Artificial Intelligence (AI) Facilitated Data-Driven Design Thinking

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Abstract. This paper describes an approach to integrating Design-Thinking (DT) and User-Centered Design Process (UCD) activities into a process that is facilitated by artificial intelligence (AI) for improved collaboration and data-driven decision-making at a faster pace, so as to improve the adoption. It also aims to identify if the AI can facilitate design thinking sessions and act as a collaborator to help the participants make decisions based on data faster. The proposed concept has been tested by developing an AI powered whiteboard software using Open AI's APIs and a custom ML model on user-profile data to manage it, which was then run by a group of users for their Design-Thinking session for testing and accessing its success in enhancing the design process. The AI-facilitated design-thinking process produced desirable outcomes in significantly less time and helped speed up the Design-Thinking process.

Keywords: Design thinking · persona · artificial intelligence

1 Introduction

Recently, AI has been rapidly evolving and making significant contributions across various industries and domains. Recognizing its potential to revolutionize practices such as Design Thinking (DT) and user-centered design (UCD), a comprehensive research initiative has been made through a two-phased approach, we sought to uncover insights and evaluate the effectiveness of AI in improving these crucial methodologies. By leveraging the power of AI, we aimed to discover areas where AI can aid user for quicker adoption through for automation, saving time and effort, and ultimately driving better outcomes in the realm of DT and UCD.

2 Phase 1 – Discover and Prioritizing the Problem to Address

2.1 Background (Phase 1)

The first phase of the research was to identify the areas that are frictions for wider adoption of Design Thinking, especially for the entrepreneurs, startup founders and Small and Medium Enterprises (SME) owners.

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2.2 Method (Phase 1)

Participants and Experimental Design. Twelve tech-startup founders, entrepreneurs, and Small and Medium Enterprises (SMEs) owners from three cities, namely Bhubaneswar, Bangalore, and Rourkela in India, participated in a survey on the challenges they face while using Design Thinking (DT) or any other User-centered Design Process (UCD) approaches to come up with their solution.

Task and Materials. The participants were asked to fill in a survey with 20 multiple choice questions. The questions were designed to understand the participant's usage, pain-points, challenges in using of DT or UCD methodologies in their organizations to solve the business problem or empathize users. The survey questions were shared over email link to Google form.

2.3 Results and Analysis (Phase 1)

Analyzing the responses from the participants, we were able to identify the challenges using the Design Thinking methodologies in organizations (Fig. 1).

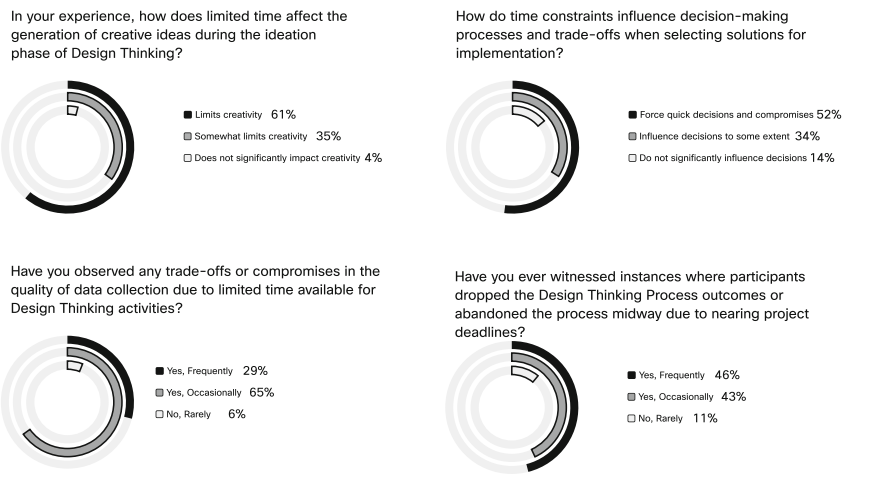

Fig. 1. Key outcome from the survey reflecting the impact of time constraint on adoption and quality of outcome.

