Enabling Entrepreneurs to Build on their Means: The Effectual Decision-Making Canvas

Marcos González M.
Karlsruhe Institute of Technology
Karlsruhe, Germany
Universidad Austral de Chile
Puerto Montt, Chile
0000-0002-6086-9854

Orestis Terzidis
Institute for Entrepreneurship, Technology-management and Innovation
Karlsruhe Institute of Technology
Karlsruhe, Germany
0000-0001-7865-7190

Benedict Heblich
Institute for Entrepreneurship, Technology-management and Innovation
Karlsruhe Institute of Technology
Karlsruhe, Germany
0000-0003-3142-6154

***Abstract* — Using the design science research approach and a framework for artifact development, this paper presents the design of an artifact in the field of entrepreneurship. More specifically, in the context of decision-making for early-stage entrepreneurs. In light of existing research indicating that the decision-making process significantly impacts an entrepreneur's effectiveness and that experienced entrepreneurs use Effectuation more often than Causation when reaching decisions, this paper presents a visual tool for assisting entrepreneurs in making decisions based on the principles of Effectuation. We finally test and evaluate the resulting "Effectual Decision-Making Canvas" with aspiring and practicing entrepreneurs.**

Keywords— entrepreneurial decision-making, Effectuation, startups

I. INTRODUCTION

Decisions are a recurring [1], difficult, and sometimes challenging topic [2] in every context. A range of decisions is made each day in companies, ranging from simple to complex ones that involve sophisticated systems. Startup founders do not face a different set of circumstances with regard to the entrepreneurship context. It is often necessary for them to make decisions with limited information concerning trends, expected performance, and market acceptance [3], as cited in [4]. Yet, each of these decisions made by entrepreneurs will have a consequence on the development of the new venture. Reference [5] expressed this idea with these words: "At some point, he must move from a "what if?" to a decision, which then becomes a design note with critical implications for further moves" [6, pp. 23-24].

While there are definitions of startups within the context of entrepreneurship [7], [8], through the lens of systems theory, a business (or a startup in this context) can be defined as an integrated decision-making system [9, p. 54]. Any entrepreneur is embedded in a decision-making system. A specific area that has gotten more attention in business research regarding entrepreneurial decision-making in the last 20 years is Effectuation as a decision-making logic [10], [11], [12], as cited in [13].

In particular, the Effectuation decision-making logic is studied in this discussion, given that the research shows that Effectuation is dominant among expert entrepreneurs [14], [15], [16]. Besides, studies show that Effectuation is positively related to measures of uncertainty [14], [17], [18]. Similarly, [7] defines a startup as an organization designed to create a new product or service under circumstances of extreme uncertainty.

Given that 11 out of 12 startups still fail [19], we emphasize the need to support the startup development process, especially at the early stage of the startup. Based on the scientific knowledge in the context of entrepreneurial decision making, we see the necessity to promote Effectuation as a complementary and alternate *mode of action* [13, p. 13], [20, p. 13] from which entrepreneurs may benefit [18, p. 388].

Finally, research about how entrepreneurs learn and organize in ventures [21] and the base of practices and knowledge used by entrepreneurship courses and accelerator programs gave us a hint about what can be done to support them. In accordance with the literature reviewed in this study, entrepreneurs have to include effective habits or heuristics in order to be able to learn fast enough. They state that it is their responsibility to formulate rules or principles and experiment with them until they determine which are the most suitable or effective for their businesses [21, p. 2]. Furthermore, tools like the Business Model Canvas, Lean Startup, or Design Thinking are used to train entrepreneurs. This situation led us to attempt to design a visual tool that could bring the entrepreneurs' attention to the *effectual* mode of action.

Therefore, the analysis presented here aims to design an artifact that allows early-stage entrepreneurs to be supported in their decision-making using the design science research approach. Due to the nature of this paper, centered on the design and evaluation of an artifact, the following research question was formulated:

RQ: How to enable entrepreneurs to apply and benefit from Effectuation as a decision-making logic through a visual decision-making support tool?

With this paper, the authors want to contribute to the ongoing efforts of researchers, academics, and governmental and non-governmental organizations to support entrepreneurs through their entrepreneurial journey.

II. RESEARCH CONTEXT

This study can be located within two primary contexts: Design Science Research (DSR) and Entrepreneurship. DSR provides a methodological approach to developing projects that are not based only on theory or

experiences but a combination of both. Reference [22] define DSR as "a research paradigm in which a designer answers questions relevant to human problems via the creation of innovative artifacts, thereby contributing new knowledge to the body of scientific evidence."

In Fig. 1, the DSR cycles are presented. In this model, [22] shows how DSR interacts with the environment and the knowledge base. Between these three elements, three primary cycles appear. Research projects and design activities are linked through the Relevance Cycle. As part of the Rigor Cycle, design science activities are connected to the knowledge, experience, and expertise that inform the research project. Research artifacts and processes are constructed and evaluated in iterations of the central Design Cycle. In a design science research project, these three phases must be evident and identifiable [22].

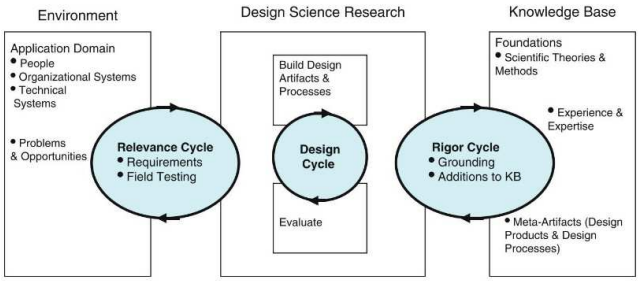


Fig. 1. Design science research cycles by [22]

The essential principle of DSR is that knowledge and comprehension of a design problem and its solution are achieved in the construction and application of an artifact [22, p.5]. Artifact as a term is used to represent something artificial or created by humans, as opposed to something that happens naturally [23] as cited in [22, p. 6].

