects one of the design propositions we de-scribed in the design section. That allows us to apply and test the design principles independently from each other. More specific the three steps are:

Step 1: The creation of a description of components of the existing business model;

Step 2: The exploration and identification of IoT opportunities and potential changes that might contribute towards an IoT business model;

Step 3: Assessment of the changes defined in the previous step. In that step, users, based on critical factors [10] assess the changes. The outcome of this step is a list with the selected changes, which, according to the user, might have a positive, negative or unknown contribution to their business.

The tool contains three parts, each of which reflects one of the design principles from Section 4. Figure 2 presents a screenshot from the developed prototype. Due to the page limitations a clickable prototype of the tool can be accessed via https://invis.io/VFGQMD0GHZC.

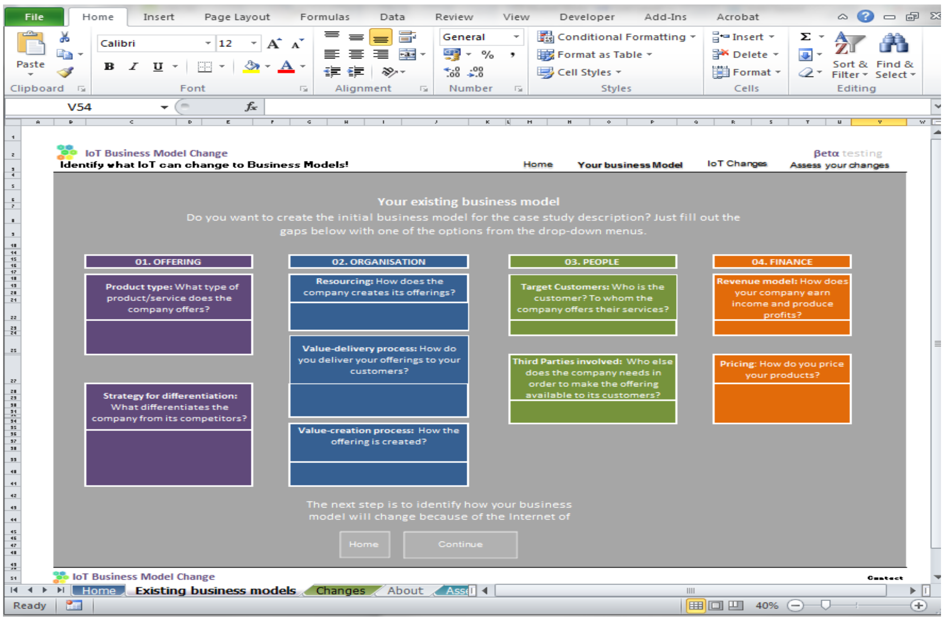

Fig. 2. Screenshot of the developed prototype. The screenshot presents the first step of the process (description of the existing business model).

6 First Cycle evaluation and Discussion

In this paper, we present the first cycle evaluation (figure 3) approach and the results. For the evaluation we collect data from interviews, short questionnaires, and pre- and post use surveys.

6.1 Evaluation approach

Initially, we asked software developers to alpha test the prototype **(1)**. With the alpha testing, we wanted to identify any major or minor technical issue. The alpha testers used and tested the prototype, and then fill out an online accessible questionnaire. We asked questions regarding major and minor mistakes (e.g. bugs), time estimation, and the response of the tool in different actions. We immediately implement their feedback. Then, we pilot test the evaluation approach with junior researchers. The pilots provide feedback for the improvement of the business model tooling and the evaluation process **(2)**.

For the beta testing, we asked the opinion of four consultants experienced with business models and technology disruption (we refer to them as beta testers) **(3)**. The researchers presented the prototype to the beta testers (physical or online). During the discussion, the beta testers provided their comments.

