IMPACT OF USER EXPERIENCE USING GENERATIVE AI IN SOFTWARE DEVELOPMENT LIFE CYCLE

by

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Dedication

To My Father N. Dhandapani,

who dreamed for me, but couldn't stay and see me reach it!

To My Mother Usha, who believed in my dreams!

To My Better Half – Bhaskar - who is always there for my dreams!

This is for all of you!!

Acknowledgements

Families are the compass that guide us. They are the inspiration to reach great heights, and our comfort when we occasionally falter. - Brad Henry

I would like to express my gratitude to Prof. Eduard Plavec whose encouragement, constructive feedback, and insights have guided me through every step of this journey.

Every step I take and every success I achieve cannot happen without the strength and support of my husband Dr. Bhaskar Patham, my children – Shrivats, Hamsiny and my mother Usha. You are my inspiration and source of energy.

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ABSTRACT

IMPACT OF USER EXPERIENCE USING GENERATIVE AI

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Sowmya Dhandapani
2024

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Co-Chair: <If applicable. Co-Chair's Name>

In the recent days, Generative Artificial intelligence is revolutionizing the way creativity is perceived. It helps in expanding the horizons of generating new content through self-learning algorithms. While the leverage of Generative AI is already being widely explored for creation of documents, pictures, videos and audio content, this research is to evaluate its impact in the software development. The intended research was to understand the current user experience models in the software development, learn the impact of Gen AI on the user experience developers and designers. Based on the exploration, the research provides a model through which Gen AI can be smoothly integrated with User Experience Development. This helped in bringing together the three areas of Generative AI, User Experience and Software Development together to provide a positive impact for the business as well as the technology team. The research involved understanding the current industry practices, and readiness for new technology through a survey. Based on the responses of the survey, a new model was proposed on how the integration of Gen AI and User Experience can be achieved in the software development lifecycle. This model was validated with case studies to confirm if aligns with the expected output.

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INTRODUCTION

1.1 Introduction

User experience may be defined as “A person's perceptions and responses that result from the use or anticipated use of a product, system or service.” - . According to ((“User Experience (UX) Market Size And Forecast,” 2024)), User Experience (UX) Market size was valued at USD 9958.02 Million in 2024 and is projected to reach USD 33190.79 Million by 2031, growing at a CAGR of 16.24% from 2024 to 2031. This huge market provides potential for research and improving the lifestyle.

Generative artificial intelligence (generative AI, GenAI,[1] or GAI) is artificial intelligence capable of generating text, images, videos, or other data using generative models, ((“Generative AI - Wikipedia,” n.d.)). Based on the reports from (“Generative AI Market Size, Share & Industry Analysis, By Model (Generative Adversarial Networks or GANs and Transformer-based Models), By Industry vs Application, and Regional Forecast, 2024 ,” 2024), the global generative AI market size is projected to grow from USD 67.18 billion in 2024 to USD 967.65 billion by 2032, exhibiting a CAGR of 39.6% during the forecast period (2024-2032). It is necessary to be able to bring the benefit of both the technologies together, to optimize the development cycle of any software.

Artificial Intelligence has reached new heights in recent years with the advent of Generative AI. This new concept in programming is a major enabler for creative and effective solutions. Generative AI is a computer technology which uses either reinforced learning or adversarial networks to generate new content from current learning. The output could be text, image, music or videos. Based on the type of input and output involved they can be classified as uni-modal and multimodal (Feuerriegel et al., 2024). The research by (Feuerriegel et al., 2024) provides a conceptualization of the Generative AI technology and explains in detail how different factors the BISE industry can use the new technology (Feuerriegel et al., 2024).

1.2 Research Problem

In software development different models are practiced optimizing the resources and making a high-quality deliverable. Scrum and Kanban are some of the agile practices in software development, which rely on iterative development with feedback loop integration. Startups are typically small establishments which begin on a small scale, with a quicker go-to-market approach. They are limited by resources and time, and hence look for quicker ways of delivering their product. Startups therefore generally forego a structured development approach which may consume time, in favor of achieving shorter times to market. The software industry is now moving towards the Lean Startup approach that allows a simpler development model, experimentation and feedback integration. The impact of user experience integration in start-ups requires more research to integrate Ux on startups working on a small scale (Kuusinen et al., 2019, 2012).

"UX is a user's holistic perception of functionality and quality characteristics of a piece of software" (Hassenzahl, 2003). User Experience (hereafter also referred as Ux) is a critical factor in the success of products (Hyun and Marsden, n.d.). A good Ux can help in improving and retaining the reach of the product. Ux Design and development is an iterative process. Many companies have recognized the criticality of user experience and are including it as a part of their development cycle. This can sometimes conflict with the agile or lean development model (Dhandapani, 2016).

1.3 Purpose of Research

The research methodology followed for this study comprised literature survey, data collection, analysis and conceptual modeling. In the first stage of the study, a review of various types of Generative AI tools and their uses was carried out. A similar state of the art review was conducted for the User Experience approaches. The literature survey was employed to identify areas of

analysis and arrive at a set of considerations to understand the practice and involvement of User Experience and GenAI in the software development cycle.

In the second stage of this study, the roadblocks and approaches of the methods were systematically identified based on a comprehensive review of current industry practices and academic research. This was done in order to develop a more focused understanding on the priority of the issues to be addressed.

Once the areas of concern were identified, a survey of industry practitioners was carried out using a questionnaire to gather responses from the software, UX and GenAI perspective, The questionnaire included questions on areas of focus, and understand their impact. The demography of the respondents was collected to ensure that the input is diverse.

After the survey was completed, the data was analyzed on the parameters identified and the major areas of problem were then identified based on those. The results were also validated by analyzing across the categories collected from the demography of survey respondents. The top 3 area of problems were then narrowed down to be resolved for the integration of Ux and Gen AI in SDLC. Finally, an integration framework intended to include GenAI as a part of some of the software design process was developed and a detailed proposal for implementation of such a framework was outlined. The framework is aimed to address the concerns identified from the survey questions. The metrics to identify the improvement were also delineated.

To validate the proposed framework, a case study was conducted using the framework. The metrics to define the success of the framework were evaluated for the case study based on the insights from the previous steps. This metrics were used to evaluate the improvement in productivity through the integration.

1.4 Significance of the Study

As per (Gauthier J et al., n.d.), there is almost 50% increase in the Ecosystem value of the startups in the past 2 years. Their success mainly depends on the value they bring to the customer. User Experience Evaluation and Research is a critical part of product development which can help in establishing not only an impactful product but also in deriving a clearer value proposition. UX is a field itself that has a large scope of research. While applying the same to startups, as explained in (Saad et al., 2021), a discipline offering unique challenges is created, wherein the conflict between the swift turnaround of software needs to be balanced with the need for creating the necessary UX enablers to establish an optimal value proposition. UX approach to match the dynamic nature of startup growth is a growing, and as yet not fully addressed need.

1.5 Research Purpose and Questions

The goal of the study is to understand the state of integration of the 4 major domains – Ux, Gen AI, Startup and SDLC. The long-term goal of the study is to provide a Ux-inclusive SDLC framework for adoption by startups.

The intent of the current study is to provide a comprehensive review of literature and survey of the current state of integration in the 4 domains and outline a conceptual framework for software development. The research will focus on answering the questions laid out in Table 1. The details of the sources to seek the answers for each question, and the expected output for each requirement are summarized in the Table 1. Most of the responses are derived from the survey responses. The new proposal is derived from the analysis of the responses.

CHAPTER II:
REVIEW OF LITERATURE

2.1 Introduction to review

Artificial Intelligence has reached new heights in recent years with the advent of Generative AI. This new concept in programming is a major milestone for creativity. Generative AI is the computer technology that use either reinforced learning or adversarial networks to generate new content from the current learning. The output could be text, image, music or videos. Based on the type of input and output involved they can be classified as uni-modal and multimodal (Feuerriegel et al., 2024). The research provides a conceptualization of the Generative AI technology and explains in detail how different factors the BISE industry can use the new technology (Feuerriegel et al., 2024). In software development different models are practiced optimizing the resources and making a high-quality deliverable. Scrum Kanban are some of the agile practices in software development which relies on iterative development with feedback loop integration. Startups are small companies which begin on a small scale, with a quicker go-to-market approach. They are limited by resources and time, and hence look for quicker ways of delivering their product. This can restrict them from a structured approach which may consume time. Hence people are now moving towards Lean Startup that allows a simpler development model, experimentation and feedback integration. The impact of user experience integration in start-ups requires more research to integrate Ux on startups working on a small scale (Hokkanen et al., 2016; Kuusinen et al., 2019, 2012).

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expanding the reach of the product. Ux Design and development is an iterative process. Many companies have recognized the criticality of user experience and are including it as a part of their development cycle. This can sometimes conflict with the development model (Dhandapani, 2016a).

This literature intends to understand the latest research done in the areas of agile development in startups, impact of user experience in startup while following agile methodology, and influence of generative AI for user experience. Based on these reviews, a proposal can be identified to include the Generative AI for User experience in an agile software development model which can be used by startups. The review explains some of the existing research in the areas mentioned above. It then discusses the overall status of the research and identifies areas of improvement. The last section explains a research plan, to investigate further into the identified topic.

2.2 Survey Approach

The literary reviews started with 120 documents identified by the keyword search. On further analysis, evaluation of the abstract of the identified documents narrowed the articles of relevance down to 70. Next level of investigation on the details in the paper and relevance for the current scope of study trimmed down the literature. Finally, there were 30 papers that were identified for detailed study.

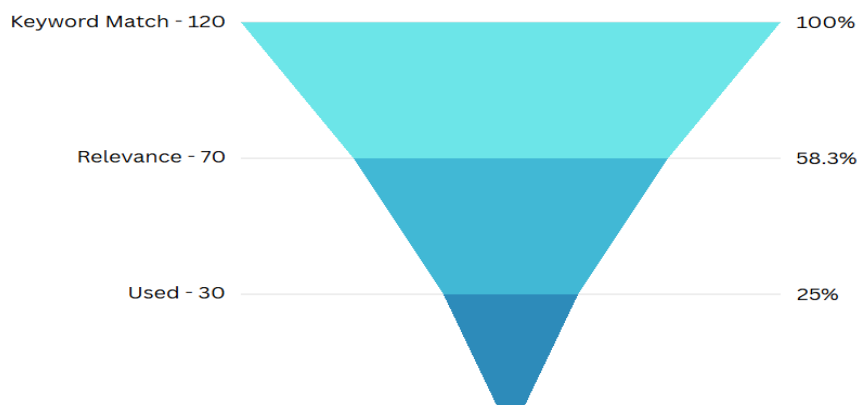


Figure 1 Literature Funnel

2.3 Literature Survey Objectives

The criteria for consideration of references were relevance to the topics discussed below. Literature was also identified, based on the forward and backward search. Details of the key words and sources used for the search are available in the Appendix. The categorization of prior art in relation to the core topic of study, i.e., the use of generative AI towards Ux in Software Development Life Cycle in the start-up environment, has been represented as a in Figure 1 below.