The second main context of this study is entrepreneurial decision-making, specifically, the Effectuation as an alternate mode of action for entrepreneurs. For this project and as a result of the review of the knowledge base of this domain, the inclusion of Effectuation decision-making logic provides avenues to make decisions more effectively for early-stage entrepreneurs [13], [17].

In her study, [17] presents the Effectuation concept and compares it to the managerial or classical decision-making approach, described by her as Causation. According to [17], Causation is consistent with planned strategy approaches, and while taking a specific goal as given, it focuses on selecting the means to achieve that goal. In contrast, Effectuation handles emergent or non-predictive strategies conceived under conditions of high uncertainty. It takes the available means as an initial point to possible outcomes.

The causation approach is also known as the managerial approach. Its main claim is "To the extent that we can predict the future, we can control it." [24, p. 6]. However, effectual decision logic says, "to the extent that we can control the future, we do not need to predict it" [24, p. 6]. Effectuation and Causation are two different strategic decision-making logics crucial to new ventures' survival and growth under high uncertainty [17], [25], [26], as cited in [27].

Five essential principles characterize Effectuation [14]. The first principle is called the *Bird-in-hand principle.* It suggests that entrepreneurs design goals based on their current resources. In other words, instead of trying to get new resources to achieve a specific goal, the effectual mode of action encourages them to leverage the founders' existing skills, resources, and networks. Under the second principle, the *Affordable loss principle*, entrepreneurs focus more on potential losses than on potential revenues. As a result of switching to the effectual mode, entrepreneurs change their primary focus from the idea of optimizing profits to the idea of what they can afford to lose in this venture. Moreover, use it as a reference to take risks and make decisions. In the third principle, the *Crazy Quilt Principle*, the effectual mode of action focuses on creating strategic alliances and stakeholders' pre-commitments to reduce competition and uncertainty. The fourth principle, called the *Lemonade principle*, can be explained with the motto, "if life gives you lemons, make lemonade." It means entrepreneurs need to see contingencies as opportunities and discover how they can take advantage of them. Finally, the fifth principle is called the *Pilot-in-the-plane principle*, which helps entrepreneurs grasp the fact that they control their businesses rather than allowing them to control them. Decisions and actions are made by them, and their actions will determine whether the startup will succeed or fail. By doing so, they become the company's pilots.

While research in this area has not been able to validate all the principles of Effectuation [13, p. 3], it is known that experimentation, affordable loss, and flexibility are constructs associated with this decision logic. Likewise, pre-commitment is a construct that is shared by Causation and Effectuation [18, p. 386].

III. METHOD

The methodology used in this study is based on DSR principles and was formulated according to [28]. For the design of the methodology, the authors employed a consensus-building approach. DSR principles were framed originally for the Information Systems context, although with the spread of DSR in other domains, it has been adopted as an artifact-centered framework [29].

In [28], the main objective was to develop a methodology that would serve as a common framework for carrying out research following the principles of Design Science presented in [30].

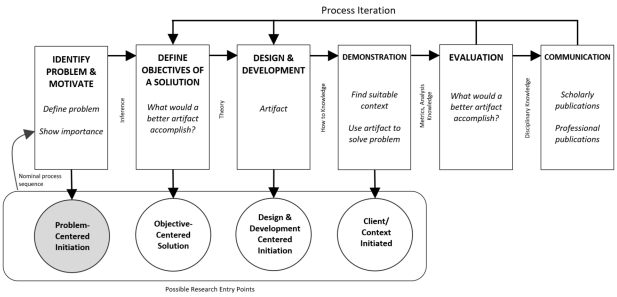


Fig. 2. Design Science Research Framework by [28]

Fig. 2 presents the methodology in detail. The six activities established by [28] are covered as part of the process, ranging from identifying and motivating the problem to communicating the results. The iteration process that serves as the basis for improving the artifact is also described. As seen in the lower part of the framework, the circles

represent the different initiation points for DSR projects. Given the nature of the project, a problem-centered approach has been emphasized since the problem was the starting point.

IV. RESULTS

A. Problem Identification, motivation & objective

Supporting early-stage entrepreneurs is an increasingly evident problem [19]. The attempt to help them is present in all areas of entrepreneurship teaching, such as business modeling courses, design thinking, and lean startup. However, none of these tools are aimed at consciously supporting the decision-making process. Entrepreneurs can move across the entire spectrum of decision logic, from Causation to Effectuation [14]. We know so far that they do so according to the level of education or experience [16]. The objective was to develop a support tool for early-stage startup founders, focusing on the Effectuation mode of action.

B. Design and Development

Motivated by simple but effective visual tools like the Business Model Canvas and Lean Canvas, the artifact is designed as a canvas for structuring a founder's decision-making process. Adopting the design ideas of [31], a canvas containing eight blocks has been developed. One of the main reasons for designing a canvas is that it is a widely used practice in entrepreneurship [32]. They are used as visual support [33] to increase practical learning [34]. Therefore, potential users of this artifact can quickly adopt it.

The blocks represent different sub-processes or activities that can be executed as part of the decision-making process. These activities are based on the Effectuation cycle and principles. Therefore, the decision process can be structured in an effectual mode rather than a causal mode when using the model to decide.

C. Artifact Description

The designed artifact was called the "Effectual Decision-Making Canvas" and has eight blocks (seven steps) inspired by the Effectuation principles and the effectual cycle presented by [14]. The version shown in Fig. 3 (also in a larger version in appendix A) is the latest version, which incorporates the results of the evaluation described in this study.