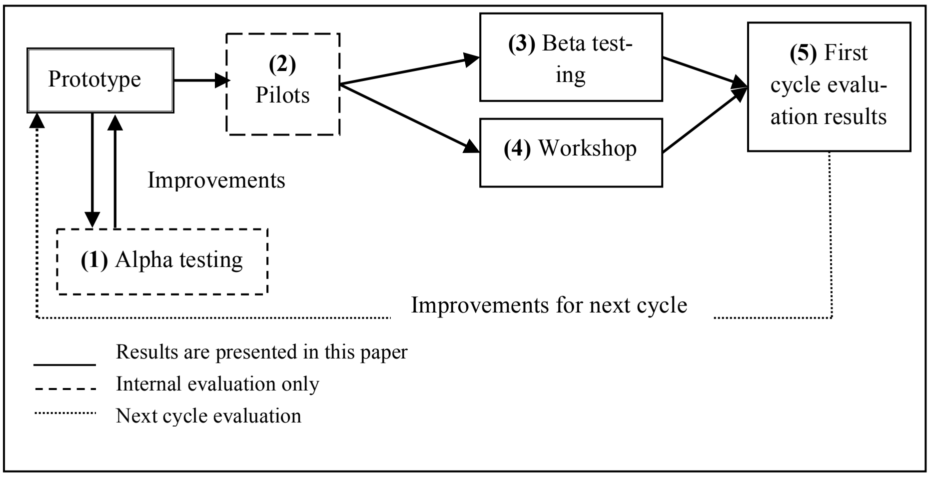

Fig. 3. Overview of first cycle evaluation outline.

As the next step, we did workshops (between November 2017 and January 2018) with 23 master level students with an entrepreneurship interest as participants to use the prototype and provide comments **(4)**. For the purposes of these workshops, we used a specific business scenario (the case of a car-renting company in the IoT era) in order to illustrate as much as possible a real case that the business model could be used and have some impact. Also, the use of a specific case allowed us to increase the validity of our evaluation because all the participants will follow the same tasks for one specific situation.

The participants of the workshops used the prototype for this specific case and filled out a pre- and post- questionnaire including questions regarding both the functional and non-functional requirements. For ethical reasons, we asked facilitators, uninvolved with this research, to be part of the workshops as facilitators of the workshops. The facilitators provided some observations from the workshops that were used for the validity of the evaluation and for future improvements.

Finally, we analyzed the collected data **(5)** from the previous steps for the first cycle evaluation. The results will be used as inputs for next iterations. Figure 3 presents the steps of our evaluation while Table 1 summarizes the data collection approach.

Table 1. Details of the data collection for the first cycle evaluation of the prototype.

Actions	Informants	Duration and Location	Focus of the feedback	Data collection methods
Alpha testing **(1)**	Software developers	~30´; Online	Technical requirements	Shot questionnaire

Internal pilot testing **(2)**	PhD researchers	~1h, workshop setting (the results from this workshop were used only for piloting the evaluation approach)	Informal testing of the prototype and the methodology for improvements	Internal use only
Beta testing **(3)**	Technology consultant, and business consultants	~30´; Online (via Skype); face to face meeting	Principles, Functional and non-functional requirements	Interviews
Workshop **(4)**	Students with entrepreneurship focus	~1.5h (Lab setting)	Use of the tool in practice	Post- and Pre-questionnaire, observations

6.2 Findings from the first cycle evaluation

The DSR actions described above allow us to collect informative feedback for the developed prototype. This section discusses the results of the first cycle evaluation. We firstly discuss the main comments we received from all the informants and then we explicitly focus on findings regarding the three design principles. We analyzed the data collected from the beta testing and the workshops.

Beta testing
All the beta testers acknowledged that the tool will be useful and that the pre-filled option is an interesting feature. Three beta testers suggested that at the next version of the tool, and more specific the second step if the IoT transformation needs to include more options regarding the disruption in order to support the users with the business model transformation, and offer more value to the users and support them more with their next actions regarding their business model exploration.
It is interesting that all the beta testers extensively commented on the last step (assessment of the changes). They argued that this step requires a lot of time and the users might not find that appealing. Additionally, they argued that we cannot use the same Key Performance Indicators (KPI) for each potential change. Finally, three of the beta testers suggested that the tool needs to provide a final recommendation to the users in the form of a prioritization list of the order the identified changes should be implemented. One of the beta testers argues that this will contribute more on the users' decision making because they will have some concrete actions to do in the near future. All the beta users argued that the tool needs to be more automated (e.g., to give suggestions, to prioritize without requesting the users to do it on their own etc.). One of the beta testers point out that the open-type answers should be eliminated because users prefer to brainstorm and decide upon specific recommendations. The dynamic nature of IoT requires constant updates on the functionalities of the business model tooling.