The top one in the list is users challenge in not having enough time for DT, is mentioned by 22.7% of the respondents as their biggest problem with the Design Thinking process. 61% of participants believed that the lack of sufficient time in their DT, limits creativity, and 52% believed that the time constraints influenced decision-making processes and trade-off through force quick decisions and compromises. Also 65% believed that quality of outcome of DT was occasionally impacted due to time constraints forcing trade-offs. 42% believed that due to nearing project deadlines, the organizations dropped the Design Thinking Process outcomes or abandoned the process midway.

2.4 Result and Analysis

We recognized that small and medium business owners struggled with the amount of time required to participate in DT sessions and complete the necessary preparatory work.

3 Phase 2 - Investigating the Effectiveness of AI in Supporting User Overcoming the Challenge

3.1 Background (Phase 2)

Based on outcome of phase-1 of this research, one of the key challenges identified in design thinking was the constraint of time. To address this challenge, we explored the option to use AI to assist users in overcoming time constraints through automation to aid the users to save time while getting quality output based on context specific data driven insights generated and provide intelligent recommendations to help users save time and effort.

3.2 Method (Phase 2)

Participants and Experimental Design. We used the same set of users to select 12 users and formed four groups with each group having 3 members. Out of these two groups used AI to support them in various tasks for each session of DT, where as the other two groups did not use any AI support and carried out activities traditionally. By comparing the approaches of the two sets of groups, this research methodology enabled an evaluation of the effectiveness and efficiency of utilizing AI in the DT process. The first set of groups relied on manual creation and qualitative studies, while the second set leveraged AI to speed up and enhance certain aspects of the process, such as persona creation and data analysis.

For this purpose, to provide AI support to participants, basic software was developed using PHP and JQuery, supporting Rest API calls using JSON. We used Open AI's APIs and a custom ML model on user-profile data, which was then run by the group of users for their Design-Thinking session for testing and accessing its success in enhancing the design process. The software leveraged the APIs of *OpenAI* and used custom datasets comprising 20 job roles and professions across four industries in India.

Its user interface offered a range of options for users to select from among various tasks within the "Design Thinking" process. Through advanced natural language processing (NLP) techniques, the software could analyse input context, diary entries, or demographic data to create empathy maps and persona maps (Fig. 2).

Tasks and Materials. Each group is asked to carry out three DT sessions to empathise with and create personas for target users of specific demographics using three different experiments:

1. Creation of a Proto-Persona
2. Persona created with Qualitative Interviews
3. Persona Created from Empathy Maps that were built from Users Diary-Studies.

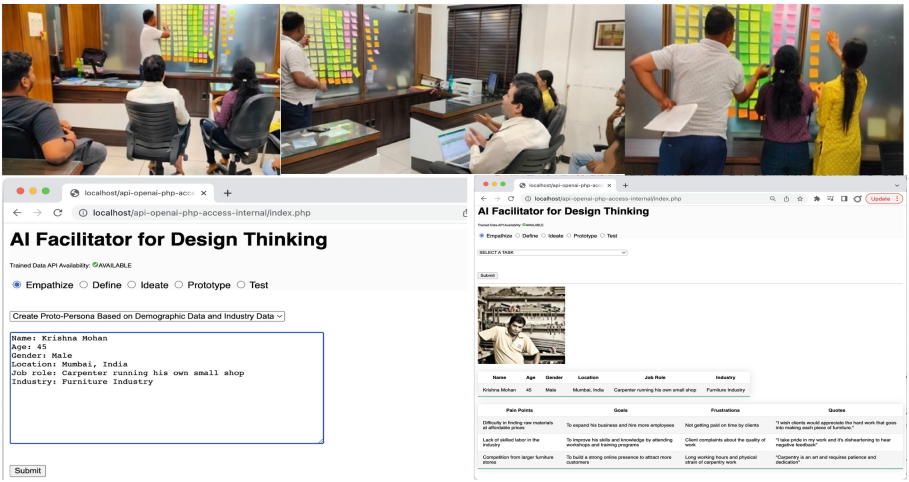

Fig. 2. Two pairs out of four groups used AI Facilitator software to quickly generate, synthesis data to come up with final persona map, whereas the other two pairs did not use AI to build persona, across all 3 sessions.