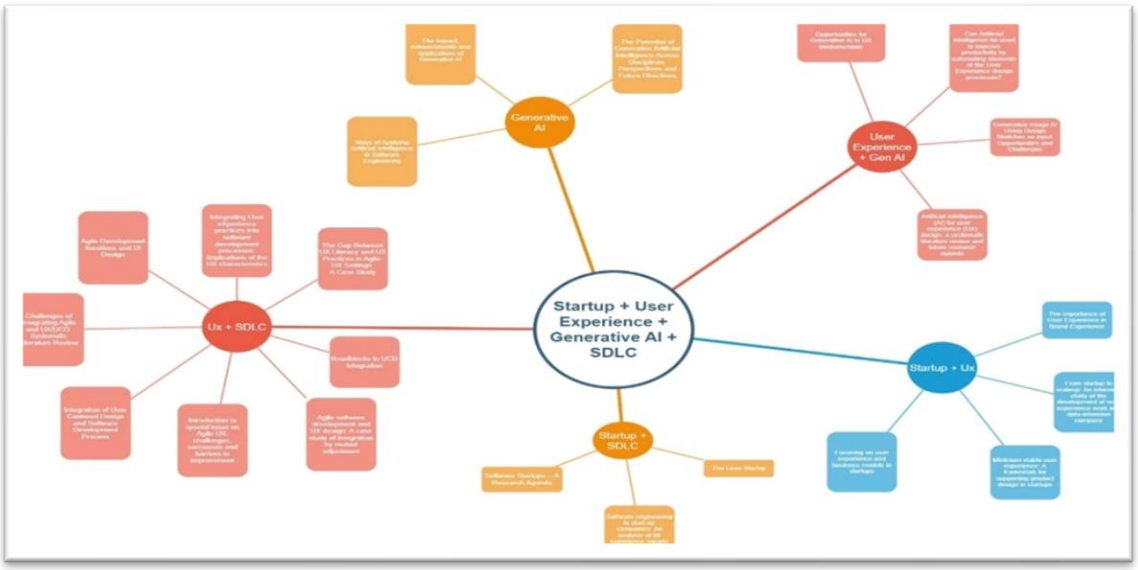


Figure 2: Literature Review approach presented in the form of a Mindmap

2.4 User Experience & SDLC

The integration of Ux practices into SDLC needs to consider different characteristics like the need to be subjective, holistic, dynamic and context driven (Kashfi et al., 2017). Limited knowledge, interpretation of qualitative inputs and channelizing them into actionable / measurable requirements and developing test-cases for the same, unclear responsibilities, limited resources, lack of methods for evaluation etc. are some of the identified areas of concerns from (Kashfi et al., 2017). This report analyzes the findings into 3 types of implications, theoretical, methodological and practical.

According to (Al-Razgan et al., 2022), in practice, there are different perspectives that need to be considered like prioritizations, timelines, work-balance, feedback. The authors discuss the different facets of the challenges during integration with probable solutions, and further discuss solution approaches for each of the facets. For example, it is suggested that issues with time may be handled with novel low-cost evaluation methods; further, aspects such as the need for training of software developers to work with Ux, using agile approach to take early feedback, etc. is emphasized. The compatibility and inter-dependency between Ux approach and SDLC depend on mutual awareness, negotiation and general engagement.

Case studies identify the gaps using a mixed method approach between the Ux literacy and what the Ux Practitioners do (Azevedo et al., 2023). The literature identifies that awareness of Ux helps practitioners improve their productivity. It also emphasizes the stakeholder's awareness about Ux is important. This is critical to ensure the organization does not deviate from strategic Ux planning and lose the edge over Ux improvements.

There are different models proposed for integration of agile lifecycle and Ux design using mutual adjustment or early sprint models. (Dhandapani, 2016b; Persson et al., 2022). The integration

through mutual adjustment as well as upfront design, makes Agility and Ux Development complementary, enhancing the benefits of each other.

All the reviews confirm that the integration of Iterative model of Agile development helps in leveraging the feedback loop from Ux Design. There are many identified issues, but the literature also shares possible solutions and their impact. There appears to be no single solution for the integration of Ux and Agile Software Development. Each individual organization and case may require customized integrations based on their context and needs.

2.5 Startups & Software Development

There are multiple areas of research that can be pursued in software startups (Unterkalmsteiner et al., 2023). One of the major areas of research is better identification of requirement gathering through lightweight processes. Agile development is an iterative software development process, insisting on the feedback loop to ensure the requirements are updated based on user input.

Many startups are now moving towards Lean Startup (Ries, n.d.) which "teaches you how to drive a startup-how to steer, when to turn, and when to persevere-and grow a business with maximum acceleration.". An analysis of the referenced reports concludes that more focused research is needed in the adoption of software practices in startups (Klotins et al., 2019).

2.6 Startups & User Experience

The brand experience of any product is driven by the user experience (Hyun and Marsden, n.d.). This is critical for the digital touchpoints where the new software startups are trying to make a mark in the market. There are models proposed to integrate the Ux as a part of the product design in a startup where development happens at a frenzied state to ensure the product reaches the market at the quickest turnaround time (Hokkanen et al., 2016). The authors have proposed a new model and validated it with a sample set of practitioners for early product design in startup.

Another literature in (Zaina et al., 2023) suggest a framework that would improve Ux in the product as well as foster the overall development with emphasis for Ux. While the former is to improve the actual product, the latter is to include the discipline of considering user experience as a main focus area in the organization. This will help in creating a culture to foster Ux from all levels.

Case study on the proposal of user experience in a company moving from startup to scaleup stage, adds to the existing understanding of the practices and challenges of integrating Ux into the SDLC cycle. The study clearly identifies that more detailed research is needed in creating practices for Ux incorporation in software development in startups (Kuusinen et al., 2019).

2.7 Generative AI

Content creation, Design and Creativity assistance is a major area where Generative AI (hereafter referred as GenAI) can be used to generate new ideas (Ramdurai, n.d.). Multiple industries like entertainment, fashion, architecture, health care, manufacturing, financial all of them have use cases that can be addressed using Gen AI. The report explains the Generative AI concepts and identifies focus areas like improved realism, adversarial training, cross modal generation, responsible and ethical AI as some of the areas of focus for future research.

The impact of generative AI on different domains varies and the related challenges that need to be tackled (Ooi et al., 2023). The areas of application include personalization, sales optimization, attribution, pricing and remarketing. The challenges of data ownership, privacy, ethical dimensions are impediments for the application of GenAI in various fields. Each field needs its customized applications to handle the challenges and achieve the required results.

(Feldt et al., 2018). Have introduced a three faceted taxonomy, that can be used to analyze and classify the application of AI in software engineering as application point, type of AI and level of automation. These allow the developers to identify the risks while applying AI to software engineering.

2.8 Software Engineering & Generative AI

As a primary step towards the use of AI in software development, the taxonomy of applying AI in software engineering is developed (Feldt et al., 2018). The report identifies the facets that can be used as a basis to understand the risk of integrating AI with software engineering practices based on the application, type of AI and the extent of automation.

(Shen and Sun, 2022) presents a new Generative Programming application, which can help the uninitiated users venture and train models specific to their domain. It helps in overcoming the limitations of lack of AI/ML knowledge for preparing custom models by domain experts. The paper explains the training and tuning that goes into making the product customizable and user-friendly for the subject matter experts, who may not have extensive knowledge on machine learning and artificial intelligence.

(Ebert and Louridas, 2023) focus on the different technologies available for software developers for code development, improved productivity, enhancing creativity, maintaining legacy and improving data quality. The potential risks of security and privacy are identified, with probable solutions of defining the boundary of what should and should not be covered by artificial intelligence.

2.9 User Experience & Generative AI

The innovative and creative potential of Gen AI may be tapped for different stages in user experience design and development. The identification of user intent by Convolutional neural networks; guided design decisions with the help of Recurrent neural networks; using auto-encoder for mining datasets; and detecting human emotions with deep belief networks; are some examples of how Gen AI can help in creating an orchestrator-based model. This can aid Ux designers in their creative process through combining different technologies (Choudhury, 2023).Click here to enter text. There are three themes identified in the design report with AI: Automating design process

with AI; (Co) creating with AI; creating with AI, and negative effects of AI use (Stige et al., 2023). This opens new areas of investigation for the research. Image-based AI facilitates design practice and brainstorming (Zhang et al., 2023). There are many pain points in UX modernization which can be resolved with Generative AI technology (Houde et al., 2022).

2.10 Discussion

Through the literature survey one can conclude that there is a large scope of research to evaluate the integration of User experience in SDLC cycles of the startup. The existing literature already discusses on the integration of each of the pairs – Ux & SDLC, Startups & SDLC, Startups & Ux, Generative AI & Ux. These explore the integration models, roadblocks, challenges and areas of research for each of the aforesaid combinations. There are case studies to understand the gap between the proposals and real-world practices which help us to identify newer areas of improvement for integration. Each of these reports bring in a new facet to the integration and related impediments.

From the application perspective, using an integral approach incorporating Ux can be useful in multiple domains and not only in SDLC. From this survey point of view the integration of Ux with SDLC was studied. Generative AI research is in nascent stages, and its impact is still being explored. While the technology brings a lot of promises to improve creativity and productivity, it comes with its own set of risks and limitations. There is an overall awareness about the risks, but in many cases the perceived advantages are seen to outweigh them. As with any technology, Gen AI has to evolve, using the right process and assimilate into the existing industry and systems. Generative AI research can be exploratory of its technology as well as application.

There is very little exploration in integrating all the four major factors – Ux, SDLC, Startups and Generative AI. The referenced prior research limits to the pairs of User Experience in Software Development, User Experience in Startups, Gen AI opportunities in SDLC and Gen AI usage in

Ux. There are no reviews or exploration of combining all the three. The review warrants the need to carry out research that may result in proposals for a model which can work for improved production of software in startups using Gen AI for Ux Development.

CHAPTER III:
METHODOLOGY

3.1 Overview of the Research Problem

The overall goal of this study is to identify and validate a SDLC model that demonstrates an effective leverage of Generative AI in integrating Ux Design in agile based startups. From the survey of existing literature summarized in the previous chapter, it may be concluded that there has not been enough research that brings together the disciplines of Gen AI and UX in the context of SDLC within the Startup ecosystem. In order to arrive at such an SDLC model, the next step required a thorough understanding of the existing industrial context where a well-defined gap may be addressed through the confluence of these disciplines. This qualitative understanding was achieved through carrying out a survey -- of a broad demographic of software product developers in start-up and scaled-up industries – containing well defined questions to probe the potential and the roadblocks for adoption of GenAI and UX in product development and SDLC. The data collected, the research will follow abduction based grounded theory (Glaser and Strauss, 2017; Timmermans and Tavory, 2012) approach to identify patterns and details from the responses, which will help in building a model for improving GenAI for productivity. Validation of this model through a case study is an extension, which can allow this research to take an action research approach.

3.2 Research Problem and Questions

The goal of the study is to understand the state of integration of the 4 major domains – Ux, Gen AI, Startup and SDLC. The long-term goal of the study is to provide a Ux-inclusive SDLC framework for adoption by startups. The top-level research questions are summarized below

Table 1: Research Questions

ID	Research Question	Input	Output
RQ-0	Profile Details	Surveys	Responses
RQ-1	Understand the extent of User Experience Development in Startups	Surveys	Responses
RQ-2	Understand the extent of current adoption of Generative AI in User Experience	Surveys	Responses
RQ-3	Understand the readiness for adopting Gen AI in Ux	Surveys	Responses
RQ-4	Understand the roadblocks in adopting Ux in Startups SDLC	Survey Response Analysis	Analysis Report
RQ-5	Identify and propose a model how GenAI can be used to improve the SDLC lifecycle in Startups	Survey Response Analysis	Analysis Report
RQ-6	Validate the proposed model with a case study	Model	Case Study

3.3 Research Plan

The steps and timeline plan under which the above-mentioned steps were executed are listed in the table below. The details of the individual action, the derived output from the respective action is also mentioned in the table. In this manner, a clear and measurable criterion was defined for the conclusion and completion of each stage.