Regarding the non-functional requirements, the layouts, color codes were well received but some improvements can be made, as the informants got confused in some situations. Two of the beta testers argued that the illustration of the existing business model (step 1 of the tool) should be always visible so the users can identify potential changes to their existing business model.

Workshops

For the first cycle evaluation, we did three workshops with master level students with an entrepreneurship focus in their studies. Regarding the outcomes from the workshops, a common feedback we received from the majority of the participants was that a clear description of the purpose of the business model tool was needed in order to be able to work with it. Additionally, some of the participants find that the third step (where they had to assess the potential changes) was too demanding and they expected that the tool would require fewer inputs from them.

Finally, we analyzed the observations of the facilitators. From the observations, it was clear that the participants were engaged in the process and the use of the tools. However, the observers noticed that the informants had some issues with the understanding of the wording, the process was time-consuming and the layout of the prototype could be improved.

Regarding the non-functional requirements, some of the participants mentioned that some of the used words and definitions in the excel sheets (i.e. the prototype) were difficult to understand.

Findings regarding the design principles

While this paper presents the first cycle evaluation iteration, it was of our interest to identify if the findings indicate that, in some extent, the design principles (discussed in section 4) that informed our prototype, contribute to the business model exploration. The alpha testers did not focus on the functionalities of the prototype and hence, the findings from this activity do not provide any indication regarding the design principles. Table 2 summarizes findings from the beta users, both supporting the choices regarding the design of the prototype, and points of improvements (i.e. findings, suggestions).

Table 2. Initial findings and suggestions form the informants regarding the design principles (DPx) from the first cycle evaluation.

	DP1: Using pre-filled business model templates facilitates the user's understanding of the components of the current business model.	**DP2:** Using templates with solution-based patterns improves idea-generation on how to change different components of the current business model.	**DP3:** Using a tool with assessment features improves user's decision making about whether to adapt components in the business model
Findings	'**Pre-filled is a perfect	'What I don't like: you put	'If it is designed well then it

	idea' (beta tester 1). The pre-filled option is interesting as it is not a common feature on the design of existing business model tooling' (beta tester 2).	the user to think the transformation. This is the job of a consultant Also, I am not sure if they will understand that you give them inspiration and not a specific solution. However, they will get inspired' (beta tester 1).	can really help the users to make decisions' (beta tester 3).
Suggestions for improve provements	'Where are questions regarding the costs?' (beta tester 3 and 4).	'Support them by making questions. Provide an overview, for example: Do you think that it will be profitable?' (beta tester 4).	Prioritization of the assessed changes is needed so users can make decisions (overall comment).

For this evaluation cycle, we collected data from 23 participants. While 23 participants are not statistically significant, the collected data allowed us to make some initial conclusions.

Table 3. Quantitative findings from workshops (N=23).

Design Principles	Statements	Test statistics
DP1	I have a solid interpretation of what the business model components are.	t(16)=2.432, p<.05
	I am able to apply my knowledge on business model on a new context/case/industry.	t(16)=2.281, p<.05
DP2	I am able to generate qualitative ideas on how business models components can be changed.	t(15)=2.112, p<.05
	I am able to estimate how unexpected my generated ideas are.	t(15)=2.449, p<.05
DP3	When it comes to a decision regarding a business model change I prefer to keep everything as it is.	t(15)=0.557 p<.05

In the workshops, we collected quantitative data to evaluate the impact of the prototype on business model exploration. We did so by asking the participants to fill out the same questionnaire before and after the use of the prototype. The questionnaires were divided into three sections, each containing statements related to one of the three design principles. Then, we ran paired t-tests to measure differences before and after using the prototype. Out of the 17 pairs of statements, five were significantly increased (p< .05), see Table 3.