For each of the above experiments, several tasks were planned for the users, to come up with the final persona map as outcome. For each group, the tasks are listed as per the following table (Table 1).

Table 1. List of tasks to complete by each group over 3 experiments.

Exp #	Experiment Name	Step #	Type	Individual or Group Activity?	Expected Duration (Hours)	Task Description
1	Creation of a Proto-Persona	1	Preparation	Individual	4	Secondary Research + Study/ Analyse Data
		2	Core Activity	Individual	2	Each participant will create 1 Proto-Persona
		3	Core Activity	Group	2	Analyse + Synthesis previous step outcome to create pre-final Proto-Persona
		4	Core Activity	Group	2	Review /Refine + Moderate to finalize Persona
2	Persona created with Qualitative Interviews	1	Preparation	Group	8	Gather Data - Primary Research
		2	Preparation	Individual	4	Study/ Analyse Data
		3	Core Activity	Individual	3	Create Empathy map based on data gathered
		4	Core Activity	Group	3	Analyse + Synthesis previous step outcome to create pre-final Persona draft
		5	Core Activity	Group	2	Review /Refine + Moderate to finalize Persona
3	Persona Created from Empathy Maps that were built from Users Diary-Studies.	1	Preparation	Group	8	Gather Data - Diary Entry by Target User
		2	Preparation	Individual	4	Study/ Analyse Data
		3	Core Activity	Individual	3	Create Empathy map based on data gathered
		4	Core Activity	Group	3	Analyse + Synthesis previous step outcome to create pre-final Persona draft
		5	Core Activity	Group	2	Review /Refine + Moderate to finalize Persona

3.3 Results and Analysis (Phase 2)

Based on all three experiments, with a total of eight sessions, it was evident that the use of AI can help speed up the overall processes significantly in DT or UCD processes during the empathise process. The effectiveness of AI in this context is maximum when it is used in preparation and during the huddle or ideation activities.

During Proto-Persona creation, where traditionally stakeholders use their assumptions to build the persona without any field data to save cost and time, the use of AI can further save almost 48.5% of the time traditionally spent, while at the same time making the proto persona more reliable due to the fact that industry-driven insights are fed into the persona creation process in real time, making the quality of information significantly better. Refer to Tables 2 and 3 below for details:

Table 2. Experiment 1 – Session 1/2 (Total time saved by AI 27%)

Exp #1: Creation of a Proto-Persona (Session 1/2: AI usage in Proto Persona Creation)															
			Preparation				**Activity**								
Group	**Members**	**Approach**	**Gather Data Primary Research**		**Secondary Research + Study/ Analyse Data** (Max. 4Hr)		**TASK 1 (Individual): Create Proto-Persona** (Max. 2Hr)		**TASK 2 (Joint): Analyse + Synthesis on Task 1 Outcomes to Create Resultant Proto Persona** (Max. 2Hr)		**TASK3 (Joint): Review /Refine + Moderate** (Max. 2Hr)		**Total Time Spend**	**Time Saved by AI**	
			Execution Type	**Duration**	**Execution Type**	**Duration**	**Execution Type**	**Duration (Actual Used)**	**Execution Type**	**Duration (Actual Used)**	**Execution Type**	**Duration (Actual Used)**		**Total**	**%**
Group 1A	3	AI + Human	Human	0:00	Human*	4:00	AI	0:05	Human	1:12	Human	1:08	6:25	1:49	22
Group 1B	3	Human	Human	0:00	Human*	4:00	Human	2:05	Human	0:45	Human	1:24	8:14		
Group 2A	3	AI + Human	Human	0:00	Human*	4:00	AI	0:05	Human	1:02	Human	0:58	6:05	2:50	32
Group 2B	3	Human	Human	0:00	Human*	4:00	Human	3:12	Human	0:56	Human	0:47	8:55		

* Approx. time used by the user (not at the same stretch).