Table 2: Research Plan

Objectives	Expected output	Period (months)	Start	End
Preparing Survey/Questionnaire	Questionnaires	0.5	May 2024	May 2024
Conducting Surveys	Responses (expected 50 participants)	2	May 2024	June 2024
Analyzing Survey Responses	Identify the pattern and formulate a theory	1	July 2024	July 2024
Proposing a new framework	New model	1	Aug 2024	Aug 2024
Implementing the framework as Case study	Response from the implementation	3	Sep 2024	Nov 2024
Analyzing the response of the case study	Case Study Report	1	Dec 2024	Dec 2024
Documentation for Thesis	Thesis	3	Jan 2025	Apr 2025

3.4 Research Design

The research will be conducted in 4 steps - Data Collection, Analysis, Proposal and Validation. At each stage the focus is on deriving best productivity by integrating the user experience and Generative AI.

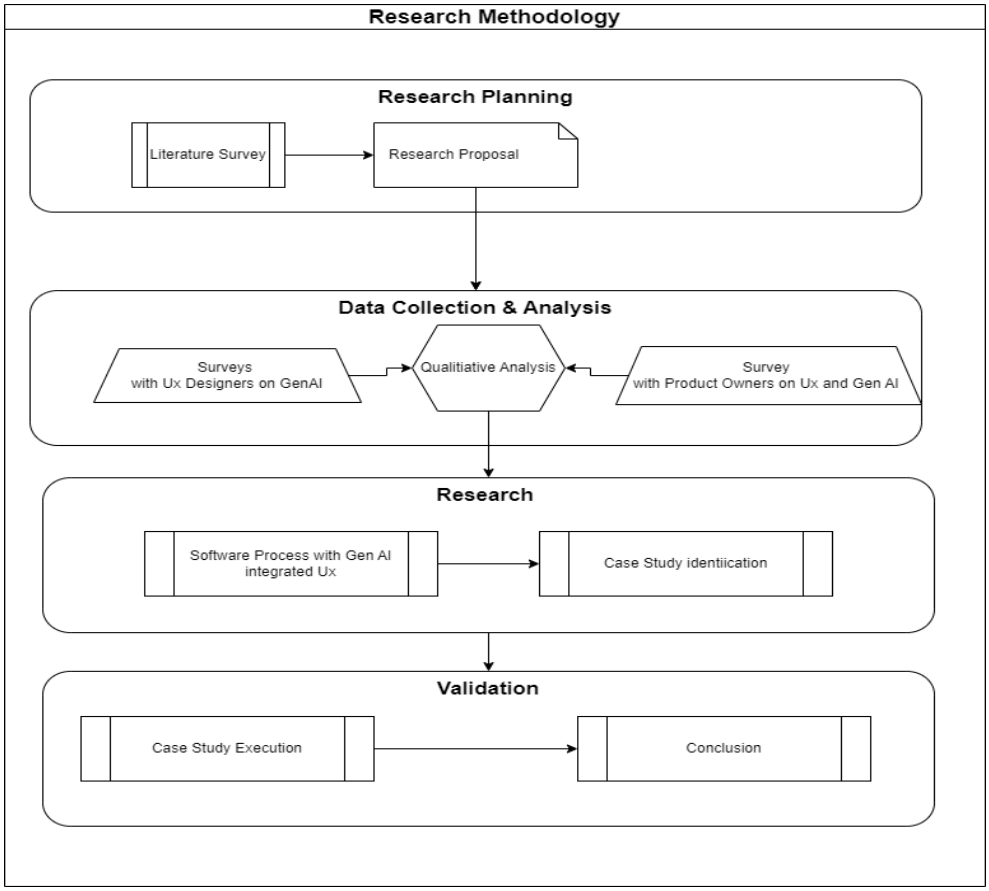


Figure 3: Research Methodology

3.5 Population and Sample

The survey was conducted on a wide audience through posts in linked in. The survey question included details about the participant (Age, Sex, Role) which were intended to help in understanding the demography of the participants. The survey also covered the details of the organization (Size, Product size) which were aimed to help in evaluating the responses from different types of organizations. The industrial standard for confidence level is 95%. This survey was carried out with a respondent sample size of 50 and keep close to 3% error margin.

3.6 Instrumentation

A survey with a detailed questionnaire was carried out to develop qualitative insights into the leverage of user experience design in software development in a sample of startups (3-5). The

research will evaluate the readiness of adopting GenAI based methods by the startups. It will also investigate with the User Experience Designers to understand the impact and usage of Generative AI. These two reports can help us focus on the areas of improvement and identify a model to bring together the generative AI based Ux Development in a Startup environment. Population for answering the questionnaire will be identified through volunteer sampling or snowball sampling techniques. The focus will be on UI/Ux Developers and Product owners of Startups.

The questions in the survey were structured to gather the a few industry experience and demographic related detail, as summarized below.

- Profile – Age, Experience, Nationality
- Behavioral – Involvement in SDLC
- Opinion – Current state & Readiness for Generative AI in Ux

No personal information of the participant is collected, and research will only gather basic details needed for demographic evaluation.

Further, the survey had detailed research questions, as listed in the Table below. As may be seen from the table, several questions were open ended, while some of them had pre-defined options out of which the responders could select or pick a rating.

Table 3: Requirement Mapping

Area	Requirement Mapping	Survey Questions	Answers Type
Profile	RQ-0	Age	
	RQ-0	Sex	
	RQ-0	Nationality	
	RQ-0	Role in the company	

	RQ-0	Age of your Company	
	RQ-0	What is your company size	
	RQ-0	Product User Base	
UX Team	RQ-1	Software Development Life Cycle followed in your company	Agile, Scrum, Kanban, Waterfall
	RQ-1	What do you think about the availability of Metrics for User success	Rate 1-5
	RQ-1	Is Ux process integrated with the SDLC	Rate 1-5
	RQ-1	Rate the Ux team involvement in requirement gathering	Rate 1-5
	RQ-1	Rate Ux team involvement during development	Rate 1-5
	RQ-1	Rate Ux team involvement during feedback gathering and analysis	Rate 1-5
	RQ-1	Mark factors that affect the integration of Ux team with the SDLC	Cost, Skills, Time, Interest, Communication
Generative AI	RQ-2	Understanding the usage of Generative AI in the company	Rate 1-5
	RQ-2	Generative AI is used in which stage of the SDLC	Requirement, Design, Development, Testing, Feedback

	RQ-2	Rate the current level of usage for Generative AI in Requirements Gathering	Rate 1-5
	RQ-2	Rate the current level of usage for Generative AI in Ux Design and Development	Rate 1-5
	RQ-3	Mark factors that affect the integration of Generative AI in UX Design	Cost, Skills, Time, Interest, Security
	RQ-3	Rate the readiness for the use of Generative AI in other areas	Rate 1-5
	RQ-3	Rate the level of usage of Generative AI in FUTURE User Experience Design	Rate 1-5
	RQ-3	Mark factors that affect the integration of Generative AI in other Areas	Cost, Skills, Time, Interest, Security

3.7 Data Collection Procedures

Data collection was done through the survey shared in the LinkedIn posts. Most of the responses were from the direct queries to the connections of the researcher. Since the nature of responses collected was qualitative, the survey was limited to 50 respondents. The respondents were limited due to the very specific combination of expertise and industry, and hence the population size was small.

3.8 Research Analysis

The analysis of survey responses also involved understanding the correlations between the demographic factors (Company size, Product size) and the maturity and potential adaptability of and roadblocks to the leverage of User Experience and Generative AI in SDLC. For the evaluation,

the survey response data was converted into panda data frames and analyzed for distribution, dependency, and reliability.

The responses from the survey were analyzed using grounded theory (Glaser and Strauss, 2017; Timmermans and Tavory, 2012), to identify patterns and details to arrive at an understanding of the extent to which Generative AI is currently used by Ux Designers and Product Owners in startups. Based on the understanding derived from the two survey analysis reports, a proposal for generative Ai inclusive Ux design has been derived. This model is aimed to be implementable with a startup as a case study. Metrics for the success of the model have been derived based on the feedback from the responder base, and include time taken to release, adoption rate, quality, and customer feedback response.

As the final step extending the proposal into a proof of concept, the proposed model will be implemented and validated in a pre-identified startup. The results from the implementation will be used to understand the feasibility and impact of the proposed model.

3.9 Research Design Limitations

This survey and the insights gained from the responses are limited to software development related expertise. Hence the observations are applicable only to the User Experience and Generative AI in the software field. The impact of applying the observations to other domains is beyond the scope of this research.

CHAPTER IV:

RESULTS

In this chapter, the methodology employed for analysis of the survey responses is described in detail to create insights into the research questions under consideration.

4.1 Analysis of Responses

The survey responses were saved in a comma separated file and used for the analysis. The type of data collected is compiled in Appendix. Many of these responses were qualitative data which were later transformed to newer columns to allow quantitative analysis.

The survey questions captured basic profile information, to categorize the responses. The main categories considered were – Size of the Company, Age of the Company, Size of the User base and Roles of the respondent. For the above demographic questions, the statistical analysis of the responses is summarized in the table below.

Table 4: Summary of Responses

Age of your Company Standard Deviation - 12.06 Standard Error - 12.06 95% confidence MoE - 3.34 Responses Above 10 years 30 5-10 years 11 2-5 years 5 0-2 years 4	Product User Base Standard Deviation - 5.88 Standard Error - 5.88 95% confidence MoE - 1.63 Responses Above 1 Million 16 1 - 1000 users 14 50k - 1Million users 10 1000 - 5000 users 5 15k - 50 k users 3 5000 - 15k users 2
What is your company size Standard Deviation - 8.15 Standard Error - 8.15 95% confidence MoE - 2.26	Role in the current/last worked company Standard Deviation - 3.77 Standard Error - 3.77 95% confidence MoE - 1.04

Responses		Responses	
More than 1K	23	CXO	12
0-50 members	12	Product	10
200-1000 members	8	Middle Management	8
100-200 members	5	Senior Management	7
50-100 members	2	Software developer	5
		Ux Designer	5
		QA	2
		Project Management	1

Within the population surveyed, the responses to these categories were normally distributed across the possible values (please refer to_Appendix_III). This confirms that the survey has covered all the categories as a part of our sample. Hence when the data collected is analyzed, it can also be validated across the categories identified for validity.

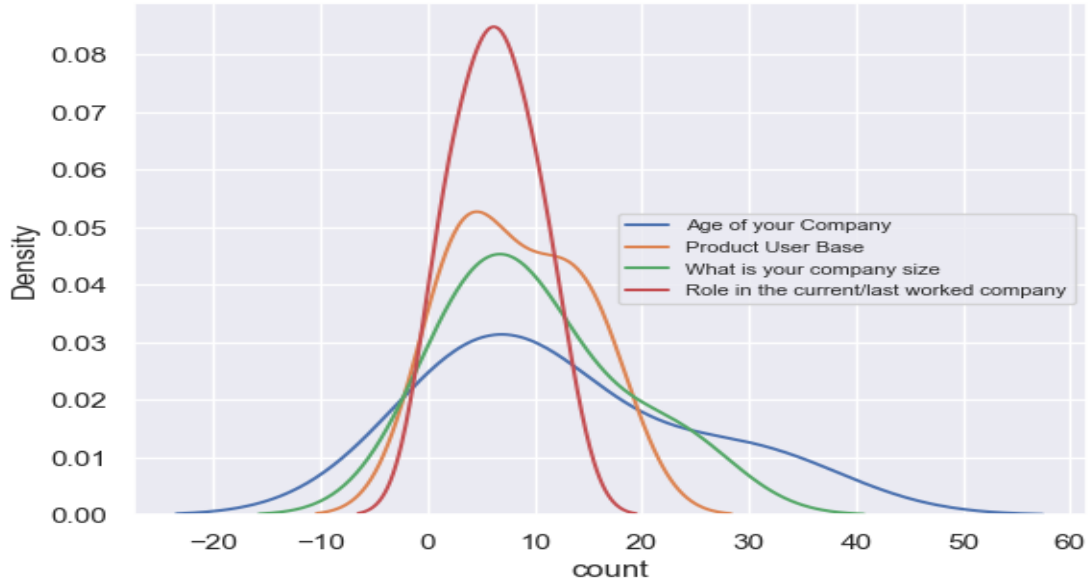


Figure 4: Distribution of Categories

4.2 RQ 1 - Understand the extent of User Experience Development in Startups

The following questions in the survey were used to evaluate the user experience in different companies. The result of each question will be analyzed and discussed in the subsequent.