7 Conclusion

In this paper, we presented the design and development of a digital tooling for business model exploration for the IoT. During the design, we developed three design principles that established the requirements of the tooling. The prototype served as an instrument to evaluate which of these principles contributes to the business model exploration process. Various informants evaluate the prototype of the digital tooling prototype. Overall, the informants appreciated the functionalities of the tooling and had a positive feedback regarding the design principles. On the other hand, they point out improvements for a future version of the tooling. The quantitative support to an extent that the developed prototype improves the business model exploration.

The limitation of this study is related to the participants and the size sample. For this paper, participants were 23 Master level students. While the participants provided us with fruitful insights, in the future we plan to revise the prototype based on the feedback we received and replicate the workshops (following an experimental design) to a larger scale and ground our findings from a larger and more representative group of informants (i.e. practitioners).

This study contributes to the business model innovation theory with the three developed design principles, with the overall aim to contribute to the business model exploration process. Additionally, this study contributes in the form of an artifact (i.e., the prototype) as an improved solution for a specific problem (business model exploration) [44]. In practice, our study contributes to the development of an easy to use tool with minimum complexity, and high automation that supports enterprises with their business model exploration and innovation process.

The results of this paper in addition to future studies can improve the functionalities of the artifact and it can deliver an updated version of the artifact. This paper is focusing on the IoT as an instance of disrupting technology. However, future studies could examine if the proposed design knowledge is applicable for other kinds of disrupting technology. Additionally, future studies could test the business model tooling in different industries (e.g. automotive, healthcare). These studies could contribute to the understating if the design knowledge suggested in this design knowledge is generalizable.

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References

1. Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., Venkatraman V.N. Digital business strategy: towards a next generation of insights. MIS Quartely 37(2), 471–482. (2013).
2. Sosna, M., Trevinyo-Rodríguez, R. N., Velamuri, S.R. Business Model Innovation through Trial-and-Error Learning: The Nature house Case. Long Range Planning, 43 (2), 383–407 (2010). http://doi.org/https://doi.org/10.1016/j.lrp.2010.02.003.
3. De Reuver, M., Bouwman, H., Maclnnes, I. Business model dynamics: a case survey. Journal of Theoretical and Applied Electronic Commerce Research 4 (1), 1–11 (2009). doi.org/10.4067/S0718-18762009000100002.

