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SUCCESS-FAILURE ANALYSIS: A TOOL FOR ADVANCING DOMAIN KNOWLEDGE, DESIGN THINKING STYLE

Julia Petra Ariane von Thienen[1]*, Anja Perlich[1], Christoph Meinel[1] & Giovanni Emanuele Corazza[2]

[1] *Hasso Plattner Institute (HPI) at the University of Potsdam, Germany*
[2] *Department of Electrical, Electronic & Information Engineering, University of Bologna, Italy*
** Corresponding author at the HPI, Prof.-Dr.-Helmert-Str. 2-3, 14482 Potsdam, Germany. Mail: Julia.vonThienen@hpi.de*

Drawing on the Dynamic Creativity Framework and Failure Theory, this paper explores what it means to advance domain knowledge with creative ambitions. Failures are analysed as an extraordinary resource in the search for radical innovation. Success-Failure Analysis is suggested as a methodological approach to advance domain knowledge based on outcome tests in creative work. The Success-Failure Matrix is introduced as a tool to support failure- and success-driven learning journeys in design thinking projects.

Keywords: *Creativity, Design Thinking, Dynamic Creativity Framework, Education, Failure, Failure Theory, Innovation, Inconclusive Outcome, Success-Failure Matrix, Success-Failure Analysis*

1. ADVANCING KNOWLEDGE WITH CREATIVE AMBITIONS: WHAT DOES IT MEAN?

"If you do something and it works, great! If you do something and it fails, maybe even better" (Roth, 2015, p. 121). "The fear of making a mistake is a very devastating emotional block to creative activity. People should realize that progress is made through failure as well as through success" (Arnold, 1959/2016, p. 86). The idea of advancing creative projects by learning from success and – maybe even more importantly – from failure is a common theme in the design thinking culture. However, "learning" is a broad concept. What exactly do we want to support in innovation education when we try to help people learn from success and failure? The learning process could aim at personal knowledge acquisition: Finding out things that others ("the experts", "the stakeholders") already know. It could be about sharing knowledge: A team reaching a joint understanding that integrates information and expertise contributed by different persons. The process could be directed at finding out something novel: Arriving at a new insight no one else has had before. It could also be about revolutionizing what the whole world thinks with regard to a subject, and this indeed would be radical innovation.

While clearly all four aspects of learning mentioned above are important in innovation projects, we will focus on the last two as these instances of learning directly imply creative progress. Building on the *Dynamic Creativity Framework* (#2) and its offshoot *Failure Theory* (#3) we will explore what it means to advance domain knowledge with creative ambitions. Failures will be analysed as decisive resources in creative projects.

While psychologically failures are naturally experienced as painful, design thinking culture appears to offer valuable approaches to fuel learning on their behalf (#4). Building on typical design thinking values and interventions, we propose the *Success-Failure Matrix* (#5) as a tool to advance domain knowledge based on prototype tests; readers are invited to try and advance this madlib as we share it under a Creative Commons license.

2. THE DYNAMIC CREATIVITY FRAMEWORK AND ITS ACCOUNT OF KNOWLEDGE DEVELOPMENT

The *Dynamic Creativity Framework (DCF)* identifies patterns in the dynamic phenomenon of creativity on small scale and large scale levels. Amongst other subjects, it covers the creative thinking process, estimating the potential of novel ideas, resistance to innovation and, most notably for our purposes, original knowledge development in the course of creative activity (Corazza 2015, 2016a, b; Corazza et al., 2016).

DCF points out that, in our times, culture has evolved to a high level of sophistication. People who pursue creative work can expect their process to endure for a considerable time before, finally, something really novel may be thought up, let alone something that in addition proves effective (Corazza, 2016a). A breakthrough idea is very unlikely to be the immediate and first outcome in a creative process. Rather, a number of *inconclusive outcomes* are usually produced first: Outcomes that are not considered sufficiently original and effective to be recognized as creative achievements. In that case, the process simply needs to continue (see fig. 1).