4.2.1 SDLC followed in the company

Based on the survey responses, more than 60% of the companies of the respondents followed SCRUM model. There were around 15% respondents who had no SDLC process in their organizations, and 14% of respondents mentioned Kanban model. The rest were custom lifecycle models. Considering Kanban to be a variation of SCRUM, there were close to 73% respondents who were following an agile model. As the majority of the respondents were already in agile mode, this factor is not have considered in understanding the impact of GenAI and Ux in the current state of implementation.

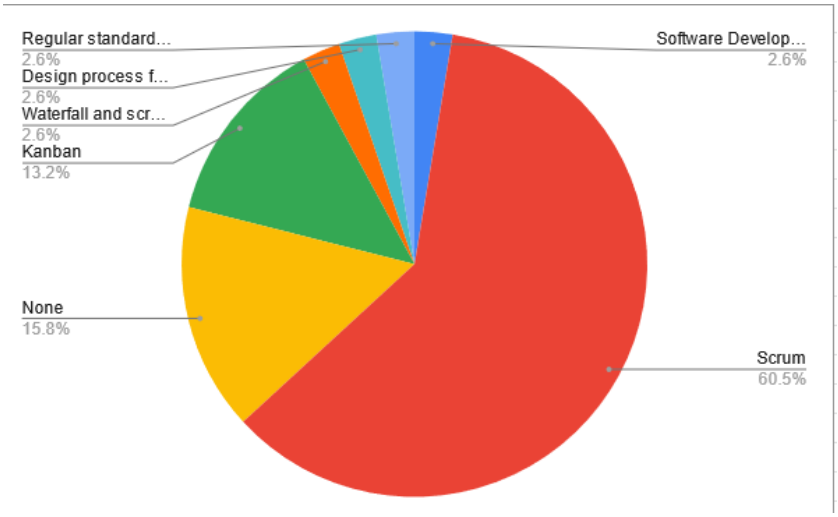


Figure 5: Distribution of SDLC Models

4.2.2 Availability of Metrics for User success

The availability of metrics for the user success for the product was measured as a rating from 1-5 (1 being the lowest and 5 being the maximum). The results showed that the respondents around 30% were having good metrics to evaluate User Succes, while the remaining were neutral or not clear about the availability of such metrics. As this distribution is not equal, this thesis will not be considered a category by itself, as the distribution of data is normal.

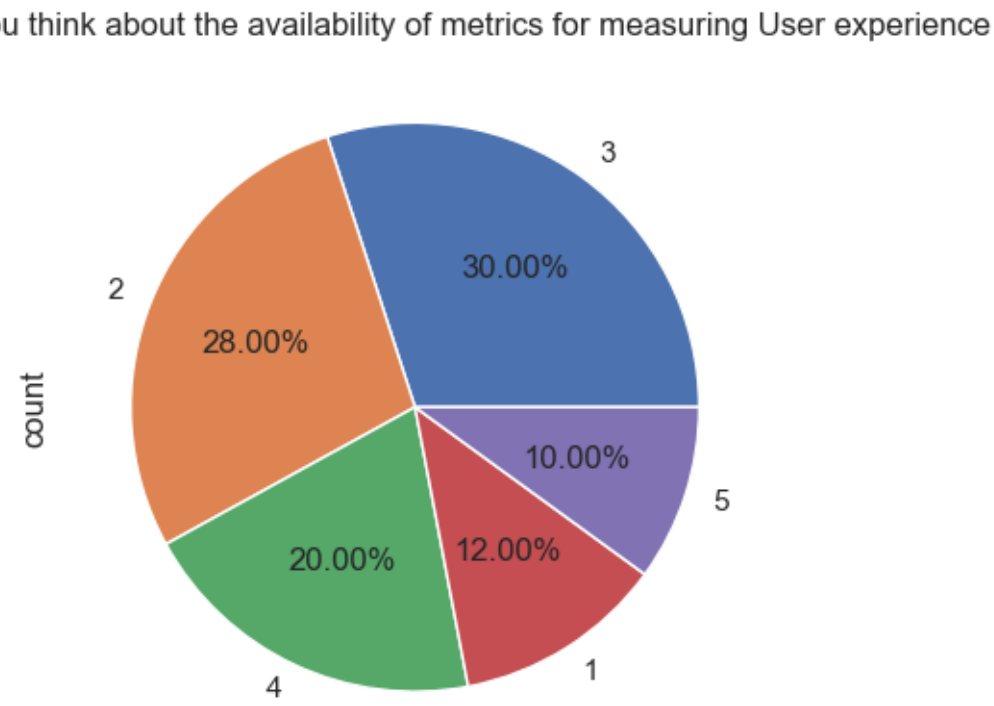


Figure 6: Availability of Metrics for measuring UX

Is Ux process integrated with the SDLC

Based on the availability of Ux metrics and SDLC details, the SDLC stages where integration of UX was already present was asked to the respondents. This was a multiple-choice question allowing the user to select one or more phases of the SDLC where Ux was selected. This detail was translated for processing, and it was identified that UX is considered more in Design and Development stage than others. It is considered less in requirement testing stage where it must be defined and evaluated.

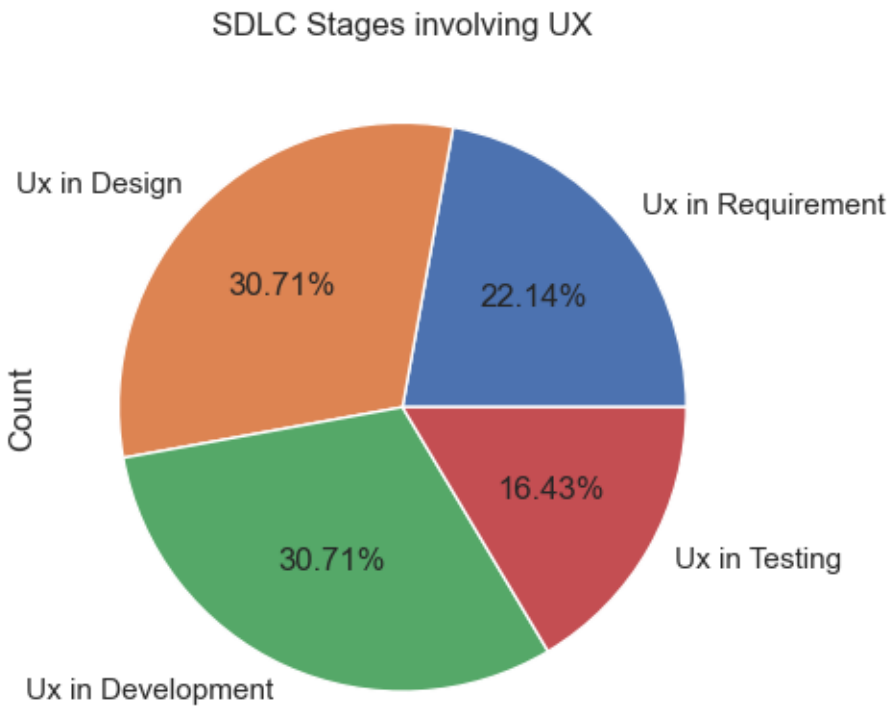


Figure 7: SDLC Stages involving UX

Rate the Ux team involvement in SDLC phases

The user could identify the rate of involvement of Ux team in different stages of SDLC (1 being the lowest and 5 being the highest). This is to get isolated ratings for each stage of software development. It is obvious from the responses that Ux is rated as high and similar in requirement and development stages. However, in the testing stage, rating of Ux involvement is reduced significantly. This is a stage where the research will assess the impact of User experience on the success of the product.

