Note on Experiment

“If Ernest Hemingway, James Michener, Neil Simon, Frank Lloyd Wright, and Pablo Picasso could not get it right the first time, what makes you think that you will?” Paul Heckel

“If you keep making the same mistakes again and again, you aren’t learning anything. If you keep making new and different mistakes, that means you are doing new things and learning new things.” David Kelley

“Prototyping is a state of mind” (Kelley & Littman, 2001, p. 103).

James Dyson, supported by his wife’s job as an art teacher, took five years and 5,127 failed prototypes before he developed the now highly successful Dual Cyclone bag-less vacuum cleaner. As Robert Sutton, Professor at the Graduate School of Business at Stanford University says, “If failure sucks, but instructs, that is a lot of learning” (Sutton, 2009).

Sutton goes on to present research done by Shmuel Ellis and his colleagues who examined the question of how and when we learn best from failure. A field experiment examined two companies of soldiers in the Israel Defense Forces, who were tested for their performance on navigation exercises. The first company had a series of after-event reviews during four days of navigation exercises that focused only on the mistakes that soldiers made, and how to correct them. The second company, in its after-event discussions, focused on what could be learned from both their successes and failures. Then, two months later, these same two companies went through two days of navigation exercises. The results showed that, although substantial learning occurred in both groups:

- Soldiers who discussed both successes and failures learned at higher rates than soldiers who discussed just failures.
- Soldiers in the group that discussed both successes and failures appeared to learn faster because they developed “richer mental models” of their experiences than soldiers who only discussed failures.

Other research extended this finding in a controlled experiment and showed that experiencing failure does lead to richer mental models than experiencing success. They found some intriguing results:

- After people succeed at a task, they learn the most when they think about what went wrong.
- After people fail on a task, it doesn’t matter whether they focus on successes or failures. They will learn so long as they do an after-event review.

Sutton’s key takeaways from these research studies are:

- After-event reviews -- whether focused on failure alone or both successes and failures -- spark learning. As he suggests, this seems obvious but it is very often not done.
- After people succeed at something, it is especially important to have them focus on what things went wrong. They learn more than if they just focus on success (so, don’t just gloat and congratulate yourself about what you did right; focus on what could go even better next time).
- When failure happens, the most important thing is to have an after event review to provoke sufficiently deep thinking -- whether you talk about successes or failures is less important. (Sutton, 2007).
The objective of the Experiment step of the Problem Finding, Problem Solving process is to obtain feedback on the concepts generated in the Ideate phase, and to refine those concepts based on that feedback. It requires being able to describe the concepts, or at least important elements of those concepts, to others and then being able to hear, document and use the feedback you get – especially about the parts of the idea you don’t yet have right. In short, it involves a highly iterative process of rapid prototyping – build, test, learn, redesign, repeat – and being able to learn from the failures.

Designers, engineers and product developers all know the importance of rigorous cycles of inquiry and learning, building and testing rudimentary prototypes to ferret out flaws before building a concept at scale. A rule of thumb is that at every successive stage of development, the cost of the project -- in time, materials, and potential problems—escalates tenfold. By the time you introduce the solution into the world of users, you need to have engineered out every error you can possibly anticipate. It is much more cost effective to do multiple, low-fidelity prototypes very early in the process and to test them with stakeholders to identify required changes. A pilot solution should be as close an approximation as possible to the final implementation. In many cases, this actually means releasing the solution a limited way to learn from a few sophisticated stakeholders, with the assumption that few (if any) changes will be made before releasing it more widely.

Prototyping can be applied to virtually any arena, from development of new organizations to generation of new curricula, programs and tools. This note describes different types of prototypes, and then provides some direction for how to use those prototypes to gather feedback from a variety of stakeholders.

**Prototypes**

Formally, a prototype is:

1. the original or model on which something is based or formed
2. someone or something that serves to illustrate the typical qualities of a class; model; exemplar: she is the prototype of a student activist
3. something analogous to another thing of a later period: a Renaissance prototype of our modern public housing

Prototyping is at the center of design processes, not only as a step and activity (to prototype) but more importantly as an attitude in addressing new solutions, and as a way to create a more meaningful dialogue and get early feedback (i.e., a prototyping attitude). In this sense, the word ‘prototype’ is used both as a noun and a verb. “Basically it’s nonstop inventiveness to meet human needs” (The World as Prototype, 2007). In Tom Kelley’s words (Kelley & Littman, 2001, pp. 103-104):

“Prototyping is problem solving. It’s a culture and a language. You can prototype just about anything–a new product or service, or a special promotion. What counts is moving the ball forward, achieving some part of our goal. Not wasting time....Prototyping is a state of mind.”

In this way of thinking, prototypes are a way to learn, and are particularly useful for complex problems that seem insoluble. Prototypes are time savers and a great way to generate a dialogue and discover new issues. Prototyping, at least at the early stages, should be fast: “Quick prototyping is about acting before you’ve got the answers, about taking chances, stumbling a little, but then making it right” (Kelley & Littman, 2001, p. 107). The figure below, for example, shows a quick prototype of a new medical device made simply with a marker, clothespin and film canister (Brown, Tim, 2008, p. 86).
Prototypes may also take the form of a business model canvas:

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<table>
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<tr>
<th>KEY PARTNERS</th>
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Prototyping helps you make choices among competing solutions and helps you sell your solutions to others.

“It is easy to reject a dry report or a flat drawing. But models often surprise, making it easier to change your mind and accept new ideas. Or make hard choices, such as forgoing costly and complex features…. A prototype is almost like a spokesperson for a particular point of view, crystallizing the group’s feedback and keeping things moving” (Kelley & Littman, 2001, pp. 111-112).