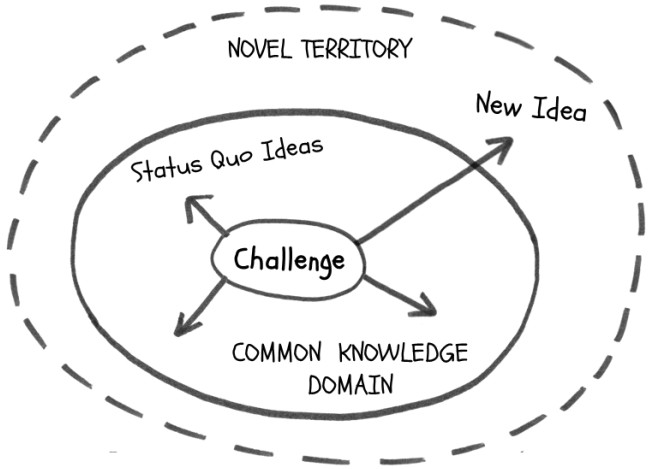

Fig. 1: Each creative project starts off from the *Common Knowledge Domain* that encompasses already existing ideas. Creative achievements can only be reached by moving beyond status quo beliefs and solutions. This, however, is not easy and multiple attempts may be necessary. Many ideas – and in particular the "likely ones" – have been tried before; they are already part of the *Common Knowledge Domain* (figure adapted from Corazza, 2016b).

3. Failure Theory

Failure Theory (FT) emerged from a reconstruction of design thinking beliefs about failure within the *DCF* (von Thienen, Meinel & Corazza, 2017). It traces the process in virtue of which failures can aid knowledge development, opening up fruitful paths out of the *Common Knowledge Domain,* moving the process beyond status quo beliefs and solutions.

Many people consider failures to be purely aversive: painful, reputation damaging, forerunners of bankruptcy. Interestingly, however, they also seem to entail a unique potential for creative progress. Upon careful analysis, failures can be a decisive resource in creative endeavours.

Adhering to design thinking parlance, where "prototypes" are the entities that undergo evaluation, *FT* suggests the following definition:

*A prototype is **failing** when it is does not deliver the expected performance in a test.*

FT assumes a strictly positive relationship between failure-degree and creative potential: The more radical a failure, the more it increases the creative potential of a project. To realize this potential, of course failures need to undergo careful analysis.

Once more addressing design thinking contexts where the "creative agent" *(DCF)* is a team and the "creativity goal" *(DCF)* is to better satisfy basic human needs, *FT* suggests three rough distinctions.

Type 1 failures occur when a team does not yet tackle a worthwhile problem. There can be two reasons for this: (i) The team tries to satisfy a need that does not exist or is of marginal importance. (ii) Needs have been overlooked that must be addressed by prototypes in this domain to achieve acceptance.

In the case of ***Type 2 failures*** the team tackles a worthwhile problem, but their solution is much worse than expected. Again, views about the domain of interest are shattered and need to be revised, but the problem understanding per se continues to provide solid grounds.

Mini failures occur when a team expects their prototype to perform badly, and so it does. In this case, expectations are reinforced rather than shattered, though knowledge may be added as to how the prototype fails in detail.

Type 1 failures are expected to entail the most creative potential and *mini failures* the least, although *mini failures* are still considered more favourable than no failures in terms of adding creative potential.

3.1 Why Failures Ease Radical Innovation

When people pick up a creative activity they are endowed by their culture, and possibly by explicit education, with beliefs about the domain of interest that other people have held before. Moreover, in design thinking projects, teams begin the creative process by exploring already existing views and solutions in the field (see fig. 2). This includes literature and product reviews next to explorations into subjective views of stakeholders and team members.

