

# Innovating Information System Development Methodologies with Design Thinking

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**Abstract:** Design thinking has emerged as a means of solving problems by focusing on the perspective of the customer to better determine the user's application requirements. A major complaint with the Waterfall System Development Methodology is the difficulty gathering all requirements up front prior to development, making it hard to implement customer change requests later in the development cycle. Alternatively, the Agile Development Methodology allows for constant system revisions and improvements, potentially making it hard to budget and plan for the completion of a system. This paper looks at integrating Design Thinking into the traditional Waterfall and Agile system development methodologies. Using the Design Thinking components of empathize, define, ideate, prototype, and test leads to improvement of both the developer and customer experience.

## 1 INTRODUCTION

Design thinking has emerged as a means of solving problems from the perspective of the customer or user in order to better determine the user and application requirements (Shapira et al., 2017; Geissdoerfer et al., 2016). Design thinking principles have been utilized by some of the world's most influential technology corporations such as SAP, IBM, Apple, Uber, Airbnb, and Capital One as a means of developing better products and services (Vetterli et al., 2016; Sutton & Hoyt, 2016; Waloszek, 2012). The concepts of innovation and empathy are a reoccurring pattern in design thinking as a development methodology. In the traditional project management and system development methodologies, whether waterfall or agile, customer interaction and participation is mostly limited to a specific time set aside to determine user requirements.

Design thinking builds on the process of empathizing and interacting with the customer from the start of the project until one has a solution that meets the customer's needs and environment (Plattner, 2016). As the name implies, design thinking is a problem-solving framework and not an exclusive project execution framework such as waterfall and agile. This paper seeks to integrate the

innovative concept of design thinking into the traditional waterfall and agile system development methodologies.

## 2 THE DESIGN THINKING CONCEPT

Design Thinking starts by defining the problem and then developing a solution—with a focus on the customer or user of the final product (Plattner, 2016). As you focus on understanding the customer's problem, you can then create a prototype solution. This prototype is then tested – allowing you to continue to learn and improve upon your solution.

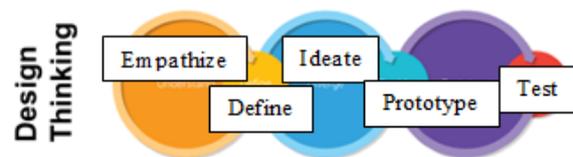


Figure 1: Design Thinking Components.

The design thinking process as a solution-based framework consists of five components including: empathize, define, ideate, prototype, and test (Dam

& Siang, 2016; Waloszek, 2012). Unlike traditional project management processes such as waterfall, design thinking is not a linear methodology. For instance, while in the empathize phase, people could also be working on a prototype to learn more about the subject, gain a deeper understanding, and create a better solution.

**Empathize:** A major component of design thinking is empathy. During the empathize phase the researcher or group works to understand the customer or the user who is going to be using the final product or service. When a researcher truly understands the user, he or she will be able to more clearly understand the issues they are facing. Requirements gathering processes such as observing, engaging through conversation, and interviewing are used – but with a deeper goal of empathizing with the user, to more thoroughly understand the problem and the related issues. Researchers should be able to develop and gain similar insights of the experiences as the users have. The goal of this phase is to gather requirements by better understanding the experiences of the users.

**Define:** Based on what is learned during the empathize phase, the define stage is where researchers bring focus and clarity to the parameters of the issue. The researcher, with the deeper understanding of the requirements gained from the empathize phase, along with their knowledge and view of the whole environment, should be able to document the requirements in a clear manner. Those working on this design thinking approach use tools to focus and understand the problems experienced by the users. The researcher should be able to step back and see the problem from a higher level or a more comprehensive perspective. By learning more about the user and the situation and environment, the researcher will see the problem more clearly. Once the requirements are defined, a research team is able to move to the next phase to generate ideas to address the problems. The define phase should conclude with a statement about the requirements that clearly sets out the scope and parameters of the problems.

**Ideate:** The ideate phase consists of generating multiple ideas that could be possible solutions to the problems previously defined, or at least part of the solution to the proposed challenge. This is done by creating the widest possible range of ideas. Generating a wide range of ideas allows researchers to use their imagination and look beyond obvious solutions potentially leading to more innovative ideas. The ideating phase includes various innovation techniques include building prototypes, body storming, mind mapping, and sketching. Prototyping is especially important during the ideating phase since it provides new views of the problems as well as of possible solutions.