Table 3. Experiment 1 – Session 2/2 (Total time saved by AI 48.5%)

Exp #1: Creation of a Proto-Persona (Session 2/2: AI usage in Proto Persona Creation + Synthesis)															
			Preparation				**Activity**								
Group	**Members**	**Approach**	**Gather Data Primary Research**		**Secondary Research + Study/ Analyse Data** (Max. 4Hr)		**TASK 1 (Individual): Create Proto-Persona** (Max. 2Hr)		**TASK 2 (Joint): Analyse + Synthesis on Task 1 Outcomes to Create Resultant Proto Persona** (Max. 2Hr)		**TASK3 (Joint): Review /Refine + Moderate** (Max. 2Hr)		**Total Time Spend**	**Time Saved by AI**	
			Execution Type	**Duration**	**Execution Type**	**Duration**	**Execution Type**	**Duration (Actual Used)**	**Execution Type**	**Duration (Actual Used)**	**Execution Type**	**Duration (Actual Used)**		**Total**	**%**
Group 1A	3	AI + Human	Human	0:00	Human*	4:00	AI	0:05	AI	0:30	Human	0:43	5:18	5:05	49
Group 1B	3	Human	Human	0:00	Human*	4:00	Human	4:00	Human	1:00	Human	1:23	10:23		
Group 2A	3	AI + Human	Human	0:00	Human*	4:00	AI	0:05	AI	0:30	Human	0:37	5:12	4:43	48
Group 2B	3	Human	Human	0:00	Human*	4:00	Human	4:00	Human	1:00	Human	0:55	9:55		

* Approx. time used by the user (not at the same stretch).

For the qualitative persona mapping activity built from qualitative interview data, the traditional approach of creation of empathy maps by individuals and then through group huddle, refining to reach to a final persona map for a specific pre-determined segment, use of AI can significantly speed up the process when used for analyzing the field data, summarizing it to build draft empathy map, and there by creating pre-final persona draft for the team to refine, moderate can save up to 48.5% of the time spent traditionally. Refer to Tables 4, 5 and 6 for details below:

For the qualitative persona mapping activity built from dairy-entries, the traditional approach of creation of empathy maps by individuals and then through group-huddle, refining to reach to a final persona for a specific pre-determined segment, use of AI can significantly reduce the time when used for analyzing the dairy entries, summarizing it to build draft empathy map, and there by creating pre-final persona draft for the team

Table 4. Experiment 2 – Session 1/3 (Total time saved by AI 13.5%)

Exp #2:Persona created with Qualitative Interviews (Session 1/3: Alusage in Empathy MapCreation)															
			Preparation				Activity								
Group	Members	Approach	Gather Data Primary Research- Interview (Expected 8Hrs)		Secondary Research + Study/ Analyse Data (Expected 4Hrs)		TASK 1 (Individual): Create Empathy Map (Expected 3Hrs)		TASK 2 (Joint): Analyse + Synthesis on Task 1 Outcome to Create Pre-final Persona Draft (Expected 3Hrs)		TASK3 (Joint): Review /Refine + Moderate (Expected 2Hrs)		Total Time Spend	Time Saved by AI	
			Execution Type	Duration	Execution Type	Duration	Execution Type	Duration (Actual Used)	Execution Type	Duration (Actual Used)	Execution Type	Duration (Actual Used)		Total	%
Group 1A	3	AI + Human	Human*	8:00	Human*	4:00	AI	0:05	Human	3:18	Human	0:35	15:58	1:58	11
Group 1B	3	Human	Human*	8:00	Human*	4:00	Human	2:34	Human	2:56	Human	0:26	17:56		
Group 2A	3	AI + Human	Human*	8:00	Human*	4:00	AI	0:05	Human	2:32	Human	0:47	15:24	2:54	16
Group 2B	3	Human	Human*	8:00	Human*	4:00	Human	2:55	Human	2:45	Human	0:38	18:18		

* Approx. time used by the user (not at the same stretch).