At the time when people wish to present their own creative outcome, there are even more reasons to be well familiar with the *Common Knowledge Domain (CKD)* relevant to one's field. After all, one's outcome

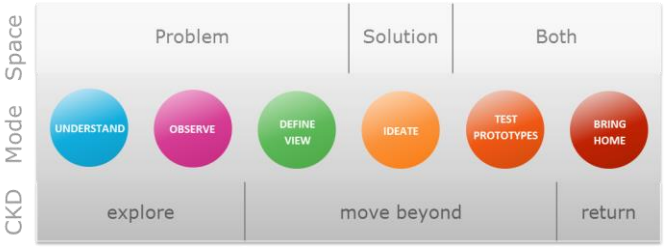

Fig. 2: Design thinking teams begin their process with a focus on the problem space: They try to understand what problem in their domain is worth tackling and how to view it from a novel, promising perspective. Then, teams focus on the solution space, ideating potential solutions. In subsequent steps, prototype tests serve to evaluate both the chosen problem view and solution ideas. Specifically at the beginning of the process, when teams invoke the design thinking modes "understand" and "observe", they explore already existing beliefs and solutions of the *Common Knowledge Domain (CKD)*. In the modes "define view", "ideate" and "test prototypes" the important task is to move beyond the CKD, i.e. exploring an innovative – as opposed to a commonplace – problem view and solution. In the "bring home" mode teams return to the CKD by communicating their key insights. Thus, project learnings (in particular regarding problem views and potential solutions) become part of the public knowledge henceforth.

shall be novel and more effective compared to already available solutions.

When a seemingly creative project outcome is put to the test and then fails unexpectedly, there is something that the creative agent "might have known", but obviously did not know. The person or team "got it wrong"; and since they should be well familiar with relevant parts of the *CKD* at this stage of the process, likely the *CKD* also "gets it wrong". Thus, established *CKD* beliefs seem insufficient and the opportunity emerges to develop novel, potentially more fruitful understandings.

3.2 How Failures Ease Radical Innovation

Analysing failures can help clarify which *CKD* beliefs to rethink. Creative efforts can then be directed at the task of finding alternative and more effective views to those that have become dubious (see fig. 3).

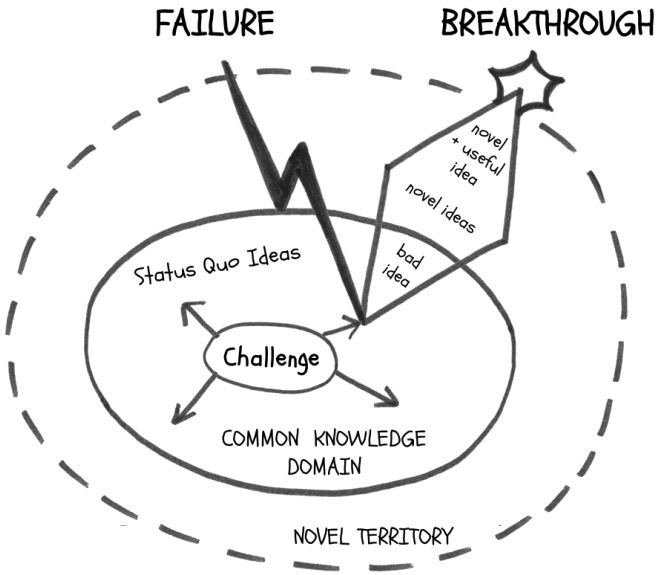

Fig. 3: A failure can be turned into a breakthrough when it is used to identify bad ideas, or questionable beliefs, in the *Common Knowledge Domain*. Then, a divergent search for novel ideas can follow, until the process converges on a novel and useful solution (figure reprinted from von Thienen et al., 2017).

The more radical a failure, the more *CKD* beliefs are called into question. *Type 2 failures* affect beliefs about the solution space; *type 1 failures* also render beliefs about the problem space dubious (cf. figures 2 and 3). Depending on how the team reframes their problem in reaction to failure observations, completely novel solution spaces may open up. Thus, upon utilizing failure observations novel problem and solution views may replace previously established ones. The more old ideas a team attempts to replace, the more revolutionary are the changes they propose. In case of a big impact, teams may really change how the whole world views and solves a certain problem.

4. Supporting Learning Journeys, Design Thinking Style

Undoubtedly, failures have a tendency to feel unpleasant (Berns, 2010). It is therefore understandable when people endorse non-adaptive failure responses such as turning away instead of paying close attention to finding explanations (cf. von Thienen et al., 2017). Design thinking, however, has promising approaches in offer that may also benefit learning journeys in the case of failure.