4. De Reuver, M., Athanasopoulou, A., Roelfsema, M., Riedl, A. Designing an ICT tooling platform to support SME business model innovation : Results of a first design cycle. In: Proceedings of BLED 2016. 7, (2016).
5. Baden-Fuller, C., Morgan, M. S. Business models as models. Long Range Planning 43(2–3), 156–171 (2010). doi.org/10.1016/j.lrp.2010.02.005.
6. McGrath, R. G. Business models: A discovery driven approach. Long Range Planning, 43(2–3), 247–261 (2010). http://doi.org/10.1016/j.lrp.2009.07.005.
7. Eppler, M. J., Hoffmann, F., Bresciani, S. New Business Models Through Collaborative Idea Generation. International Journal of Innovation Management 15 (6), 1323–1341 (2011). doi.org/10.1142/S1363919611003751.
8. Cosenz, F., Noto, G. A dynamic business modelling approach to design and experiment new business venture strategies. Long Range Planning In press. (2017) doi.org/10.1016/j.lrp.2017.07.001.
9. Roelens, B., Poels, G. The Development and Experimental Evaluation of a Focused Business Model Representation. Business & Information Systems Engineering 57 (1), 61–71. doi.org/10.1007/s12599-014-0363-z (2015).
10. Bouwman, H., De Vos, H., Haaker, T. Mobile service innovation and business models. Springer-Verlag Berlin Heidelberg (2008). doi.org/10.1007/978-3-540-79238-3.
11. Fritscher, B., Pigneur, Y. Computer Aided Business Model Design: Analysis of Key Features Adopted by Users. In: Proceedings of the 47th Hawaii International Conference on System Sciences. 3929–3938 (2014). doi.org/10.1109/HICSS.2014.487.
12. Kyriazis, D., Varvarigou, T. Smart, autonomous and reliable Internet of Things. In Procedia Computer Science 21, 442–448 (2013). doi.org/10.1016/j.procs.2013.09.059.
13. El Sawy, O., Pereira, F. Business Modelling in the Dynamic Digital Space - An Ecosystem Approach. Springer Briefs Series in Digital Spaces 68 (2013). doi.org/10.1007/978-3-642-31765-1.
14. Berends, H., Smits, A., Reymen, I., Podoynitsyna, K. Learning while (re-) configuring: Business model innovation processes in established firms. Strategic Organization (1) (2016). doi.org/10.5465/AMBPP.2013.15477abstract.
15. Cavalcante, S., Kesting, P., Ulhøi, J. Business model dynamics and innovation: (re)establishing the missing linkages. Management Decision, 49(8), 1327–1342, (2011). doi.org/10.1108/00251741111163142.
16. Bisbe, J., Malagueño, R. How Control Systems Influence Product Innovation Processes: Examining the Role of Entrepreneurial Orientation. Accounting and Business Research 44 (0), 1–46 (2012).
17. Kallio, J., Tinnilä, M., Tseng, A. An international comparison of operator-driven business models. Business Process Management Journal 12 (3), 281, (2006). doi.org/10.1108/14637150610667962.
18. Linder, J., Cantrell, S. Changing Business Models : Surveying the Landscape. Accenture Institute for Strategic Change, 1–15 (2000). doi.org/10.4018/978-1-59904-939-7.
19. Solaimani, S., Bouwman, H. A framework for the alignment of business model and business processes: A generic model for trans-sector innovation (2012).
20. Casadesus-Masanell, R., Ricart, J. E. From strategy to business models and onto tactics. Long Range Planning 43(2–3), 195–215 (2010). doi.org/10.1016/j.lrp.2010.01.004.
21. Leem, C. S., Suh, H. S., Kim, D. S. A classification of mobile business models and its applications. Industrial Management and Data Systems, 104 (1), 78–87 (2004). doi.org/10.1108/02635570410514115.

22. Chandra, L., Seidel, S, and Gregor, S, (2015). Prescriptive Knowledge in IS Research: Conceptualizing Design Principles in Terms of Materiality, Action, and Boundary Conditions, H, USA.
23. Magretta, J. Why business models matter. URL: https://hbr.org/2002/05/why-business-models-matter (2002) (visited on 25 /11/2017).
24. Minerva, R., Biru, A., Rotondi, D. Towards a definition of the Internet of Things (IoT). Technical report, Politecnico di Torino (2–86), (2015).
25. Brody, P., Pureswaran, V. The next digital gold rush: how the internet of things will create liquid, transparent markets. Strategy & Leadership Vol. 43 (1), 36-41 (2015). doi.org/10.1108/SL-11-2014-0094.
26. Uckelmann, D., Harrison, M., Michahelles, F. Architecting the Internet of Things. Architecting the Internet of Things. Springer. doi.org/10.1007/978-3-642-19157-2. (2011).
27. Geerts, G. L., O'Leary, D. E. A Supply Chain of Things: The EAGLET Ontology for Highly Visible Supply Chains. Decision Support Systems 63 (1), 3–22 (2014).
28. Ju, J., Kim, M., Ahn, J. Prototyping Business Models for IoT Service. Procedia - Procedia Computer Science 91, 882–890 (2016). http://doi.org/10.1016/j.procs.2016.07.106.
29. Osterwalder, A., Pigneur, Y. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. A handbook for visionaries, game changers, and challengers. John Wiley en Sons Ltd, (2010). doi.org/10.1523/jneurosci.0307-10.2010.
30. Bouwman, H., De Vos, H., Haaker, T., Faber, E., Fielt, E., Haaker, T., De Reuver, M. STOF Model: Critical Design Issues and Critical Success Factors. Mobile Service Innovation and Business Models. In: Bouwman, H. De Vos, H. and T. Haaker ed Mobile service innovation and business models 71-88 (2008), 81–88. doi.org/10.1007/978-3-540-79238-3.
31. De Reuver, M., Bouwman, H., Haaker, T. Business Model Roadmapping: a Practical Approach To Come From an Existing To a Desired Business Model. International Journal of Innovation Management 17 (1). 1340006, (2013). doi.org/10.1142/S1363919613400069.
32. Foresight cards URL: Available at https://foresightcards.com/workshops/business-models/ (visited on 04 /04/2018).
33. Leenstack. URL: https://leanstack.com/ (visited on 04 /04/2018).
34. Business Model Canvas app. URL: https://play.google.com/store/apps/details?id=com.thirdmobile.modelcanvas&hl=en.
35. SWOT Analysis app. URL: https://play.google.com/store/apps/details?id=com.v1_4.learning4managersswotanalysis.com&hl=en (visited on 04 /04/2018).
36. Gassmann, O., Frankenberger, K., Csik, M. The St. Gallen Business Model Navigator. Working paper. University of St. Gallen. (2014).
37. Business Innovation kit. URL: http://www.uxberlin.com/businessinnovationkit/ (visited on 04 /04/2018).
38. Foresight cards URL: Available at https://foresightcards.com/workshops/business-models/ (visited on 04 /04/2018).
39. E3 value. URL: https://www.e3value.com/ (visited on 04 /04/2018).
40. March, S.T, Smith, G.F., Design and natural science research on information technology, Decision Support Systems, 15 (4), 251-266, (1995). https://doi.org/10.1016/0167-9236(94)00041-2.
41. Hevner, A. R., March, S. T., Park, J., Ram, S. Design Science in Information. MIS Quarterly, 28(1), 75–105, (2004).
42. Peffers, K., Tuunanen, T., Rothenberger, M. A., Chatterjee, S. A Design Science Research Methodology for Information Systems Research. Journal of Management Information Systems 24 (3), 45–77 (2007). doi.org/10.2307/40398896.