Table 5. Experiment 2 – Session 2/3 (Total time saved by AI 20.5%)

Exp #2: Persona created with Qualitative Interviews (Session 2/3: AI usage in Empathy Map Creation + Synthesis)															
			Preparation				Activity								
Group	Members	Approach	Gather Data Primary Research - Interview (Expected 8Hrs)		Secondary Research + Study/ Analyse Data (Expected 4Hrs)		TASK 1 (Individual): Create Empathy Map (Expected 3Hrs)		TASK 2 (Joint): Analyse + Synthesis on Task 1 Outcome to Create Pre-final Persona Draft (Expected 3Hrs)		TASK3 (Joint): Review /Refine + Moderate (Expected 2Hrs)		Total Time Spend	Time Saved by AI	
			Execution Type	Duration	Execution Type	Duration	Execution Type	Duration (Actual Used)	Execution Type	Duration (Actual Used)	Execution Type	Duration (Actual Used)		Total	%
Group 1A	3	AI + Human	Human*	8:00	Human*	4:00	AI	0:05	AI	0:00	Human	1:00	13:05	3:21	20
Group 1B	3	Human	Human*	8:00	Human*	4:00	Human	2:57	Human	1:00	Human	0:30	16:27		
Group 2A	3	AI + Human	Human*	8:00	Human*	4:00	AI	0:05	AI	0:05	Human	1:00	13:10	3:30	21
Group 2B	3	Human	Human*	8:00	Human*	4:00	Human	3:10	Human	1:00	Human	0:30	16:40		

* Approx. time used by the user (not at the same stretch).

Table 6. Experiment 2 – Session 3/3 (Total time saved by AI 42.5%)

Exp #2: Persona created with Qualitative Interviews (Sesson 3/3: AI usage in Preparatory Analysis + Empathy Map Creation + Synthesis)															
			Preparation				Activity								
Group	Members	Approach	Gather Data Primary Research - Interview (Expected 8Hrs)		Secondary Research + Study/ Analyse Data (Expected 4Hrs)		TASK 1 (Individual): Create Empathy Map (Expected 3Hrs)		TASK 2 (Joint): Analyse + Synthesis on Task 1 Outcome to Create Pre-final Persona Draft (Expected 3Hrs)		TASK3 (Joint): Review /Refine + Moderate (Expected 2Hrs)		Total Time Spend	Time Saved by AI	
			Execution Type	Duration	Execution Type	Duration	Execution Type	Duration (Actual Used)	Execution Type	Duration (Actual Used)	Execution Type	Duration (Actual Used)		Total	%
Group 1A	3	AI + Human	Human*	8:00	AI**	0:30	AI	0:05	AI	0:00	Human	0:45	9:20	7:11	44
Group 1B	3	Human	Human*	8:00	Human*	4:00	Human	2:57	Human	1:00	Human	0:35	16:32		
Group 2A	3	AI + Human	Human*	8:00	AI**	0:30	AI	0:05	AI	0:05	Human	1:32	10:12	7:06	41
Group 2B	3	Human	Human*	8:00	Human*	4:00	Human	3:10	Human	1:00	Human	1:08	17:18		

* Approx. time used by the user (not at the same stretch). ** Approx. time used for both summary generation and readout by the user

to refine, moderate can save up to 42.5% of the time spent traditionally. Refer to the Tables 7, 8 and 9 for details below:

Table 7. Experiment 3 – Session 1/3 (Total time saved by AI 12%)

Exp #3: Persona created with from Diary Study (Session 1/3: AI usage in Empathy Map Creation)															
			Preparation				Activity								
Group	Members	Approach	Gather Data Primary Research - Diary Entry by Target User (Expected 8Hrs)		Analyse Data (Expected 4Hrs)		TASK 1 (Individual): Create Empathy Map (Expected 3Hrs)		TASK 2 (Joint): Analyse + Synthesis on Task 1 Outcome to Create Pre-final Persona Draft (Expected 3Hrs)		TASK3 (Joint): Review /Refine + Moderate (Expected 2Hrs)		Total Time Spend	Time Saved by AI	
			Execution Type	Duration	Execution Type	Duration	Execution Type	Duration (Actual Used)	Execution Type	Duration (Actual Used)	Execution Type	Duration (Actual Used)		Total	%
Group 1A	3	AI + Human	Human*	8:00	Human*	4:00	AI	0:05	Human	2:32	Human	0:46	15:23	2:23	13
Group 1B	3	Human	Human*	8:00	Human*	4:00	Human	2:04	Human	2:47	Human	0:55	17:46		
Group 2A	3	AI + Human	Human*	8:00	Human*	4:00	AI	0:05	Human	3:02	Human	0:51	15:58	1:57	11
Group 2B	3	Human	Human*	8:00	Human*	4:00	Human	2:34	Human	2:38	Human	0:43	17:55		

* Approx. time used by the user (not at the same stretch).