Generally, the community designs education experiences as much as design thinking students learn to design solutions (von Thienen, Royalty & Meinel, 2016). This includes the preparation of easy to handle madlibs, i.e. templates that fuel creative thinking processes by stirring pointed analyses while not invoking restrictive formalities (d.school, 2010). It also includes emotion management as championed by design thinking facilitators (d.school 2012a). Furthermore, methods are practiced in order to impact the mindset: to convey values and favourable thinking habits (Arnold, 1956/2016; d.school 2012b). While this pertains to individuals, habitual method practice will also impact community culture. In this regard, using methods in teams can be an important step beyond shaping individual mindsets to establishing such a favourable community culture.

We believe there is a great potential in adopting such an approach also in the case of learning journeys that include failures. By making knowledge development in the course of prototype tests visible or even tangible, it becomes obvious how both success and failure advance the team's domain understanding. Emotionally and cognitively, learning from failure may become easier: Failures give rise to crucial insights – what a success after all!

5. Success-Failure Analysis with the Success-Failure Matrix

Success-Failure Analysis is a methodological approach that investigates successful and failing outcome tests in creative endeavours with the aim of advancing domain knowledge to, ultimately, tap fruitful paths beyond status quo ideas. In line with the model presented in fig. 3, the analysis seeks to identify "bad ideas" among presently held beliefs. Such ideas can then be replaced by original and effective alternative views. In the following, we specifically suggest the *Success-Failure Matrix* (*SF-Matrix*) as a tool to advance domain knowledge in a design thinking manner (see fig. 4). Teams can use it to illuminate how well they already understand their domain and to improve this understanding based on observations ranging from consistent success to radical failure.

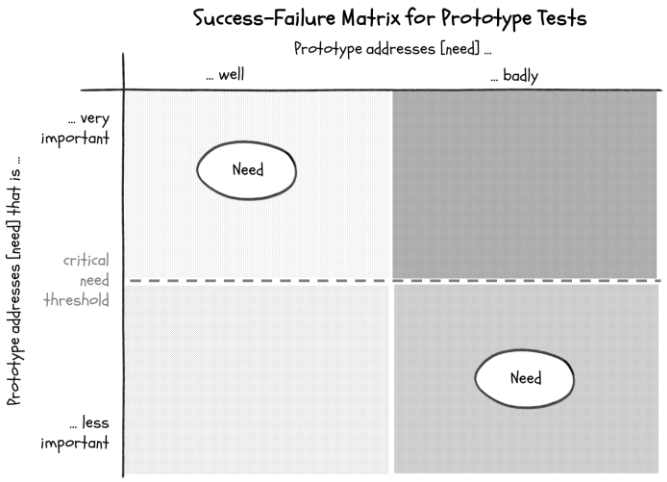

Fig. 4: The *SF-Matrix* inquires what needs are known in the domain and whether they are considered important or unimportant. It also visualizes to what extent prototypes presumably (pre-test) or actually (post-test) meet the specified needs. Prototypes ought to accommodate all needs above the critical need threshold, or they will be perceived as deficient.

In line with design thinking objectives, the *SF-Matrix* focuses on user needs when inquiring about the domain knowledge of a team. As the madlib intends to support knowledge development in the course of a prototype test, we suggest filling it in twice, before and after a test.

If a prototype addresses all important needs well – test users are fully convinced and want to adopt the novel solution – the test is successful and the innovation project can proceed without further iterations. When a prototype fails to address one or more critical needs well or rather addresses the wrong needs, a failure occurs and the team has the opportunity to advance their domain understanding. When a test reveals unaddressed needs, these may be clear or unclear after the test. Understanding them better likely becomes a major goal for subsequent work, as in the following project case.

In one design thinking challenge at the HPI D-School a team focused on convenient stores that were open beyond the normal shop closing hours. The team learned that shop owners often worked ten to twelve hour shifts. This would be challenging specifically for shop owners with children, who regularly ended up bringing their kids to the workplace in the evenings.

The team prototyped a play book to keep the children quietly entertained behind the counter. Parents would have the opportunity to join book activities from time to time. Thus, the play book was designed to help the whole family spend meaningful time together despite of all the constraints that the shop environment entailed.