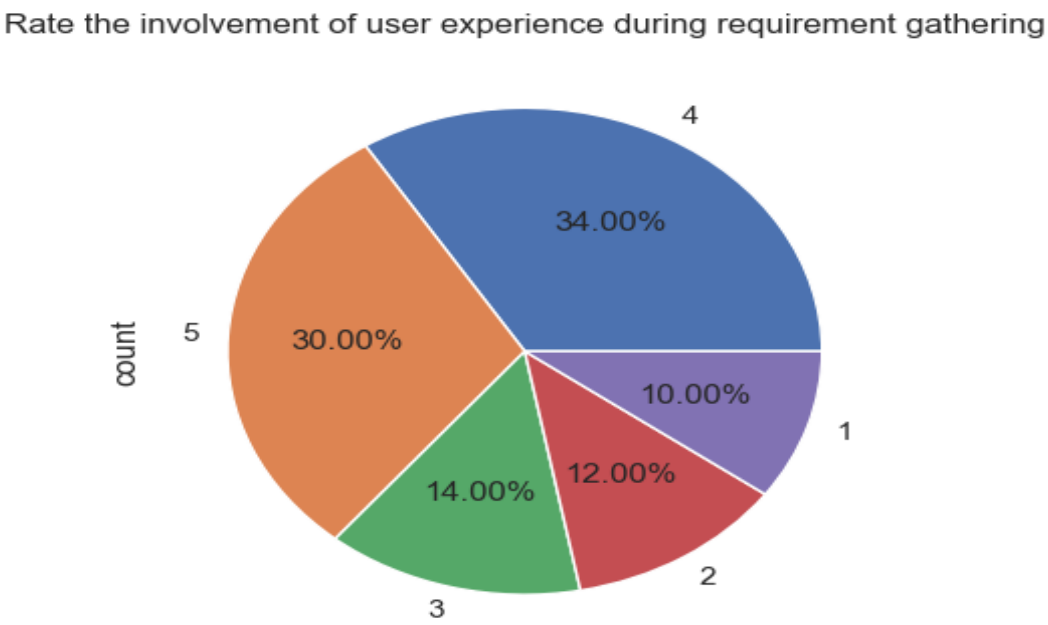


Figure 8: Rating involvement of UX during Requirement Gathering

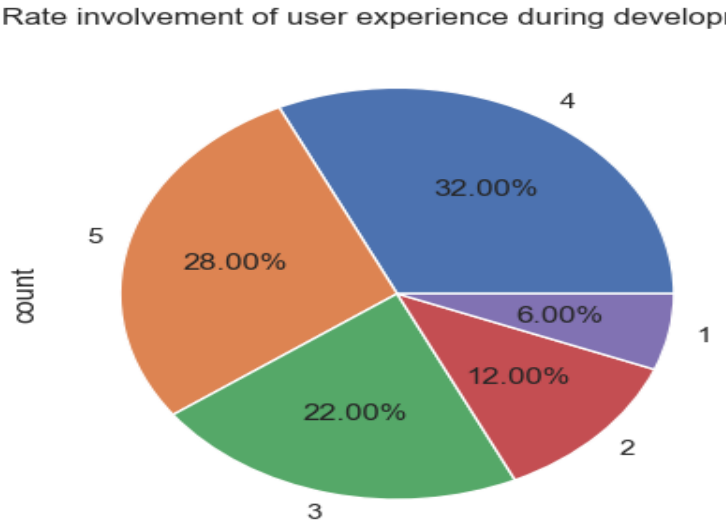


Figure 9: Rating involvement of UX during Development

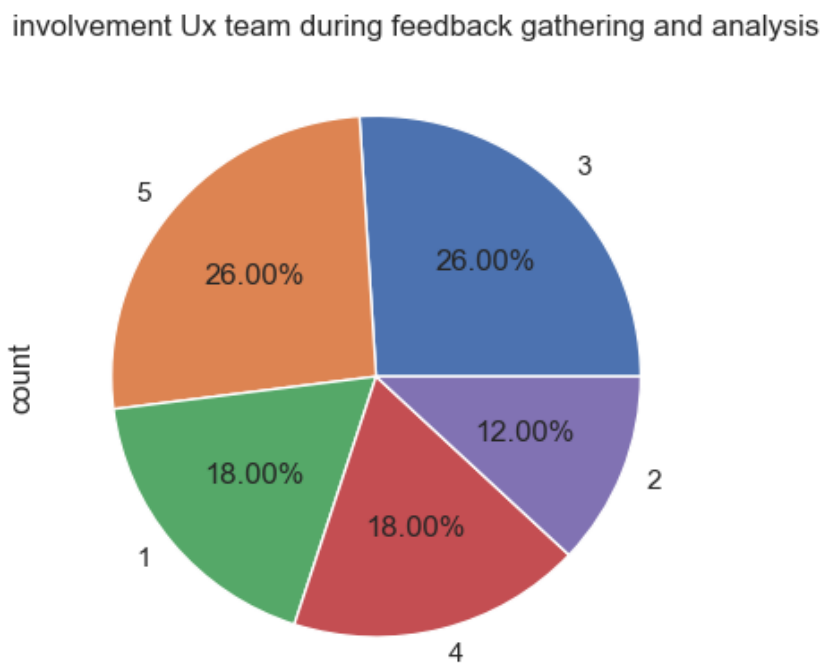


Figure 10: Rating involvement of UX during Feedback Gathering and Analysis

Mark factors that affect the integration of Ux team with the SDLC

The user had been given the opportunity to identify the roadblocks for Ux in their SDLC cycle with options such as awareness, communication, planning and capacity. These choices are derived from the options identified in (Silveira et al., 2021) & (Kashfi et al., 2017). Following were the considerations while preparing the survey questions

1. Lack of Communication – Teams are not able to communicate effectively about Ux requirements
2. Lack of Planning – Ux is not given importance, time or budget while planning in agile environment
3. Lack of Capacity – Unavailability of skills to have effect Ux evaluation and implementation

4. Lack of Awareness – The team and management are unaware of the benefits and impact of User experience in their product.

The answers to identify major factors affecting the integration of Ux in Agile environments. The data collected about the roadblocks of User Experience shows a big gap in the awareness and communication about the Ux. Lack of capacity is not a major issue but again, planning does not seem to cover the Ux tasks.

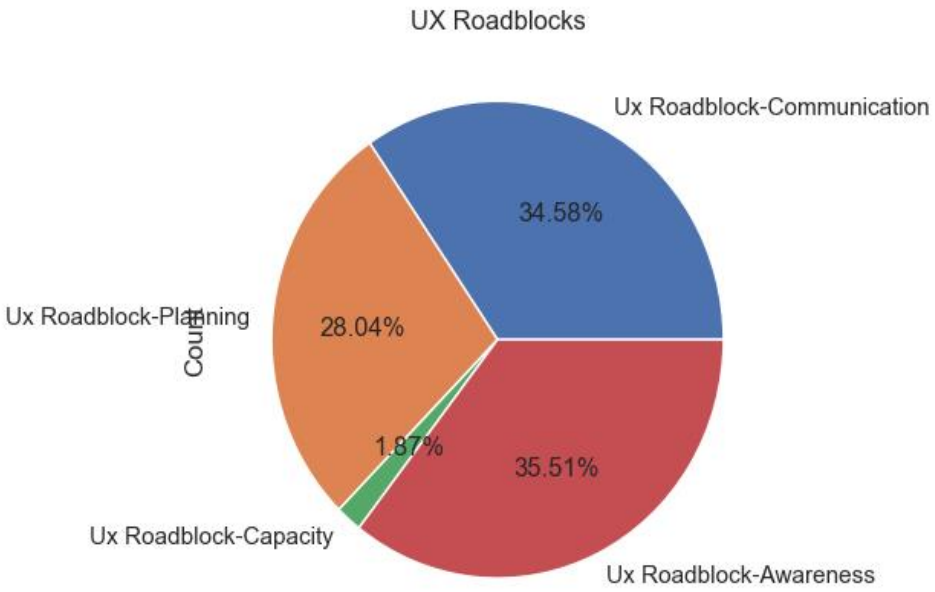


Figure 11: UX Roadblocks

4.3 RQ 2 - Understand the extent of current adoption of GenAI in Ux

The following questions in the survey are used to evaluate the Generative AI experience in different companies.

4.3.1 Understanding the usage of Generative AI in the company

The survey asked the users to rate the extent of generative AI in their work (scale of 1-5, 1 being the lowest and 5 being the maximum). The usage showed that majority of them are not using GenAI yet in their companies. Only 30% use the GenAI extensively

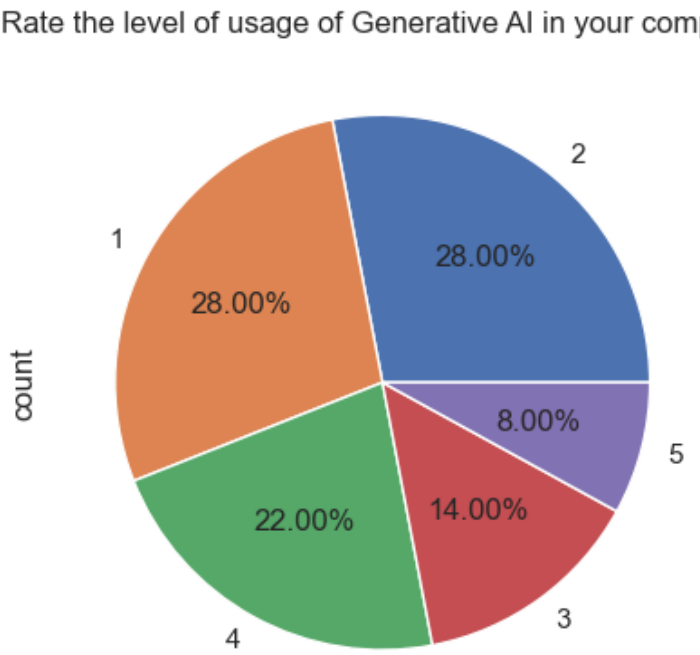


Figure 12: Rating usage of GenAI in your company

4.3.2 In which stage of the SDLC is Generative AI used

The questions tried to understand the stages in SDLC where the GenAI is used in their work environment. This is to understand the current state of usage of GenAI in the industry and derive our learning from the same. The responses show that the Generative AI is used the most in development. Design and Requirement still use the GenAI but it is not used much in Testing.

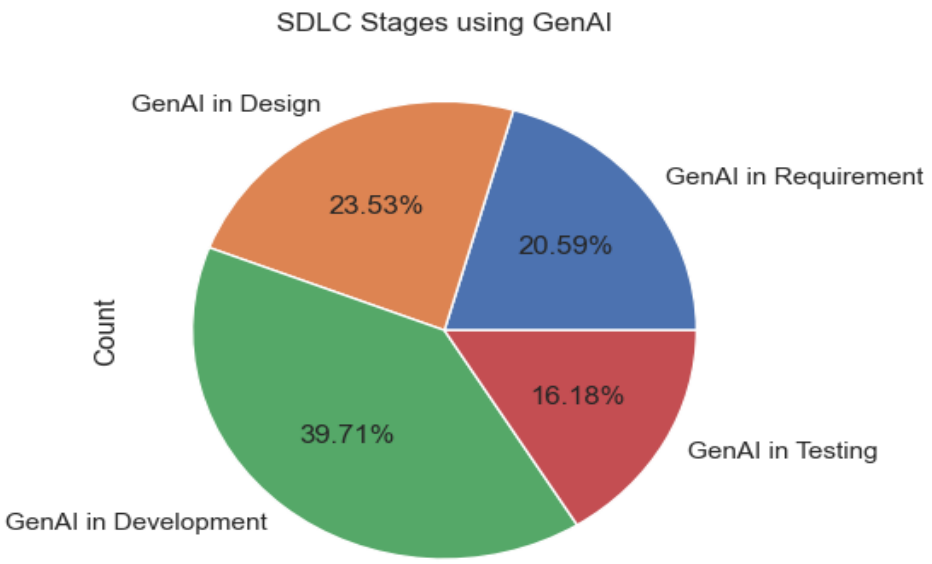


Figure 13: SDLC Stages using GenAI

4.3.3 Rate the current level of usage for Generative AI in Different SDLC Stages

The responses to rating the usage of GenAI shows that it is used low in Requirement and Development. The respondents were asked to rate the usage of Gen AI in major stages of the SDLC in their experience. This is used to understand rating at the two stages individually. The rating related questions to understand the usage at individual stage while the previous query was to understand the areas of involvement. The answers can be co-related to understand stages and the extent of usage of GenAI.