Using this visual decision tool requires the user to recognize the existence of *means* linked to the decision to make in the first instance. In this first step (1), the decision-maker must ask themself three questions: Who am I? What can I do? Whom do I know? These questions are intended to make evident the competencies; knowledge, skills, and attitudes [35, p. 30]; values [36], as well as the network of people who may be able to assist with this endeavor. This block is associated directly with the Bird-in-Hand principle of Effectuation. It occupies a significant area and has a prominent role within the design; therefore, the decision-maker can gain an understanding of the relevance of setting up the procedure by listing the available means. Although we have used the terms means and resources as synonyms in this study, means are also considered methods or ways to accomplish a task in the context of Effectuation.

The next step (2) is the generation of *resourced-based goals*. At this stage, the entrepreneur should ask the following question regarding the decision: What can I do with these available means? The results should reflect the potential objectives resulting from the listed resources. The importance of this step becomes apparent in that the entrepreneur does not extend his vision to a complex or hard-to-achieve goal. These objectives are the foundation for the next step, which involves immediate action.

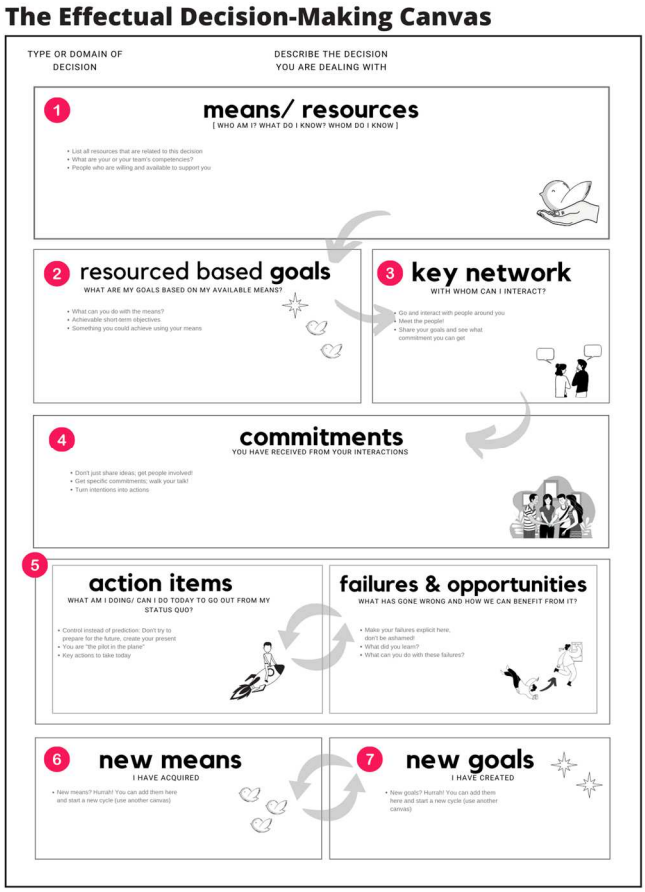


Fig. 3. Effectual decision-making canvas.

In the third step (3), the *key network*, the task is an invitation for the user to interact with other people in their network. The entrepreneur must ask themself: With whom can I interact? Rather than being passive, this interaction seeks out people who are interested in joining the endeavor, developing new objectives, or capturing new possibilities. The motto here is a call to act and share the resources-based objectives that will help to set up the next step.

The *commitments* step (4) directly references the crazy-quilt principle and includes the declaration of all commitments that might be derived from the interaction with the key network. By encouraging entrepreneurs to engage in dialogue, this section aims to move them closer to their goals by securing pre-commitments. This interaction is intended to lead to new commitments and, as a result, the creation of new action items (block 5), as well as the acquisition of new resources (6) or the generation of new objectives (7).

The next step (5), which includes the blocks *action items* and *failures & opportunities*, seeks to trigger two principles of Effectuation. First, it invites the entrepreneur to take action based on the situation analysis: What can I do today to get out of my status quo? The canvas invites the entrepreneur to

avoid predicting the possible future but promotes its realization: "You are the pilot in the plane." All possible actions should be listed here. Second, the *failures & opportunities* block, inspired by the lemonade principle, allows the decision-maker to declare and incorporate failures into the decision-making process. Failures should not be concealed but acknowledged and utilized as learning opportunities. Entrepreneurs should take these failures and transform them into opportunities.

The last two blocks (6 and 7) represent the end of a cycle and the beginning of a new one (if necessary). The new goals represent the implications of the process in the decision and should also be stated as action elements. New means allow for the possibility of iteration of the process since they enable the cycle to be re-initiated. Possible new resources and objectives acquired in any previous steps should be explicit here.

D. Demonstration

As part of an institute offering training for entrepreneurs and aspiring entrepreneurs, the researchers used the opportunity to demonstrate the effectiveness and usability of the tool. Initially, they interviewed entrepreneurship experts. The interviews were conducted in an unstructured manner to allow the interviewees to elaborate on giving feedback on the design.

The next step was to conduct a test in two entrepreneurship programs in which startup founders and students participated. A 45-minute intervention was included in both programs, which provided the designed artifact to aspiring and practicing entrepreneurs to use within their projects. Finally, they were given a survey to evaluate the artifact considering the requirements established by [28].

E. Evaluation

The effectual decision-making canvas met the objectives of the project. Through expert interviews and feedback from startup founders and entrepreneurship students, the researchers were able to understand the users' needs. The students and founders were surprised at how much difference consciously shifting to a more effectual approach can make. The evaluation of usability and clarity was successful (see following Evaluation subsection).