**Prototype:** A prototype could range anywhere from post-it notes on a board to a tangible product. The more realistic the prototype is to what an actual user is going to use, the better the feedback and insights for improvement. Prototypes allow teams to recognize flaws in their design thinking progress while having the freedom to iterate their product.

**Test:** Testing is a way to solicit feedback from the prototypes and ideas created in the previous phase. Testing allows for repeating the process of applying empathy to how users experience the prototype and comparing the feedback to their initial notes. Feedback from the testing phase will help refine prototypes, and ultimately indicate whether the defined problems are addressed appropriately.

Although design thinking has been introduced as phases in a framework, often these five stages are not sequential. The team may return to a phase or even start again at the first phase of empathizing, as they try to determine if an idea or prototype actually meets the requirement, or exposes other related issues. These stages could also be viewed as components that contribute to a project, rather than a step-by-step guide.

### 3 DESIGN THINKING AND THE WATERFALL METHODOLOGY

The waterfall system development methodology consists of major sequential steps or phases, including: analyze, design, build, test, and deploy (Royce, 1970; Bell & Thayer, 1976). With the waterfall method, approval committees and project sponsors are required to sign-off at the conclusion of each phase in order for the project to proceed to the next sequential phase. While the waterfall methodology is beneficial in identifying requirements before a system is developed, it is not meant to be iterated upon once the design phase is complete. This leads to projects missing requirements or including feature and requirements that are not needed or wanted by users. This poses challenges in dynamic environments where potential new technology and new requirements are desired by users. Another downfall to the waterfall methodology is that researchers and teams often become overwhelmed with satisfying project approvals and meeting deadlines that they lose focus on the primary goal of the project; which is to develop a better product for the users and sponsoring organizations.

Although the waterfall methodology does share similar steps to design thinking, the latter is distinguished by its extremely heavy emphasis on empathy and human-centered design. Thus, for those companies looking to improve their products while retaining their waterfall system development practices, it is possible to incorporate both methodologies, as shown in figure 2 below. Design thinking can be combined into the waterfall method during the analysis and design phases.

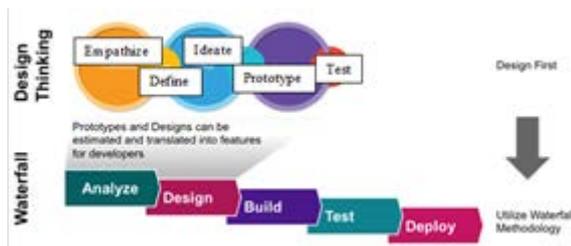


Figure 2: Design Thinking and Waterfall Methodology (adapted from Kramer, 2016).

In traditional project management methodologies, a project is determined successful if it is completed on time and within budget, assuming that the project goals and methods of achieving them are defined at the beginning of a project (Turner & Cochrane, 1993). Organizations continue to base project success on defined goals, budgets, and

timelines which has proven successful if the goals and constraints are clear from the start. In the case where goals and constraints are ill-defined or unknown, organizations suffer adequate guidance and base project success on irrelevant benchmarks. According to Turner and Cochrane (1993), projects where the desired value and goals are not clearly known are most likely to fail.

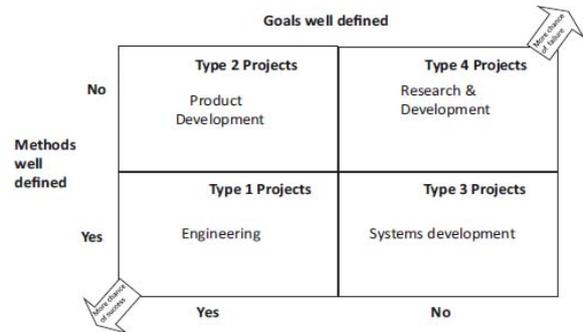


Figure 3: Goals-and-Methods Matrix (adapted from Turner & Cochrane, 1993).

For instance, in the analysis phase of waterfall, a well-defined goal and a quick interpretation of a situation are essential in order to move forward. This could be in the form of a team receiving an assignment from a client to complete a project. Design Thinking approaches problem formulation as the start of a dialogue with decision makers and users. Goals and parameters are uncovered through intensive observation, challenging stereotypical perception, and postponing problem definition. (Dijksterhuis & Silviu, 2016) In other words, the Design Thinking process is best utilized for an ill-defined problem in an organizational and/or social context.