When the team tried to test their play book prototype, they experienced surprising rejections. No shop owner was even willing to take a look at the book. All of them were fast to point out that they didn't have kids, or that they would never bring kids to the workplace – even though field observations and interviews with other nearby shop owners clearly suggested otherwise.

In the test situation, the need to spend meaningful time with their children at the shop seemed to have a low priority for the parents. Something else was more important. What exactly this unanticipated key need amounts to requires interpretation and further learning. It seems the shop owners wanted to stay out of trouble. There appeared to be the view that shop owner and parent responsibilities required other solutions than bringing kids to the workplace.

This design thinking test experience is typical in that it leaves a lot of room for different problem views, which

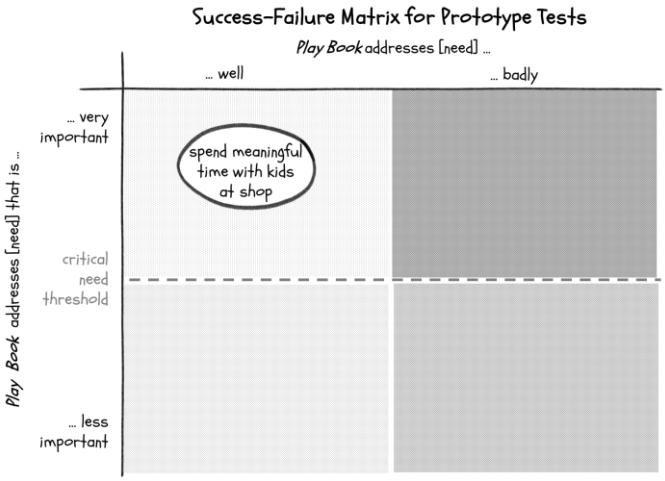

Fig 5a: Pre-Test

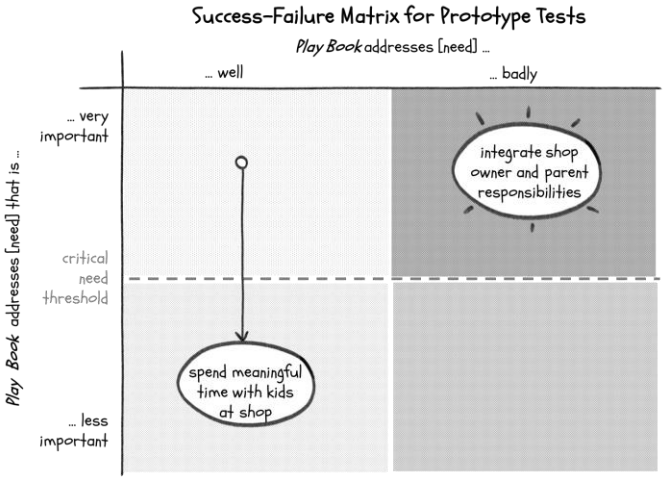

Fig 5b: Post-Test

Fig. 5: A design thinking team tests their play book prototype for shop owners with children. Learning occurs from pre-test (5a) to post-test (5b); domain beliefs change. Before the test, the team assumes that shop owners wish to spend meaningful time with their children at the shop. The team also assumes a play book would address this need well. However, after the test the team comes to assume that this need is of low importance to the parents. As for a novel hypothesis, it seems that the parents are mostly concerned that they might potentially fail to comply with their obligations as shop owners and as parents in case they regularly brought their children to the workplace.

then channel the search for solutions in vastly different directions. If the newly discovered need was named "complying with legal obligations", emotional needs of children and their parents to spend time together would be out of sight. Potential other need descriptions include "feeling good about kids at the shop" or "integrating shop owner and parent responsibilities". The latter formulation arguably is more favourable since it covers both legal and emotional aspects. Clearly the question what is learned from a test, or what novel beliefs shall be added to the CKD, requires active interpretations and some details may stimulate controversial discussions. In this regard, the *SF-Matrix* visualizes interpretive decisions taken by the team (see fig. 5).