This valuable information and the successful use of the artifact in practice enabled the researchers to have the initial "proof-of-concept"-level validation [37], [38] as cited in [28]. The researchers used the results to plan the next development steps using experiments.

E. Evaluation

This section presents the distribution of responses (in percentage) using box plots and t-tests. The primary purpose of this evaluation is to observe whether the artifact has a favorable effect on the different evaluated areas. As there is no control group, in this proof-of-concept level evaluation, the significance of the means based on the Likert scale is statistically tested.

A t-test One Sample Mean (One-Tail right side) is used for the iterations. Even when the sample of both iterations is small (N1= 4 teams and N2=20 participants), the use of this test is entirely arguable according to the analysis of [39]. In his study, he argues that "there are no objections to using a t-test with extremely small samples, as long as the effect size is large" and, in case the results show a "statistically significant effect based on an extremely small sample size, it is probably grossly inflated concerning the true effect because effect sizes in psychological/ behavioral research are typically small" [39, pp. 7-8].

According to the applied Likert scale - from 1 to 7 - the following hypotheses are derived:

$$H0: \mu <= 4$$

$$H1: \mu > 4$$

The value 4 represents either "Neither disagree nor agree" (for functionality items) or "Neither bad nor good" (for usability items). It is interpreted as the neutral response, which indicates no positive or negative relation. A significantly higher mean of 4 is interpreted as a statistically validated rejection of the null hypothesis. The specific evaluation items were orientated on the ISO 9126 (International Standard for the Evaluation of Software Quality), which is recommended to evaluate DSR artifacts [40].

For this study, the dimensions of functionality and usability were operationalized. Items in the functionality dimension are integrated to indicate whether the artifact has helped change the target group's decision mode. As a result, it was possible to measure the relevance and effectiveness of effectual decision-making in entrepreneurial activity. The usability dimension is used to measure the user experience. Based on different criteria of the ISO 9126 regarding this dimension, understandability, usability, joy, and portability of the tool. The samples' descriptions and results of both iterations are shown in the following sections, including the box plots charts and the t-test.

A. Samples

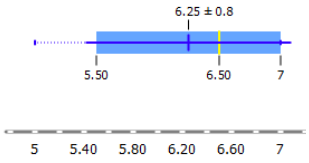
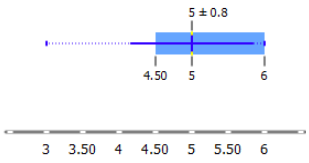
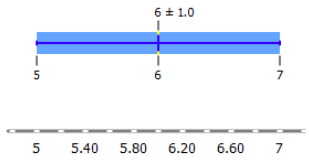
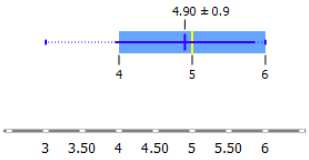
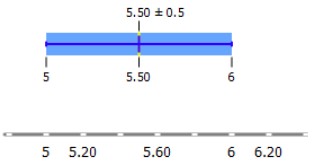
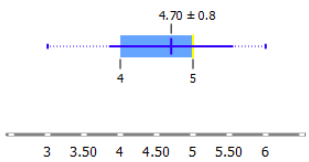
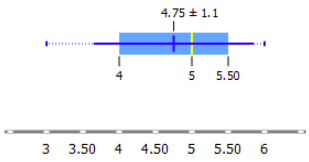
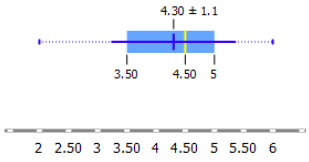
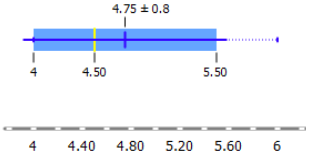
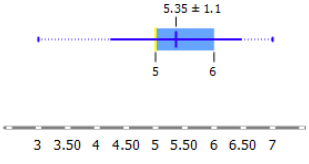
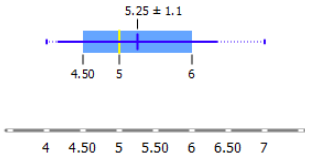
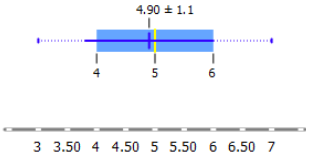
The artifact was integrated into the entrepreneurial programs. In that scope, the trainers presented and introduced it to aspiring and practicing entrepreneurs for the application in their projects. The first iteration was conducted with four teams in an accelerator program, and the second was executed with 20 students in an entrepreneurship course; three (15%) of them were female and 17 (85%) males. Due to the context of both programs, it is perceived that all participants are entrepreneurs or aspiring entrepreneurs. However, as part of the evaluation, the entrepreneurial intention was also measured using the scales proposed by [41], considering the statement: "I have the firm intention to start a firm someday."

In the first iteration, the four teams were initiating their business and were therefore characterized as practicing entrepreneurs by us. In the second iteration, the average, on a Likert scale of 1 to 7, was 5.7 with a standard deviation of 0.9. Besides, six (30%) of the participants declared to be in the process of founding a startup. With this information, we can conclude that the sample chosen to make the evaluation was valid [42] for this context.

B. Functionality items

Participants answered all functionality questions using a scale of 1 (strongly disagree) to 7 (strongly agree), the degree to which the following (see Table 1) statements applied.