Table 8. Experiment 3 – Session 2/3 (Total time saved by AI 19%)

Exp #3: Persona created with from Diary Study (Session 2/3: AI usage in Empathy Map Creation + Synthesis)															
			Preparation				Activity								
Group	Members	Approach	Gather Data Primary Research - Diary Entry by Target User (Expected 8Hrs)		Analyse Data (Expected 4Hrs)		TASK 1 (Individual): Create Empathy Map (Expected 3Hrs)		TASK 2 (Joint): Analyse + Synthesis on Task 1 Outcome to Create Pre-final Persona Draft (Expected 3Hrs)		TASK3 (Joint): Review /Refine + Moderate (Expected 2Hrs)		Total Time Spend	Time Saved by AI	
			Execution Type	Duration (Actual Used)	Execution Type	Duration (Actual Used)	Execution Type	Duration (Actual Used)	Execution Type	Duration (Actual Used)	Execution Type	Duration (Actual Used)		Total	%
Group 1A	3	AI + Human	Human*	8:00	Human*	4:00	AI	0:05	AI	0:00	Human	1:43	13:48	2:55	18
Group 1B	3	Human	Human*	8:00	Human*	4:00	Human	2:57	Human	1:00	Human	0:47	16:44		
Group 2A	3	AI + Human	Human*	8:00	Human*	4:00	AI	0:05	AI	0:05	Human	1:12	13:22	3:23	20
Group 2B	3	Human	Human*	8:00	Human*	4:00	Human	3:10	Human	1:00	Human	0:35	16:45		

* Approx. time used by the user (not at the same stretch).

Table 9. Experiment 3 – Session 3/3 (Total time saved by AI 40%)

Exp #3: Persona created with from Diary Study (Session 3/3: AI usage in Preparatory Analysis + Empathy Map Creation + Synthesis)															
			Preparation				Activity								
Group	Members	Approach	Gather Data Primary Research - Diary Entry by Target User (Expected 8Hrs)		Analyse Data (Expected 4Hrs)		TASK 1 (Individual): Create Empathy Map (Expected 3Hrs)		TASK 2 (Joint): Analyse + Synthesis on Task 1 Outcome to Create Pre-final Persona Draft (Expected 3Hrs)		TASK3 (Joint): Review /Refine + Moderate (Expected 2Hrs)		Total Time Spend	Time Saved by AI	
			Execution Type	Duration	Execution Type	Duration	Execution Type	Duration (Actual Used)	Execution Type	Duration (Actual Used)	Execution Type	Duration (Actual Used)		Total	%
Group 1A	3	AI + Human	Human*	8:00	AI**	0:30	AI	0:05	AI	0:05	Human	1:34	10:14	6:40	39
Group 1B	3	Human	Human*	8:00	Human*	4:00	Human	2:57	Human	1:20	Human	0:37	16:54		
Group 2A	3	AI + Human	Human*	8:00	AI**	0:30	AI	0:05	AI	0:05	Human	1:13	9:53	6:56	41
Group 2B	3	Human	Human*	8:00	Human*	4:00	Human	3:10	Human	0:56	Human	0:43	16:49		

* Approx. time used by the user (not at the same stretch). ** Approx. time used for both summary generation and readout by the user

4 Conclusion

From the experiments conducted in both phases, it is concluded that one of the key adoption challenges for DT is the constraint of time, which enforces tradeoffs leading to reduced quality outcomes and hence creating friction for adoption. The experiments demonstrated that AI can significantly speed up the design thinking process by providing data driven insights specific to the context of demographics, industry, and job role, particularly during the empathise phase. By using AI for tasks like Proto-Persona creation and qualitative persona mapping, substantial time savings of up to 48.5% were achieved. Additionally, the use of AI improved the reliability and quality of the personas by incorporating real-time industry data-driven insights. These findings highlight the potential of AI to enhance efficiency and decision-making in design thinking, making it a valuable tool for practitioners to overcome time constraints and achieve better outcomes.

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