The play book test illustrates two straightforward failures: addressing a need of subordinate importance and overlooking a crucial need. However, very often test experiences are less homogenous. Specifically when a prototype bears on a number of different needs, some may be well-addressed, others less so. In that case, the *SF-Analysis* serves to distinguish between parts that are successful and parts that fail. Further attention can then be devoted to better understanding those aspects that went badly.

Figure 6 provides typical examples of how success and failure "look" in the matrix and can be visually identified. A team may also decide to make their model tangible, e.g., with acrylic tiles similar to tangible business process models (cf. Luebbe & Weske, 2011). We provide the *SF-Matrix* under the Creative Commons license CC-BY-SA: Readers are welcome to use and modify the scheme upon referencing the original. An empty template is provided in the appendix.

Perlich et al. (in press) offer an extensive example of how *Success-Failure Analyses* can be carried out in practice. They apply the *SF-Matrix* repeatedly in a real life design project to make sense of test observations and to determine future paths of action.

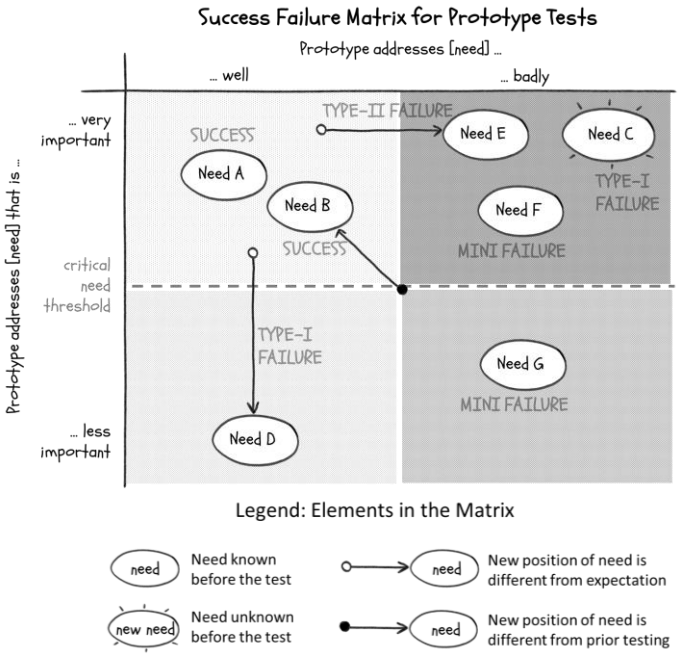

Fig. 6: The *SF-Matrix* visualizes a dynamic learning process in creative endeavours. Domain understandings can improve from pre- to post-test (white dot arrows) or from one prototype test to the next (dark dot arrows).
A *success* occurs when important needs are well-addressed by the tested prototype (examples *A* and *B*). While in the case of *Need A* all domain beliefs are immediately confirmed (no movement), in the case of *Need B* a novel solution has been tested, which performs much better than the previous one.
Type 1 failures occur when an important need has been overlooked and is thus badly addressed (*C*) or when a well-addressed need turns out to be of minor importance (*D*).
Need E illustrates a *type 2 failure*: an important need is addressed less well than expected.
Mini failures occur when needs are badly addressed by the prototype and this has already been anticipated. So here, too, no movement is visible in the matrix. *Mini failures* can pertain to both important (*F*) and less important needs (*G*).

6. Conclusions

The *Dynamic Creativity Framework* illuminates the potential for knowledge to develop in the course of innovation projects, allowing highly original and effective creative achievements. It also explains why there are typically many inconclusive outcomes in a creative process before, finally, a creative achievement may materialize. *Failure Theory* holds that failures are uniquely valuable inconclusive outcomes: They bear a huge potential to support the necessary knowledge development in a creative process to culminate in radical innovation.

Building on these frameworks, *Success-Failure Analysis* is introduced as a methodological approach to advance domain knowledge in creative projects based on outcome tests. The *SF-Matrix* is shared under a Creative Commons license as a madlib to support *Success-Failure Analyses* in design thinking projects.

All in all, there are good reasons to believe that radical innovation is promoted by explicitly identifying failures and by analysing them carefully. To what extent the envisioned progress in innovation projects de facto materializes, only tests can tell.

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Appendix: SF-Matrix