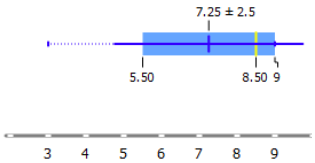
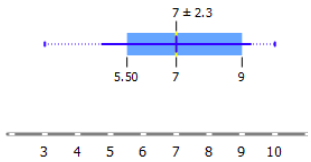
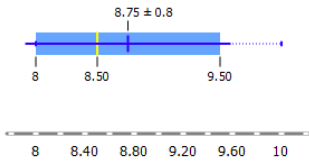
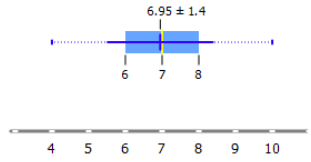
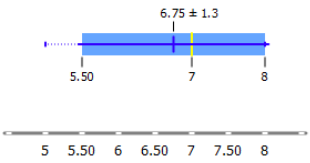
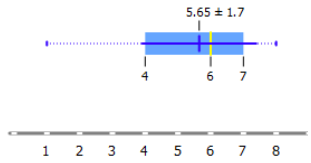
TABLE 1. DETAILED RESULTS OF THE FUNCTIONAL ITEMS.

Iteration 1	Iteration 2
The tool helps me to understand the relevance of decision-making in the life of startups	
	
Mean: 6.25; s^2= 0.9167	Mean: 5.00; s^2= 0.7368
t-Stat= 4.70 > t-Critical= 2.35	t-Stat= 5.20 > t-Critical= 1.73
With this tool, I am able to structure my decision-making process using Effectuation	
	
Mean: 6.00; s^2= 1.3333	Mean: 4.90; s^2= 0.9368
t-Stat= 3.46 > t-Critical= 2.35	t-Stat= 4.16 > t-Critical= 1.73
The canvas's content and structure help me know how to make the most of the means (resources) I currently possess.	
	
Mean: 5.50; s^2= 0.3333	Mean: 4.70; s^2= 0.7473
t-Stat= 5.19 > t-Critical= 2.35	t-Stat= 3.62 > t-Critical= 1.73
The content and structure of the canvas help me to use contingencies as opportunities.	
	
Mean: 4.75; s^2= 1.5833	Mean: 4.30; s^2= 1.1684
t-Stat= 1.19 < t-Critical= 2.35	t-Stat= 1.24 < t-Critical= 1.73
The content and structure of the canvas help me to understand better the impact of building partnerships.	
	
Mean: 4.75; s^2= 0.9167	Mean: 5.35; s^2= 1.2921
t-Stat= 1.57 < t-Critical= 2.35	t-Stat= 5.31 > t-Critical= 1.73
The content and structure of the canvas help me understand that I can control the future rather than predict it during my venture creation process.	
	
Mean: 5.25; s^2= 1.58	Mean: 4.90; s^2= 0.1.2526
t-Stat= 1.98 < t-Critical= 2.35	t-Stat= 3.59 > t-Critical= 1.73

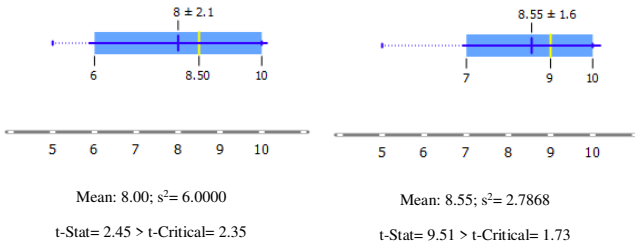
C. Usability items

Participants assessed the usability aspects of the artifact using a scale of 0 (very bad) to 10 (very good). The items evaluated were:

TABLE 2. DETAILED RESULTS OF THE USABILITY ITEMS.

Iteration 1	Iteration 2
Understandability of the blocks' names and description	
	
Mean: 7.25; s^2= 8.2500	Mean: 7.00; s^2= 5.3684
t-Stat= 1.57 < t-Critical= 2.35	t-Stat= 3.86 > t-Critical= 1.73
Usability of the Canvas	
	
Mean: 8.75; s^2= 0.9167	Mean: 6.95; s^2= 0.2.1552
t-Stat= 7.83 > t-Critical= 2.35	t-Stat= 5.94 > t-Critical= 1.73
Already the process of using the canvas was fun	
	
Mean: 6.75; s^2= 2.2500	Mean: 5.65; s^2= 3.1868
t-Stat= 2.34 < t-Critical= 2.35	t-Stat= 1.63 < t-Critical= 1.73

The tool presented could be carried with me on any physical or digital device (Portability)



Mean: 8.00; s^2= 6.0000

t-Stat= 2.45 > t-Critical= 2.35

Mean: 8.55; s^2= 2.7868

t-Stat= 9.51 > t-Critical= 1.73

i. Summary of the evaluation

The means, standard deviations, and the corresponding p-values of all the items evaluated in this study are presented in Table 2.

TABLE 2. MEANS AND STANDARD DEVIATIONS OF THE ITEMS

	Aspects	Mean 1ST ITERATION	SD	P-value	Mean 2ND ITERATION	SD	P-value
FUNCTIONALITY	Relevance of decision-making	**6.25****	0.957	0.009	**5.00*****	0.858	0.0000
	Effectuation	**6.00***	1.154	0.020	**4.90****	0.967	0.0002
	Bird-in-hand principle	**5.50****	0.577	0.006	**4.70****	0.864	0.0009
	Contingencies as opportunities	**4.75**	1.258	0.159	**4.30**	1.080	0.1148
	Partnerships	**4.75**	0.957	0.107	**5.35*****	1.136	0.0000
	Pilot-in-the-plane	**5.25**	1.258	0.070	**4.90****	1.119	0.0009
USABILITY	Understandability	**7.25**	2.872	0.107	**7.00****	2.316	0.0005
	Usability	**8.75****	0.957	0.002	**6.95*****	1.468	0.0000
	Joy	**6.75**	1.500	0.050	**5.65**	1.785	0.0599
	Portability	**8.00***	2.449	0.045	**8.55*****	1.669	0.0000

**:= p < 0.05, ** := p < 0.01, *** := p < 0.001*

F. Communication

The artifact development process will be reported in entrepreneurship, decision-making, business conferences, and journals.

