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Design Thinking in Research

Dineshkumar Singh[1*]

[1]Digital Farming Initiative, Tata Consultancy Services, 5G34, Yantra Park, Thane, India 400601.

[*]Corresponding author, e-mail: saidinesh@gmail.com

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Introduction

Design Thinking (DT) is a human centred design methodology, where the end user is at the heart of the research. It combines creative and critical thinking which helps in simplifying the ambiguous and difficult problems, by organizing the ideas and information in a structured manner. It is iterative, collaborative and prototype driven. Hence, it provides ample feedback loops to improve over multiple iterations.

It is a mindset focused on identifying the key beneficiary and defining the right problem to be solved. The research team must always question the problem at hand and empathize with the given stakeholder whose problem they are solving and how their experience can be improved. DT provides tools like Empathy Map and Affinity Diagram to represent the problem or scenario in a visual way. This painting of the picture simplifies the thinking and helps in ideating on a solution to address a problem.

John E. Arnold was one of the first authors to use the term 'design thinking' (https://en.wikipedia.org/wiki/Design_thinking, accessed on September, 2020).

Design Thinking Stages

Major stages of Design Thinking (https://www.linkedin.com/pulse/design-thinking-remaining-track-while-going-depth-dinesh-singh/?trk=public_profile_article_view, accessed on September, 2020).

- Empathy
- Define
- Ideate
- Prototype
- Testing

Every stage has different types of activities and different tools to help us cover the design journey through each stage. Some of the important guidelines can help us remain on track and end with successful solutions.

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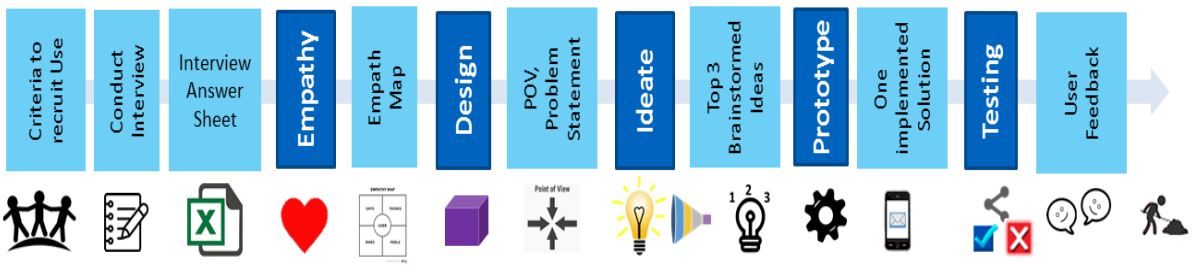

Figure 1: Design thinking stages

Interview is a pre-*Empathy* phase and very crucial. There could be many stakeholders, but we must identify who is the Primary Stakeholder(s) of our research? During this phase open-ended questions are asked to stakeholders to get their point of view of the world and the problem. Interview content is grouped in various buckets of *Say, Do, Think, Act, Feel, Pain* and *Gains*. This separates the grain from the husk and designs the *Persona* of each stakeholder.

Empathy Map of Primary stakeholder must be retained and displayed. If the participants are mixing the stakeholder maps, then they should explicitly highlight the Empathy Map points of the primary stakeholders, otherwise it leads to conflicting pain and gain.

Next stage is to *Define HMW* (How Might We) statement. It is a high level, but not too broad statement of the key problem to be solved. For example, it can be a statement like How Might We create a safe, affordable and easy to administer and maintain COVID19 vaccine at room temperature. We must be able to trace it back to specific pain and gain it by addressing a given persona, so that the link does not break, and we remain continuously focused on our prime objective.

Ideation phase is the beginning of the problem-solving phase. The researchers collaborate and brainstorm on various ideas, leading to the solution. Highlight the ideas generated during ideation phase and give at least some reason on why you chose an idea for the prototype. This will help in the future, when you want to have incremental innovation and know what could be done next.

If your *prototype* does not cover all the pain and gains; or does not cover complete HMW, you must highlight "What are you planning to cover through your prototype?", so that there is clarity. Rest items may be done in an iterative way in agile methodology but knowing what is left to be done is crucial from completeness perceptive. Highlight features addressing pains and gains, their functional value; elegance and ease-of-use, aesthetics. Establishing clear emotional engagement aspects, uniqueness, originality of Solution and then

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potential outcomes also helps describe the solution and gain user acceptance.

Testing of the prototype with the primary or end stakeholder is key. During testing phase, we must validate and highlight –

a) User feedback score for HMW, such as whether it is met or not met or get star ratings like 3-stars, 5 stars.
b) Measurement on the impact on User Experience,
c) Overall Innovation impact is primarily due to Research output and not due to other supporting technologies alone.

Design Thinking in Genomic Research

Scientists implementing Genomic selection in various crops exploit the genotype-to-phenotype relationship at the whole-genome level. Scientist from Plant Breeding Dept. at IOWA State University has conducted a *Genomic selection project using design thinking, data mining, and optimization*. They combined the knowledge from quantitative genetics and data mining, and examined the data from maize, rice, and wheat. They used design thinking to enable more researchers' collaborations, mindfulness, and experimentation. The iterative metacognitive process helped in improving the genomics assisted breeding method. They could establish effective genomic prediction models with just a training set of 2 to 13 percent of the size of the whole set, enabling an efficient exploration of many genetic combinations (https://www.plantbreeding.iastate.edu/project/genomic-selection-design-thinking-data-mining-and-optimization, accessed on Jan. 2021).

Dr. Tingting Guo and others from the Department of Agronomy, Iowa State University demonstrated that both, design thinking and data mining techniques, could be leveraged to optimize genomic prediction of hybrid performance. Their training set designs outperformed earlier methods such as to use random sampling or to minimize the mean of prediction error variance or maximize the mean of generalized coefficient of determination (Gou et al., 2019).

Designed methods using design thinking and data mining are better due to pattern in relationships between genomic and phenotype.

Besides these, work is also going on to design interactive and visually appealing educational, digital applications, generate academics and researchers' interest in genomics. This requires breaking the complex data, which needs professional's expertise to analyze, into simple, intuitive, easy to understand fun filled information (https://blog.usejournal.com/ux-case-genomic-app-edde0d653bf, accessed on January 2021).

Hence, Design Thinking can help the research to be more collaborative, iterative and creative.

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