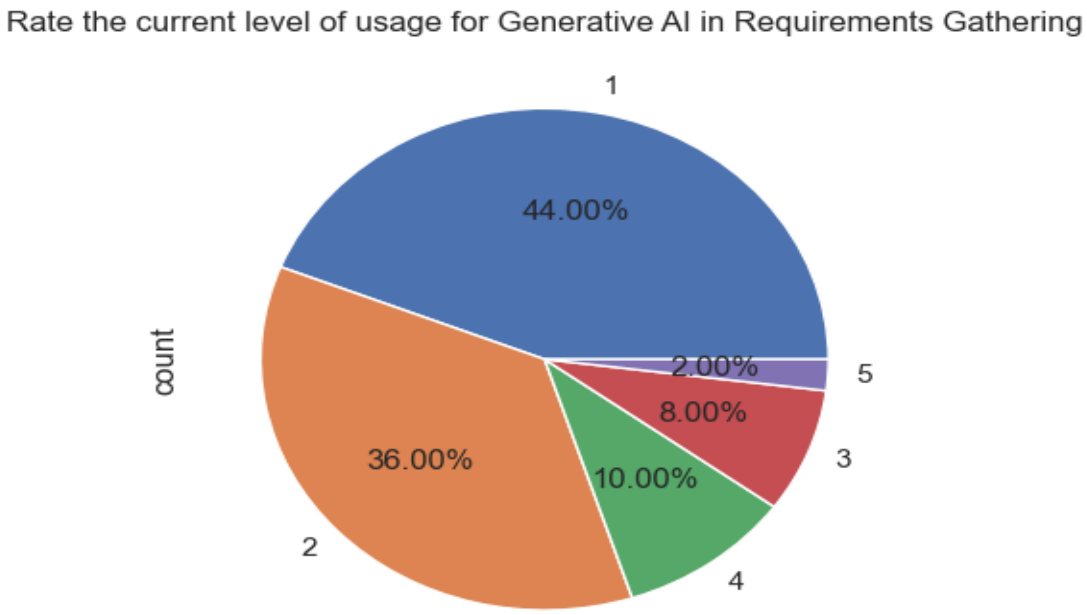


Figure 14: Rate the current level of usage for GenAI in Requirements Gathering

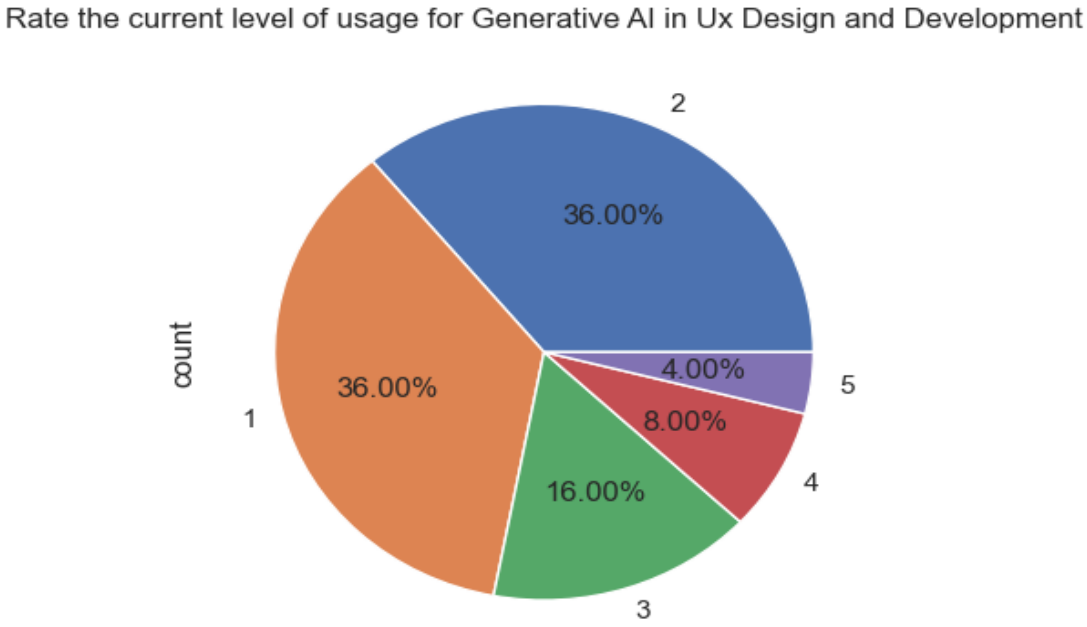


Figure 15: Rate the current level of usage for GenAI in UX Design and Development

4.4 RQ 3 - Understand the readiness for adopting Gen AI

The following questions in the survey are used to evaluate the readiness for Generative AI experience in different companies.

4.4.1 Rate the readiness for the use of Generative AI in other areas

The ratings about the readiness show that the more than 50% respondents felt that they are not ready for taking up GenAI in Ux or other areas. The survey intent was to understand the perspective of where the practitioners feel they stand in moving to use AI. This was for covering other areas than requirement and design development. The respondents also rated their ratings on readiness to move to a Gen AI for User Experience in Future. More than 30% was positive about the adaptability readiness for future in Ux as well as other areas.

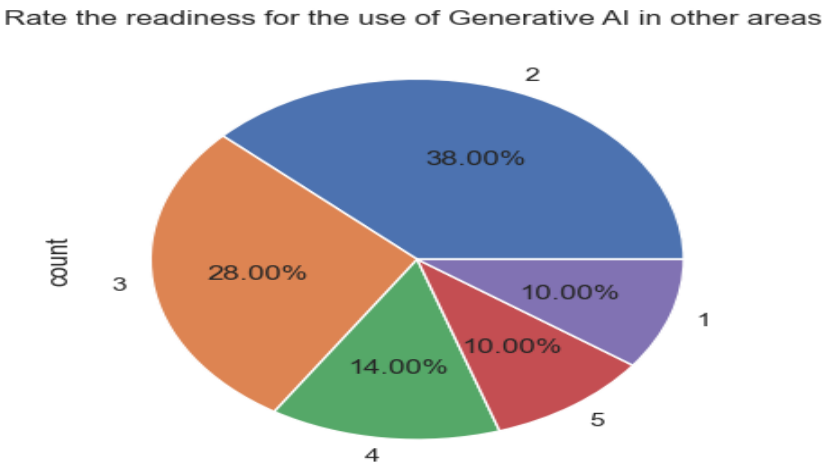


Figure 16: Rate the readiness for the use of GenAI in other areas

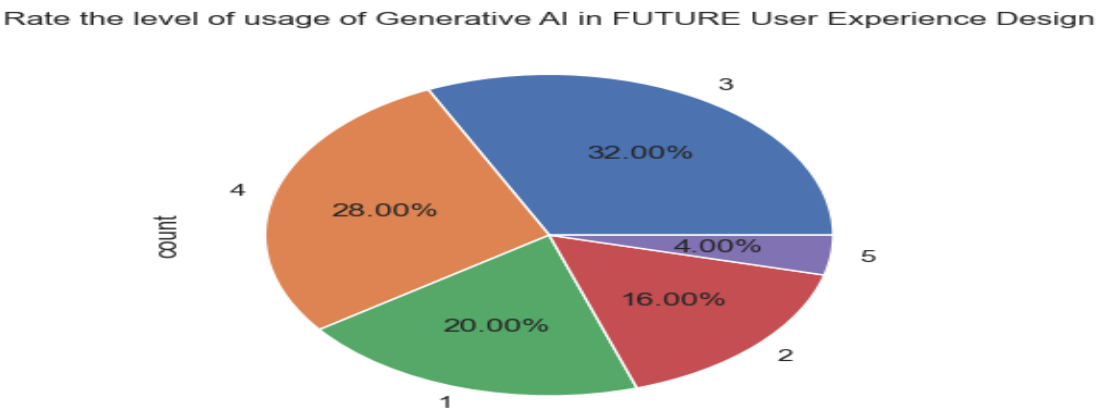


Figure 17: Rate the level of usage of GenAI in future UX Design

4.5 RQ 4 - Understand the roadblocks in adopting Ux & Gen AI in Startups SDLC

The following questions in the survey are used to roadblocks in adopting Ux and GenAI in startups. Following was considered for the survey to understand the roadblocks.

1. Lack of Skill - Lack of understanding of how to effectively work with AI
2. Lack of Intent - Gaps in understanding AI limitations in current literature
3. Infrastructure – Lack of Infrastructure for AI
4. Product – Lack of feasibility to adopt due to product design
5. Cost – Lack of budget to effectively transition to Gen AI

4.5.1 Roadblocks for the use of Generative AI in User Experience Design

The survey responders had to choose among the available options about the possible roadblocks for integration of Generative AI in SDLC cycle. The choices were derived from the (Bertão and Joo, 2021). One may conclude from the responses that lack of intent is a major reason why the industry may not have yet transitioned towards a more holistic integration of Gen AI in Ux. Majority of the respondents found that the lack of intent was the reason impacting the integration of the GenAI.

Lack of Intent, may stem from several reasons – it may be indicative of lack of a full understanding of the potential impact of Gen AI, which, in turn, may stem from the lack of competence and skill sets in Gen AI. This clearly shows that the industry needs more examples of validation proofs-of-concepts, and success-cases demonstrating the impact of Gen AI in Ux and other aspects of SDLC. Another important reason seems to be cost. The users also found lack of investment in infrastructure to cause impedance. Of course, it may be argued that with lack of intent, the budget allocation for Gen AI may have also been low for the respondent's companies.

Interestingly lack of skill was not identified as a major hurdle to adoption of Gen AI, though the product design had a significant role. Clearly, this indicates that the respondents are either confident of their own capability to adopt to Gen AI skillset or of the ready availability of such skillset within the industry that may be hired or leveraged when the need arises.

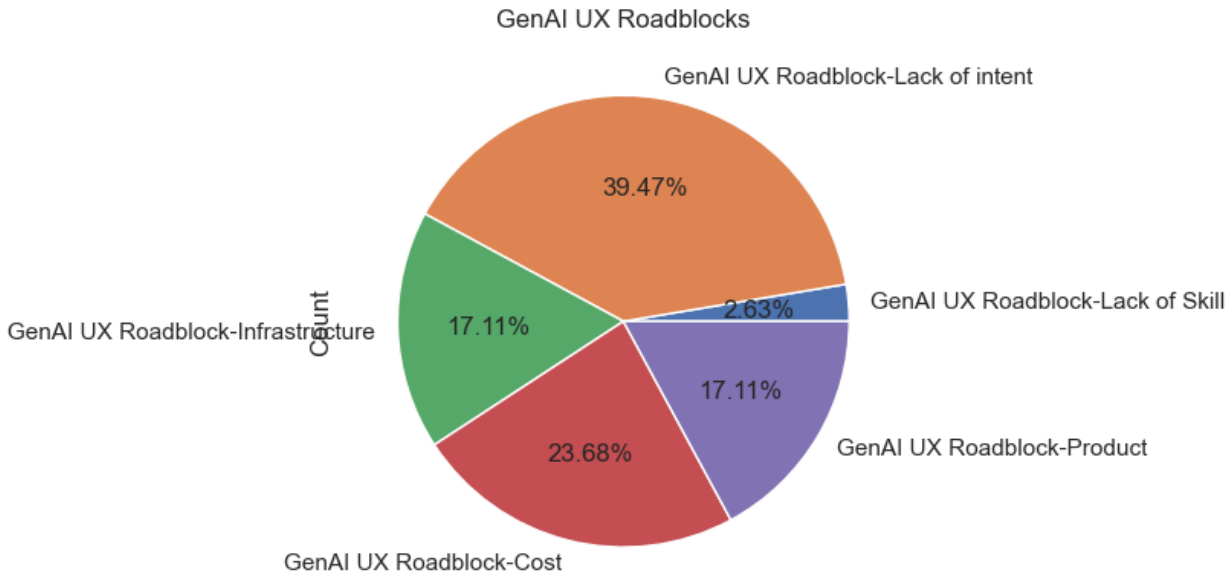


Figure 18 Roadblocks in the Use of Ux

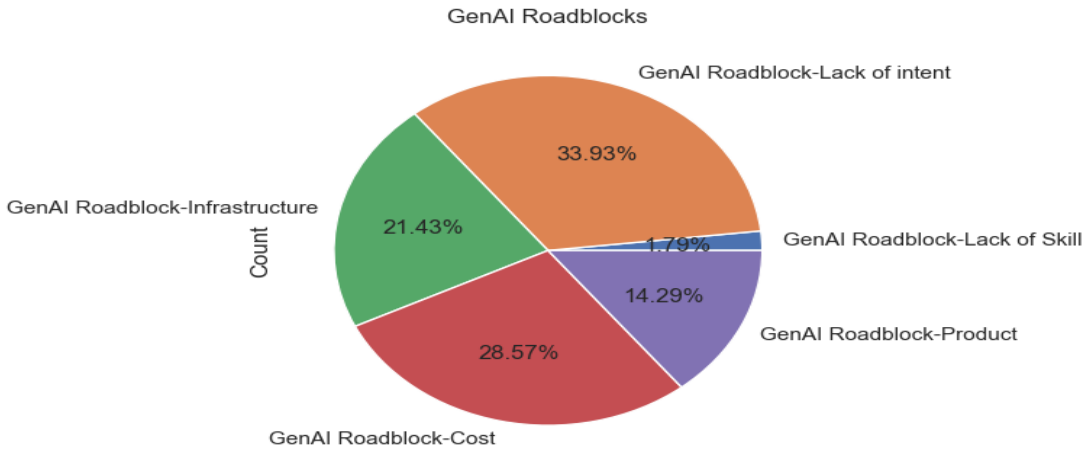


Figure 19: Roadblocks in the use of GenAI

4.6 RQ 5 - Identify a model for GenAI inclusive SDLC

The inferences from the analysis indicate that the biggest roadblocks for the Ux and GenAI is lack of intent or awareness. This is clearly a major problem and needs training the companies with the benefits of the inclusion of the user experience practices and GenAI technologies in the SDLC.