V. DISCUSSION AND CONCLUSIONS

The development of an artifact to enable entrepreneurs to use and benefit from Effectuation as a decision-making logic using the DSR framework of [28] was described in this paper. The study described the different stages, from identifying the problem and motivation to its subsequent evaluation. It has been observed that this methodology assists the researchers in their quest for relevance and rigor in the design of the artifacts. Through different iterations of the DSR approach, it was also possible to grasp the importance of learning from, measuring, and improving the artifact.

Fig. 3 shows the final design of the artifact once all the feedback of the process has been integrated. In order to evaluate the different design aspects, relevant elements were evaluated based on the ISO 9126 standard. The usability and functionality aspects were successfully evaluated. This testing was performed considering the t-test and establishing hypotheses.

The first aspect evaluated was the relevance of the decision-making process. In both iterations, it was concluded that the participants understood its significance (Mean first iteration= 6.25**; Mean, second iteration= 5.00***). The second aspect evaluated was the ability to structure their decision-making process using the Effectuation approach. In both iterations, it is concluded that the participants were positively affected by the use of the artifact (Mean, first iteration= 6.00**; Mean, second iteration= 4.90**).

The next component of the evaluation was the Bird-in-the-Hand construct. This principle focuses on the entrepreneur's effort to use the available means. In both iterations, the effect was positive (Mean first iteration= 5.50**; Mean, second iteration= 4.70**), and it is concluded that the objective was achieved.

The fourth aspect evaluated is whether the artifact helped to see contingencies as opportunities (lemonade principle). In both iterations, the null hypothesis is not rejected (not significant). Therefore, it is concluded that the effect of this feature of the artifact was not effective. One of the possible explanations that the researchers concluded is the terminology used to express the evaluation. However, this aspect was considered to be an opportunity to enhance the final design of the artifact.

The last two aspects of functionality were whether the artifact provided insight into the impact of partnership creation and control perception. The first iteration of these features did not show a significant effect; however, in the second iteration, and as a result of improved design after the first iteration, an effect was observed on both features (Partnerships: Mean, first iteration=4.75; Mean, second iteration= 5.25***; Pilot-in-the plane: Mean first iteration= 5.25; Mean, second iteration= 4.90**).

The tested usability aspects were understandability, usability, joy, and portability. All aspects showed a positive effect within the study (Understandability: Mean first iteration= 7.25; Mean, second iteration= 7.00**; Usability: (Mean 1st iteration= 8.75**; Mean, 2nd iteration= 6.95***; Portability: (Mean first iteration= 8.00*; Mean, second iteration= 8.55***), except for the "Already the process using the canvas was fun" aspect. This usability aspect was considered to improve the latest design.

Overall, the presented Effectual Decision-making Canvas was evaluated as effective and usable by fulfilling most aspects in both dimensions. We encourage using the tool in entrepreneurial teaching and will further iterate the canvas and communicate the learnings to the relevant research and teaching community.

A limitation of this study is the number of iterations executed and the number of participants in the evaluation. However, according to [39], the type of evaluation conducted in this study mitigates this limitation within the analysis. The last version of the current tool is already being tested in new sessions with entrepreneurs and students.

REFERENCES

[1] S. S. Friday-Stroud and J. S. Sutterfield, "A conceptual framework for integrating six-sigma and strategic management methodologies to quantify decision making," The TQM Magazine, vol. 19, no. 6, pp. 561–571, 2007, doi: 10.1108/09544780710828412.

[2] S. Le Bris, A. Madrid-Guijarro, and Martin Dominique Phiippe, "Decision-making in complex environments under time pressure and risk of critical irreversibility: the role of meta rules," 22(1), pp. 1–29, 2019.

[3] D. Miller and P. H. Friesen, Organizations: A Quantum View: Prentice Hall, 1984.

[4] L. W. Busenitz and J. B. Barney, “Differences between entrepreneurs and managers in large organizations: biases and heuristics in strategic decision-making,” Journal of Business Venturing, vol. 12, no. 1, pp. 9–30, 1997, doi: 10.1016/S0883-9026(96)00003-1.

[5] D. A. Schon, Educating the reflective practitioner. San Francisco: Jossey-Bass, 1987.

[6] D. Dimov, The Distinct Domain of (Design Science of) Entrepreneurship: Unpublished, 2021.

[7] E. Ries, The lean start-up: How today's entrepreneurs use continuous innovation to create radically successful businesses: Currency, 2011.

[8] S. G. Blank and B. Dorf, The startup owner's manual. Vol. 1: The step-by-step guide for building a great company / Steve Blank and Bob Dorf. Pescadero, California: K & S Ranch, 2012. [Online]. Available: http://books.google.com/books?vid=isbn9780984999309

[9] R. J. Mockler, “The Systems Approach to Business Organization and Decision Making,” California Management Review, vol. 11, no. 2, pp. 53–58, p.54, 1968, doi: 10.2307/41164159.

[10] G. A. Alsos, D. Eide, and E. L. Madsen, Handbook of research on innovation in tourism industries. Cheltenham: Edward Elgar, 2014.

[11] J. Gabrielsson and D. Politis, “Career motives and entrepreneurial decision-making: examining preferences for causal and effectual logics in the early stage of new ventures,” Small Bus Econ, vol. 36, no. 3, pp. 281–298, 2011, doi: 10.1007/s11187-009-9217-3.