Schrage (1999, p. XIII) emphasizes that fast prototyping is a way to create a dialogue and co-develop with clients. Prototyping forces organizations to become more explicit and to externalize their thoughts. He uses the MIT Technology Media lab as an example of an organization whose culture is based on “‘Demo or
Die’ (which) captures the prevailing belief that it’s not enough to have brilliant ideas; you have to be able to demonstrate them”.

Prototypes do not have to be physical: “If you are working on a project that has a service or human component, sometimes it helps to have a team member-and even clients-express the project through archetypal characters in a little improvisational skit. Living, moving prototypes can help shape your ideas” (Kelley & Littman, 2001, p. 112).

Prototypes “provide the means for examining design problems and evaluating solutions” (Houde & Hill, 1997). Selecting the focus of a prototype is the art of identifying the most important open design questions. If the solution is to provide new functionality for end users, and thus play a new role in their lives, then the most important questions may concern exactly what that role should be and what features are needed to support it. If instead, it is the goal of the solution to present its functionality in a novel way, then prototyping would focus on the look and feel of the solution instead. If the solution is based on a new technique, then questions about how to implement to design may be the focus of the prototyping efforts.

Prototyping and testing business model canvases similarly requires understanding the areas of the canvas that are the sources of the greatest risk. Can we deliver through a new channel? Will the customers be willing to pay the price we are asking? Can we actually execute the activities needed to deliver this value proposition to our target segment. If the organization is offering a new value proposition, then it would focus its prototypes around communicating and testing that new value proposition. If the organization wanted to try a new revenue model, its prototypes would focus on eliciting information from potential customers about that model.

A prototype can take many different forms (Buxton, 2007) and (Ulrich & Eppinger, 2008):
- Verbal descriptions
- Sketches, renderings or photos
- Role play, scenarios, experiences
- Storyboards – a series of images that communicates a temporal sequence of actions involving the product
- Videos – dynamic storyboards
- Simulations
- Interactive multimedia – combines the visual richness of video with the interactivity of simulation
- Physical appearance models
- Working prototypes

In the terms of this class, “A business model prototype can take the form of a simple sketch, a fully thought-through concept described with the Business Model Canvas, or a spreadsheet that simulates the financial workings of a new business” (Osterwalder & Pigneur, 2010, p. 162).

There are four fundamental uses of prototypes (Ulrich & Eppinger, 2008):
- Learning: answering questions about performance or feasibility
- Communication: demonstrating a solution to garner feedback from:
  - Customers and users
  - Team members
  - Others in the organization
  - Partners outside the organization
- Integration: of elements of the solution
• Testing: assessing the viability of a solution in the marketplace

The role of prototypes varies throughout the design cycle. In the earliest stages, prototypes may be built to inspire – to engage people, including customers, in a process of imagining what could be. Osterwalder (2010, p. 164) describes prototypes used at this stage as “a tool of inquiry”. In the middle stages of development, prototypes allow the design to evolve – some core elements of the solution may be fixed at this point, but others can be modified and played with. Finally, at the later stages prototypes are used to validate – to ensure the design team and others in the organization that the solution is the right one with which to move forward.

The prototypes used at each of these stages are different. Prototypes used to inspire are relatively crude and malleable so they invite feedback and change (i.e., a “napkin sketch”), while those used in the validate phase more closely approximate the final solution and are thus viewed as less changeable (i.e., the “field-test”). And, accordingly, the people to whom you show the inspire prototypes must be able to engage with and give feedback in a more forgiving and interactive way than perhaps those giving feedback on a validate prototype might. It is possible to interpret the issue you read about in Data and Decisions at Google as one in which the company was applying “validate” level criteria to concepts that should perhaps still have been in the “inspire” stage (Helft, 2009).

There are several distinct audiences with which you might discuss prototypes (Erickson, 1995):

• Designers evaluate their options with their own team by critiquing prototypes of alternate design directions.
• They show prototypes to users to get feedback on evolving designs.
• They show prototypes to their supporting organizations (such as project managers, business clients, or professors) to indicate progress and direction.

Gathering Feedback

By the time you get to the Experiment stage, you will have generated a broad and diverse set of inputs leading to a vast collection of new data, insights and ideas all “contained” in a set of provisional concepts about how to move forward successfully. At this stage, you can use multiple different mechanisms to put your concepts – in the form of prototypes -- in front of a wide range of thinkers, exploiting the wisdom of diverse experts and stakeholders about the challenges or opportunities they see. The data generated in the validation process generates solid support for the decision process that follows, during which you determine which concepts to invest in as more detailed and refined prototypes.

Just as you generate different types of prototypes for different purposes, you must be clear when you take those prototypes out to gather feedback what it is you want to learn and how you want to learn it. The steps in concept testing include (Ulrich & Eppinger, 2008):

1. Define the purpose of the test
2. Choose a population with which to test
3. Choose a format in which to collect feedback
4. Communicate the concept
5. Measure customer response
6. Interpret the results

To get really in-depth understanding of a prospective user’s response to a concept, however, you need to take your prototypes back out in much the same way you did your observational research. You have to engage prospective users in interactions with your prototypes, preferably in their use environment, and
watch how they integrate the solution, the issues they have with it, and how they react to it. All the principles of observation (Note on Observe) apply in this case to prototype testing.

**Summary**

The Experiment step of the Problem Finding, Problem Solving process aims to:

- Create prototypes of the concepts chosen or tests for the hypotheses identified in the Ideate step
- Test, or gather feedback on, those prototypes
References