It is clear that for a natural transition of the practitioners towards adoption of Gen AI and Ux, the advantages and value proposition of these approaches need to be made clearly visible. In this study, we propose that a task-based model, which implements the integration of these approaches into specific tasks, will create practical examples of the implementations that may be easily adopted, thereby nudging the user base towards a natural model of adoption. This approach is expected to be more successful than proposing systemic changes advocating broad adoption of Gen AI and UX which will require more significant changes to existing industry infrastructure, thereby adding costs, which may not be viewed favorably. Removing the "intent" roadblock with simple examples, will automatically enable the practitioners to create a "Bottom-Up" adoption strategy to convince their stakeholders to include these as a part of planning and budget, which are the next level of roadblocks to overcome.

To create a body of such translations or success stories, the model identified replacing some of the key activities of the software development with GenAI technologies. Following is the flow identified for the new model. The main considerations for effective implementations of these changes will be the prompts and contextual querying to ensure the right response is derived.

Table 5: New Proposal Steps

Stages in Lifecycle	Source	Output	Approvals
Requirement	Functionality	Req Document	Reviews
Design	Req Document	Ux Design & Architecture	Code Reviews
Development	Ux + Architecture	Code	

Testing	Req Document	Test Cases	Reviews
Deployment	Architecture	Deployment plan	Reviews
Feedback	Production Data	Reviews and Analysis	Analysis report

The difference between the regular SDLC cycle and the proposed model will be identified using effort in **hours metrics**. This will help in understanding both resource and cost benefit. One of the metrics that is not considered are learning and skill development for the specific domain/technology related to each stage.

4.7 RQ 6 - Validate the proposed model with a case study

To demonstrate the implementation of the proposed model as well as to demonstrate the methodology of quantifying its benefits, two short case studies were conducted. The case study involved identifying the steps for development of two products that are actual software start-up ideas on which the author is presently working. Once the concept was identified, a plan related to the steps to be followed for the lifecycle was put together. The estimate of the efforts in terms of hours for the tasks based on regular development cycle (without extensive use of Gen AI and UX), was then put together. Once the estimates were finalized, they were aligned with the product owner, for an independent endorsement of the project effort outlay so as to ensure that the estimated efforts were realistic and consistent with industry practice. Then the researcher started executing the project using Generative AI tools. The effort at each stage was noted. Once the expected results are achieved the comparison of the estimated versus actual effort was carried out. This comparison helped in identifying the impact of the generative UI in different stages of software development. Deployment was not considered as a part of the case study, as automation is already available through many technologies (like AWS, GCP, Azure) for the same. Case Study 1 involved developing the mobile app for waiter calling service, to ping the waiters using a table-

top device. This app needs to show the latest notification based on the table layout, along with associated alarms. Case Study 2 involved developing a mobile application to know about the tourist places in the google map, with audio facility. Details of the case studies are available as appendices - _Appendix_–_1, _Appendix_IV:_Case

Both case studies explore the integration of Generative AI in various stages of project development, from requirements gathering to design and UX. At each stage the AI was used to generate the first output, which was then reviewed and refined. The research focus is on understanding how AI impacts efficiency, accuracy, and resource management.

4.7.1 Key Details

- **Requirements Generation**:
    - **Talking Tourist**: Estimated at 8 hours, completed in 2 hours (1 hour coding, 1 hour review).
    - **Waiter Calling App**: Estimated at 12 hours, completed in 2 hours (1 hour coding, 1 hour review).
- **Design Generation**:
    - **Talking Tourist**: Estimated at 4 hours, completed in 2 hours (1 hour coding, 1 hour review).
    - **Waiter Calling App**: Estimated at 4 hours, completed in 2 hours (1 hour coding, 1 hour review).
- **UX Design**:
    - **Talking Tourist**: No additional hours required.
    - **Waiter Calling App**: No additional hours required.

4.7.2 Main Takeaways

- **Efficiency Gains:**

Time Reduction: AI significantly reduced the time required for generating documents. Both case studies showed a substantial decrease in actual hours compared to estimates.

- **Accuracy and Quality**:

  First Iteration Approval: Documents generated by AI were approved in the first iteration, indicating high quality and accuracy.

- **Human Oversight**:

  Critical Review Process: Human review remained essential to ensure the AI-generated content was accurate and appropriate.

- **Resource Management**:

  Efficient Allocation: The use of AI allowed for more efficient allocation of human resources, enabling team members to focus on strategic aspects of the projects.

- **Tools Used**:

  ChatGPT's Role: ChatGPT was effectively used to handle complex tasks like requirements and design document generation.

4.8 Summary of Findings

Overall, the respondents have answers that cover the current usage, issues and future readiness for the User experience and Gen AI. Based on the overall responses, following conclusions can be made.

- Ux and Gen AI integration is still an open issue in the SDLC

- Major roadblock for Ux integration is lack of awareness and communication between teams

- Gen AI is not used in SDLC extensively and there is scope for the use of the GenAI capabilities, to improve productivity.

- Lack of intent and cost are two major costs for using Gen AI in SDLC.

Case study using the proposed model shows significant improvement in the effort required for development, which can help in cost reduction. The awareness of this can help in overcoming the identified roadblocks for software development.

4.9 Conclusion

The survey responses confirm that the integration of Gen AI with SDLC is an open topic for research. The usage of Gen AI for User Experience can be improved improving the lack of awareness for the User Experience and Generative AI.

The case studies demonstrate the transformative impact of Generative AI on project workflows. AI tools like ChatGPT can drastically reduce the time and effort required for document generation, leading to enhanced productivity and streamlined processes. However, the need for human oversight ensures that the outputs meet quality standards. This balance between AI efficiency and human expertise is key to achieving optimal project outcomes, making AI an invaluable asset in modern project management and development.

CHAPTER V:

DISCUSSION

5.1 Discussion of Results

This section discusses in detail the data collected from the survey, and identify the learnings on each research question. The inferences are derived based on the data collected. The sample is representative of only a small part of the population. These inferences could differ when applied to the industry based on the individual implementations. Hence, the discussion attempts to arrive at an indicative conclusion based on the information that was collected.

The analysis of the research questions regarding the current implementation involves evaluating the survey results across different categories and comparing the same with the overall results. Evaluation also the dependency across different groups on the stages. The categories considered for the analysis are:

1. Age of Company – This parameter understands company of different ages and how the responses vary as the company grows older. The age groups considered for the survey were (0-2 years, 2-5 years, 5-10 years, 10 years and above). The distribution of the survey responses across the age group is as below

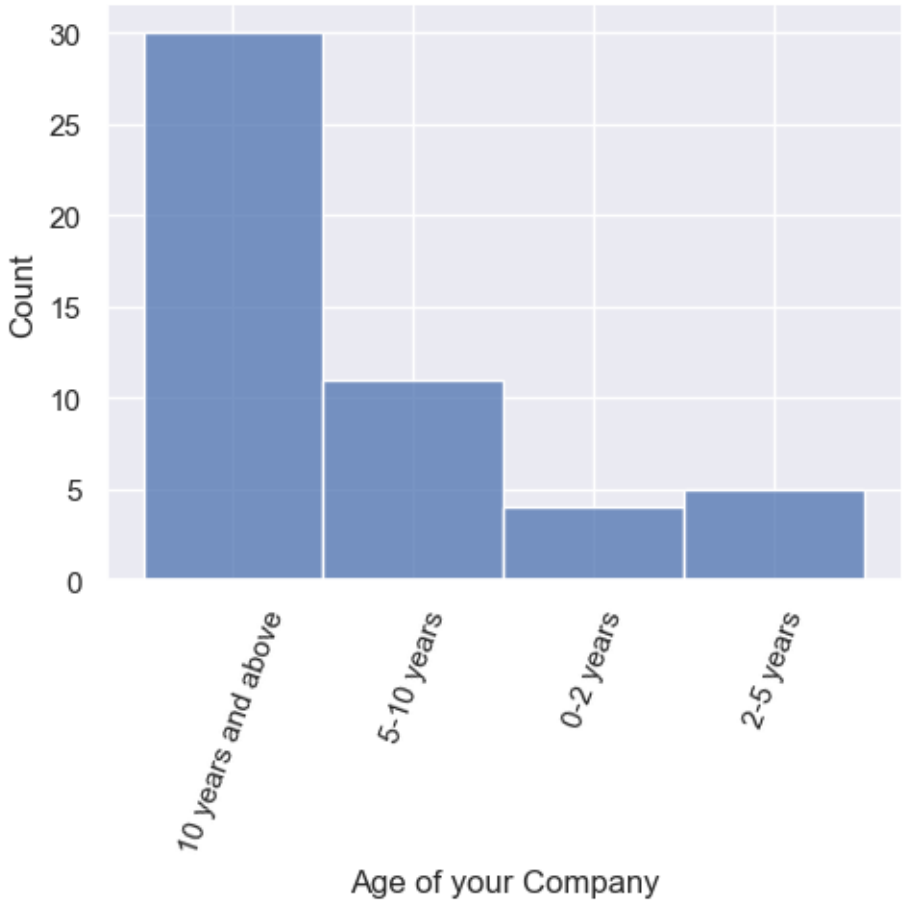


Figure 20: Age of the Company Analysis

2. Product User Base – This parameter is to identify if the size of the product user will impact the adoptions or roadblocks that are analyzed. The possibility such as the large user base may need different evaluation techniques to adopt Ux or AI, prompted to gather this demography as well. Products were classified based on the user size being (0-1k, 1k-5k, 5k-15k, 15k-50k, 50k-1M, 1M & above). Following is the distribution of the responses across the categories.

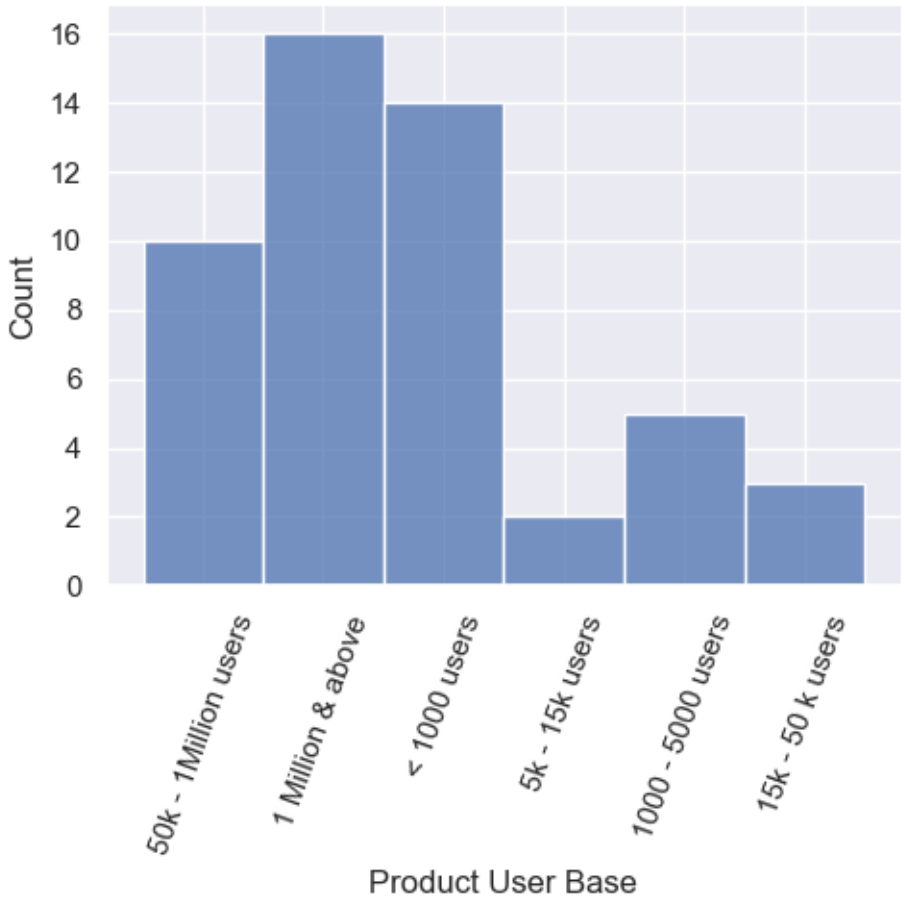


Figure 21: Product User Base Distribution

3. Company Size – Size of the company can impact the skill and the cost factor. The size is also an indirect indication of the budget availability. Hence the number of employees were grouped in the range (0-50,50 – 100, 100-200, 200-1000, 1k & above). Following is the distribution of the responses across the categories. Following is the distribution of the responses across the categories.