[12] J. T. Perry, G. N. Chandler, and G. Markova, “Entrepreneurial Effectuation: A Review and Suggestions for Future Research,” Entrepreneurship Theory and Practice, vol. 36, no. 4, pp. 837–861, 2012, doi: 10.1111/j.1540-6520.2010.00435.x.

[13] D. A. Grégoire and N. Cherchem, “A structured literature review and suggestions for future effectuation research,” Small Bus Econ, vol. 54, no. 3, pp. 621–639, 2020.

[14] S. D. Sarasvathy, Effectuation: Elements of entrepreneurial expertise. Cheltenham, Northampton, Mass: Edward Elgar, 2008.

[15] N. Dew, S. Read, S. D. Sarasvathy, and R. Wiltbank, “Effectual versus predictive logics in entrepreneurial decision-making: differences between experts and novices,” Journal of Business Venturing, vol. 24, no. 4, pp. 287–309, 2009, doi: 10.1016/j.jbusvent.2008.02.002.

[16] D. A. Shepherd, V. Souitaris, and M. Gruber, “Creating New Ventures: A Review and Research Agenda,” Journal of Management, vol. 47, no. 1, pp. 11–42, 2021.

[17] S. D. Sarasvathy, “Causation and Effectuation: Toward a Theoretical Shift from Economic Inevitability to Entrepreneurial Contingency,” AMR, vol. 26, no. 2, p. 243, 2001, doi: 10.2307/259121.

[18] G. N. Chandler, D. R. DeTienne, A. McKelvie, and T. V. Mumford, “Causation and effectuation processes: a validation study,” Journal of Business Venturing, vol. 26, no. 3, pp. 375–390, 2011.

[19] Start-up Genome, “Global Startup Ecosystem Report 2019,” 2019. [Online]. Available: https://startupgenome.com/reports/global-startup-ecosystem-report-2019

[20] J. Alzamora-Ruiz, M. M. Del Fuentes-Fuentes, and M. Martinez-Fiestas, “Effectuation or causation to promote innovation in technology-based SMEs? The effects of strategic decision-making logics,” Technology Analysis & Strategic Management, vol. 33, no. 7, pp. 797–812, 2021.

[21] H. E. Aldrich and T. Yang, “How do entrepreneurs know what to do? learning and organizing in new ventures,” J Evol Econ, vol. 24, no. 1, pp. 59–82, 2014.

[22] A. Hevner and S. Chatterjee, Design Research in Information Systems. Boston, MA: Springer US, 2010.

[23] H. Simon, The Sciences of Artificial, 3rd ed. Cambridge, MA.: MIT Press, 1996.

[24] S. D. Sarasvathy, What Makes Entrepreneurs Entrepreneurial?, 2006. [Online]. Available: Available at SSRN 909038.

[25] I. M. Reymen, P. Andries, H. Berends, R. Mauer, U. Stephan, and E. van Burg, “Understanding Dynamics of Strategic Decision Making in Venture Creation: A Process Study of Effectuation and Causation,” Strategic Entrepreneurship Journal, vol. 9, no. 4, pp. 351–379, 2015, doi: 10.1002/sej.1201.

[26] R. Guo, L. Cai, and W. Zhang, “Effectuation and causation in new internet venture growth,” Internet Research, vol. 26, no. 2, pp. 460–483, 2016, doi: 10.1108/IntR-01-2015-0003.

[27] R. Guo, “Strategic decision-making logics, entrepreneurial capability and opportunity exploitation in high-tech new ventures,” Journal of Business Economics and Management, vol. 19, no. 2, pp. 235–252, 2018, doi: 10.3846/jbem.2018.5201.

[28] K. Peffers, T. Tuunanen, M. A. Rothenberger, and S. Chatterjee, “A Design Science Research Methodology for Information Systems Research,” Journal of Management Information Systems, vol. 24, no. 3, pp. 45–77, 2007, doi: 10.2753/MIS0742-1222240302.

[29] A. Maedche, S. Gregor, and J. Parsons, “Mapping Design Contributions in Information Systems Research: The Design Research Activity Framework,” CAIS, vol. 49, no. 1, pp. 355–378, 2021.

[30] A. Hevner, S. March, J. Park, and S. Ram, “Design Science in Information Systems Research,” MIS Quarterly, vol. 28, no. 1, p. 75, 2004, doi: 10.2307/25148625.

[31] A. Osterwalder and Y. Pigneur, Business model generation: a handbook for visionaries, game changers, and challengers: John Wiley & Sons, 2013.

[32] A. Kozlowski, C. Searcy, and M. Bardecki, “The reDesign canvas: fashion design as a tool for sustainability,” Journal of Cleaner Production, vol. 183, pp. 194–207, 2018.

[33] S. de Santis, C. Giuliani, C. Staffoli, and V. Ferrara, “Visual Thinking strategies in nursing: a systematic review,” 3 (4), pp. 297–302, 2016, doi: 10.14616/sands-2016-4-297302.

[34] M. Akerdad, A. Aboutajeddine, and M. Elmajdoubi, “Reverse engineering canvas (REC): a visual tool for supporting reverse engineering activities,” Int J Interact Des Manuf, vol. 15, 2-3, pp. 249–257, 2021, doi: 10.1007/s12008-021-00763-3.

[35] A. Tittel and O. Terzidis, “Entrepreneurial competences revised: developing a consolidated and categorized list of entrepreneurial competences,” Entrep Educ, vol. 3, no. 1, pp. 1–35, 2020, doi: 10.1007/s41959-019-00021-4.