43. Verschuren, P., Hartog, R. Evaluation in design-oriented research. Quality and Quantity, 39 (6), 733–762 (2005), doi.org/10.1007/s11135-005-3150-6.
44. Gregor, S., Hevner, A. R. Positioning Design Science Research for Maximum Impact. Management Information Systems Quarterly, 37, 337–355 (2013).
45. Bower, J. L., Christensen, C. M. Disruptive Technologies: Catching the Wave, (1995). URL: https://hbr.org/1995/01/disruptive-technologies-catching-the-wave (visited on 04 /04/2018).
46. Christensen, C. M., Bartman, T., Van Bever, D. (2016). The hard truth about business model innovation. MIT Sloan Management Review, 58(1), 31.
47. Chesbrough, H. Business model innovation: Opportunities and barriers. Long Range Planning 43 (2–3), 354–363 (2010). doi.org/10.1016/j.lrp.2009.07.010.
48. Demil, B., Lecocq, X. Business model evolution: In search of dynamic consistency. Long Range Planning 43 (2–3), 227–246 (2010). doi.org/10.1016/j.lrp.2010.02.004.
49. Achtenhagen, L., Melin, L., Naldi, L. Dynamics of Business Models – Strategizing, Critical Capabilities and Activities for Sustained Value Creation. Long Range Planning (46) (2013). doi.org/10.1016/j.lrp.2013.04.002.
50. Krotov, V. The Internet of Things and new business opportunities. Business Horizons 60 (6), 831–841 (2017). doi.org/https://doi.org/10.1016/j.bushor.2017.07.009.
51. Heikkilä, M., Bouwman, H., Heikkilä, J., Solaimani, S., Janssen, W. Business model metrics: an open repository. Information Systems and E-Business Management, 14(2), 337–366 (2016). doi.org/10.1007/s10257-015-0286-3.
52. Sterman, J. Systems Thinking and Modeling for a Complex World. McGraw-Hill Higher Education (2000).
53. Gassmann, O., Frankenberger, K., Csik, M. The St. Gallen Business Model Navigator. Working paper. University of St. Gallen (2014).
54. Remane, G., Nickerson, R., Hanelt, A., Tesch, J., Kolbe, L. A taxonomy of carsharing business models In: Proceedings of 37th International Conference on Information Systems (ICIS 2016) (2016).