While more research and case studies are needed for the integration of design thinking into system development, a couple of use case success stories are worth mentioning. For example, Netflix’s 2011 User Experience (Web interface) redesign was design thinking inspired. The lesson learned there was that though initially there seemed to be a loud, vocal resistance, that the minority voice was overruled by the sheer number of new users delighted with the simplified interface. Similarly, Japan’s largest airline, All Nippon Airways (ANA) used design thinking principles to create a customer loyalty (WonderFLY) platform offering customers products never offered before.

## 4 THE AGILE DEVELOPMENT METHODOLOGY

Although examples of iterative development came up time after time in software development history, agile methods did not gain popularity until the 1990s (Houston, 2014). During this time, software engineers began to question traditional waterfall methods and looked for methods that they felt better supported an engineer’s requirements to develop good working software in an efficient manner.

The Agile manifesto, published in February 2001, is based on four values of agile methodologies, as paraphrased by Houston (2014):

- Individuals and interactions over processes and tools;
- Working software over comprehensive documentation;
- Customer collaboration over contract negotiation;
- Responding to change over following a plan.

Agile methodologies do not follow sequential development practices that traditional methodologies like waterfall follow. Agile focuses on an incremental approach for developing an application. Agile is often used where there is ambiguity of the requirements and the organization does not know what they want up front. With agile, organizations provide a general idea, and then the system is developed in sprints, each time working on another aspect of the system or changing those parts that do not meet the user requirements.

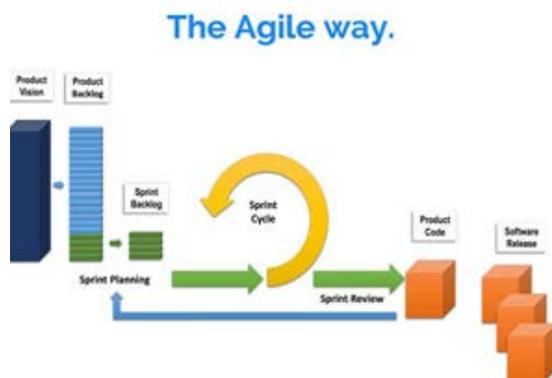


Figure 4: The Agile Development Methodology.

## 5 DESIGN THINKING AND THE AGILE METHODOLOGY

Integrating Design Thinking into the Agile system development methodology means that not only is the

customer a part of every sprint, but that much more focus is put in the beginning to determine the customer needs, requirements, and environment (Roach, 2015). Design Thinking would enable clearer focus of the customer requirements – affecting the product vision and product backlog. There would be less rework during the sprints, since there is a more clear vision of requirements and customer expectations at the start.

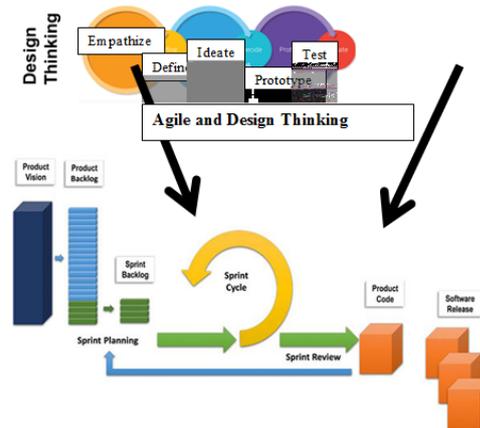


Figure 5: Design Thinking and Agile Development Methodology.

Cicoria et al. (2013) document a number of IDEO’s integration of design thinking with the agile methodology in which IDEO’s work helped some of the largest corporations in the world. This includes Apple & Microsoft’s computer mouse design and development as well as the Ford Motor Company and Wayne Helix manufacturing divisions.

## 6 CONCLUSION AND FUTURE RESEARCH

The essence of design thinking as a problem-solving methodology is meant to bring the user’s experience with a product to the system designers, engineers, and developers – who will then be able to understand and solve user issues more accurately. The premise of design thinking is that products need designing from the user’s perspective in order to be most effective. By concentrating on the user, the development teams will be able to build products and services better suited to customer needs. Furthermore, design thinking can and should be combined with waterfall and agile system development methodologies to more clearly understand system requirements. Design thinking will require the different system development

methodologies to spend more time and focus on analyzing user requirements.

While clearer requirements will provide significant advantages in system development, further research is needed to determine how the extra time spent up front will affect the total project timeline and cost. Even though design thinking enables customer requirements to be better understood and a more innovative solution may be offered, customers will potentially still have change requests. It is not clear to what degree there will be fewer change requests due to the implementation of design thinking into the system development methodologies.

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