[36] B. Heblich, ““How can entrepreneurs lead themselves?” Empirically-based development and testing of interventions for healthy and effective self-regulation in the context of entrepreneurship to trigger positive individual and collective effects,” Karlsruhe Institute of Technology, Jan. 2021.

[37] K. Peffers, C. E. Gengler, and T. Tuunanen, “Extending Critical Success Factors Methodology to Facilitate Broadly Participative Information Systems Planning,” Journal of Management Information Systems, vol. 20, no. 1, pp. 51–85, 2003, doi: 10.1080/07421222.2003.11045757.

[38] K. Peffers and T. Tuunanen, “Planning for IS applications: a practical, information theoretical method and case study in mobile financial services,” Information & Management, vol. 42, no. 3, pp. 483–501, 2005, doi: 10.1016/j.im.2004.02.004.

[39] J. de Winter, “Using the Student's t-test with extremely small sample sizes,” Practical Assessment, Research, and Evaluation Vol. 18, Article 10, 2013.

[40] J. Venable, J. Pries-Heje, and R. Baskerville, “FEDS: a Framework for Evaluation in Design Science Research,” European Journal of Information Systems, vol. 25, no. 1, pp. 77–89, 2016, doi: 10.1057/ejis.2014.36.

[41] F. Liñán and Y.-W. Chen, “Development and Cross–Cultural Application of a Specific Instrument to Measure Entrepreneurial Intentions,” Entrepreneurship Theory and Practice, vol. 33, no. 3, pp. 593–617, 2009.

[42] J. Greenberg and D. E. Eskew, “The role of role playing in organizational research,” Journal of Management, vol. 19, no. 2, pp. 221–241, 1993.

APPENDIX

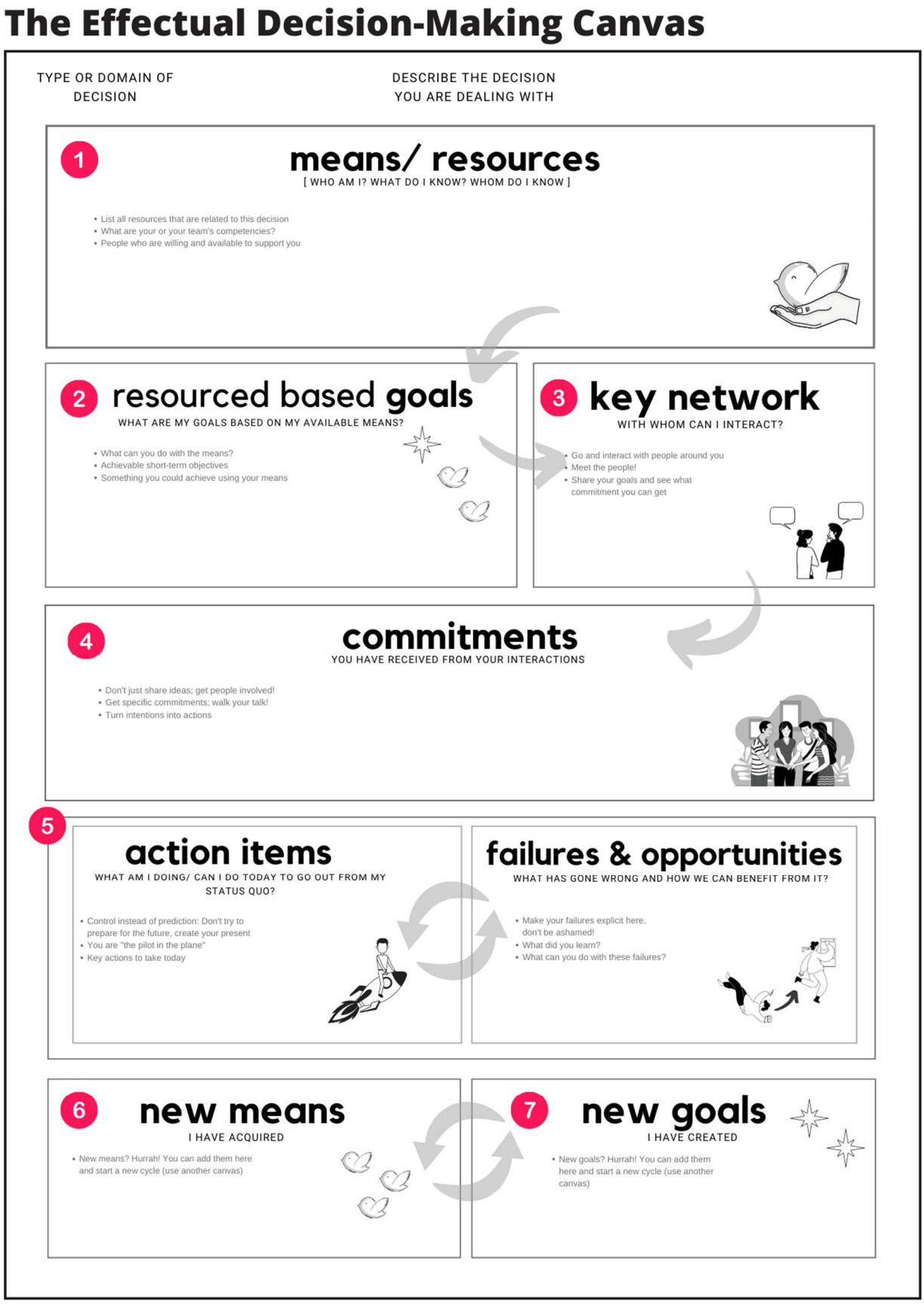


Fig. 3. Effectual decision-making canvas. Own creation, illustrations adapted from Canva.com