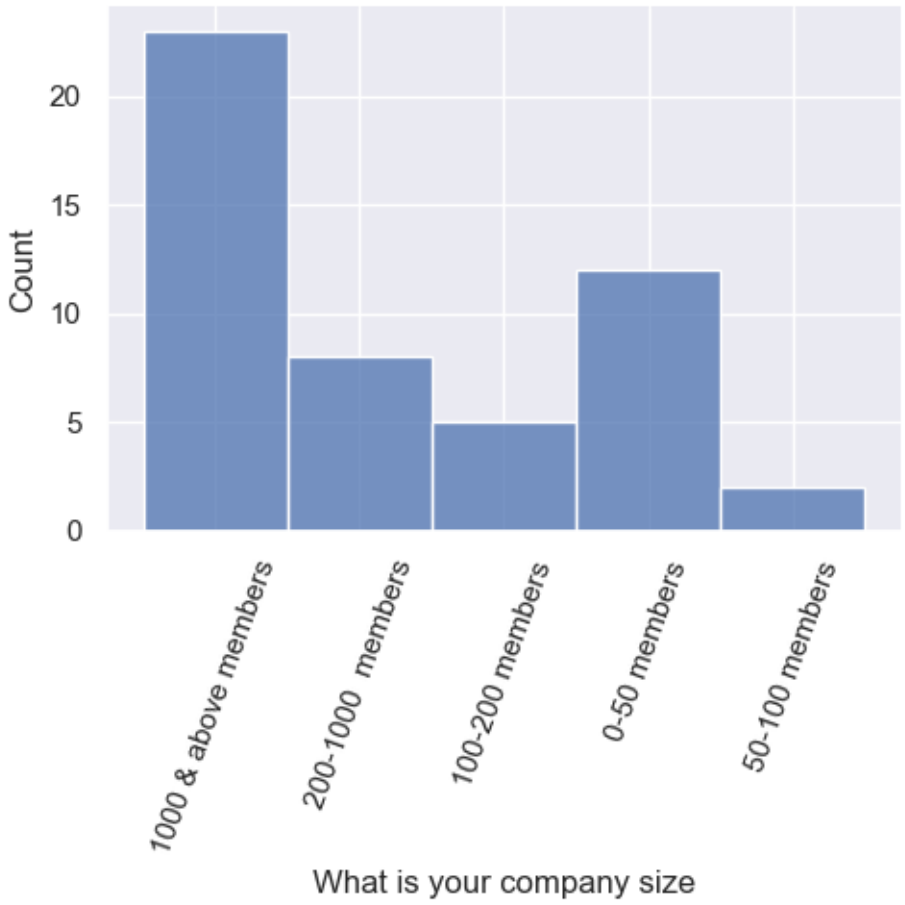


Figure 22: Distribution of Company Size

4. Role in the Company – The perspective about the usage is different based on the role an individual plays in the company. Hence the users were grouped under following roles to understand how their responses are different as their role varies (CxO, Product Management, Project Management, Developer, QA, Senior Management, Ux Designer). Product Management, Software Development and Ux Designer were kept specific as their role directly impacts the areas of consideration for this research. Following is the distribution of the responses across the categories.

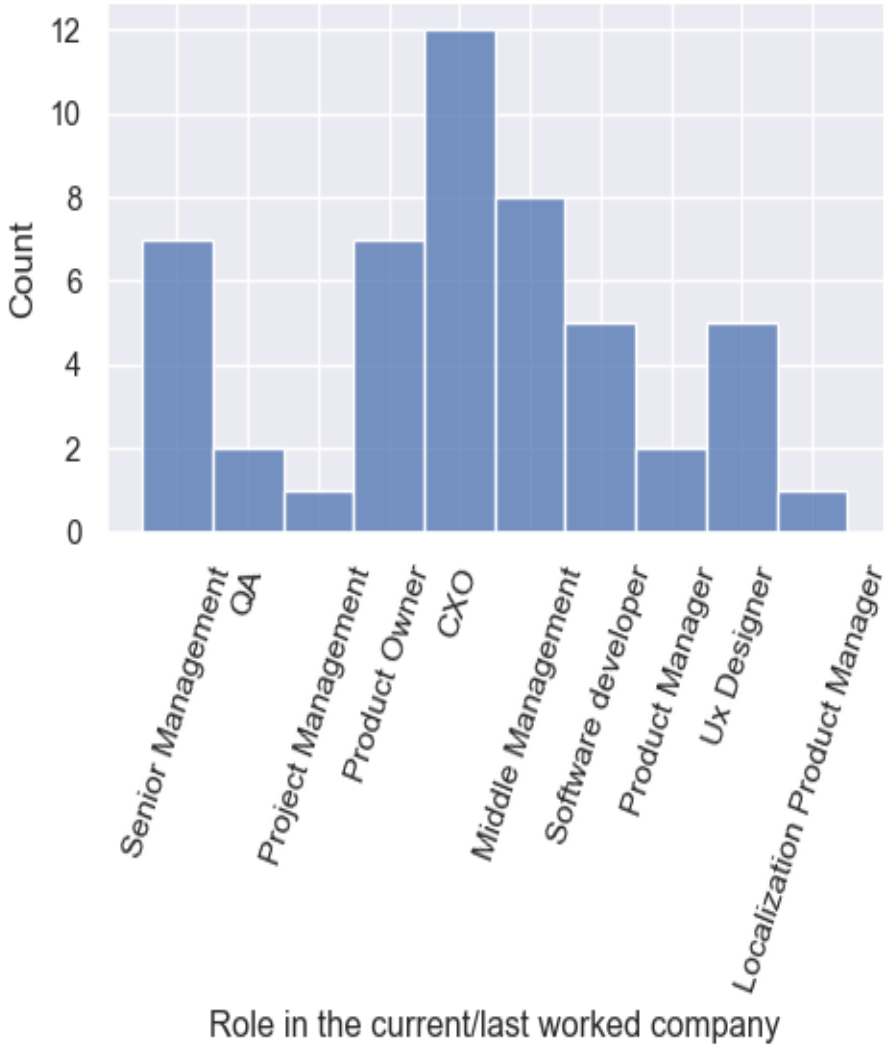


Figure 23: Distribution of Roles

The overall distributions shows that the distribution of the categories across the responses can be classified as normal based on the following details:

- Age of your Company
    - SD - 12.069244660154448 SE 12.069244660154448
    - Count - 50

- Target 95% confidence with 50 records 3.3454239392539376
  95% confidence MoE 3.3454239392539376
  90% confidence MoE 2.8163007651882634

- Product User Base
  - SD - 5.8878405775518985 SE 5.8878405775518985
  - Count - 50
  - Target 95% confidence with 50 records 1.6320261435814483
    95% confidence MoE 1.6320261435814483
    90% confidence MoE 1.3738995596476478

- What is your company size
  - SD - 8.154753215150045 SE 8.154753215150045
  - Count - 50
  - Target 95% confidence with 50 records 2.2603822685554755
    95% confidence MoE 2.2603822685554755
    90% confidence MoE 1.902872828120681

- Role in the current/last worked company
  - SD - 3.5901098714230026 SE 3.5901098714230026
  - Count – 50
  - Target 95% confidence with 50 records 0.9951276858328839
    95% confidence MoE 0.9951276858328839
    90% confidence MoE 0.8377350416450298

5.2 RQ 1 - Understand the extent of User Experience Development in Startups

Evaluating the data of user experience across different categories, helps to understand the consistency of the results across different categories and groups of the responses.

5.2.1 Age of Company

The data across the age of company shows the User Experience in Requirements, Design and Development as consistent. The involvement of user experience is consistent across the different sizes of the companies. As the age of the company increases, the user experience is used more, which is evident from the percentage of rating increase.

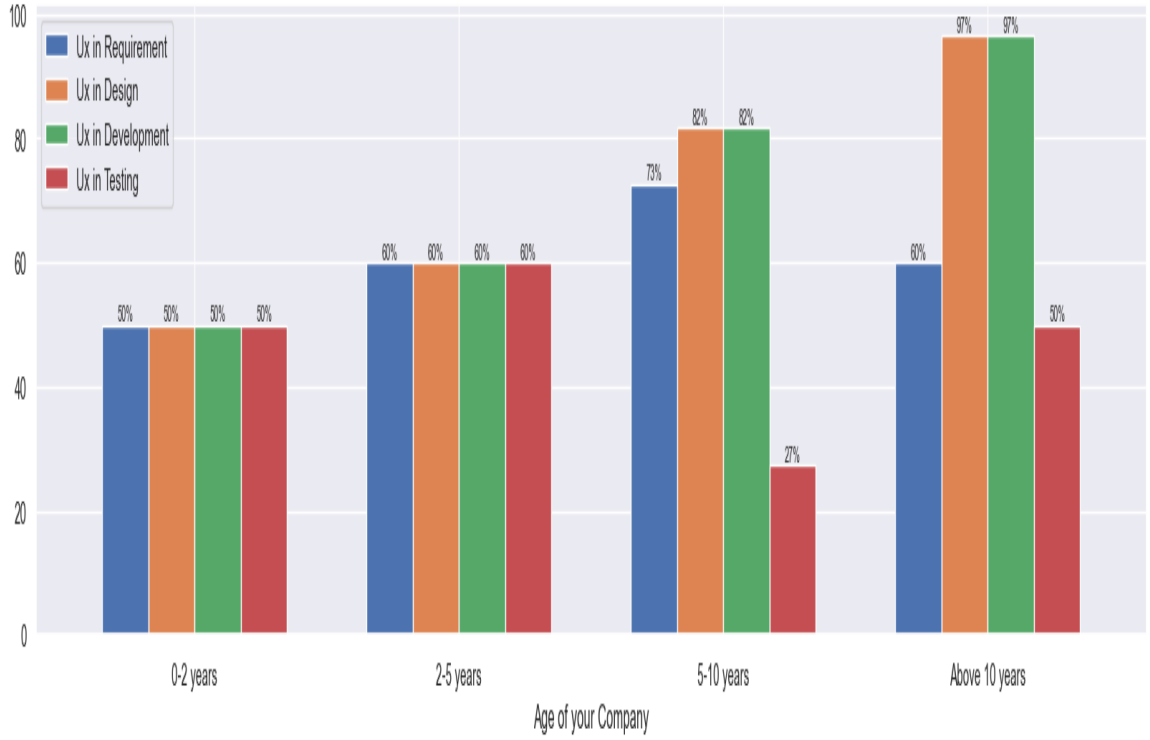


Figure 24: Ux Usage grouped by Company age

However, the user experience involvement in requirement & testing stage seemed to dip as the age of the company increases. This could be considered due to confidence in sustaining in the market, which makes the business overlook the Ux requirements. This is an open area of discussion to be taken

5.2.2 Company Size

The analysis across different sizes of company shows that design and development include Ux in their consideration. Requirements and testing do not consider Ux, consistently. Ux

involvement varies across the company size, indicating that the company size is not dependent on size of the company.

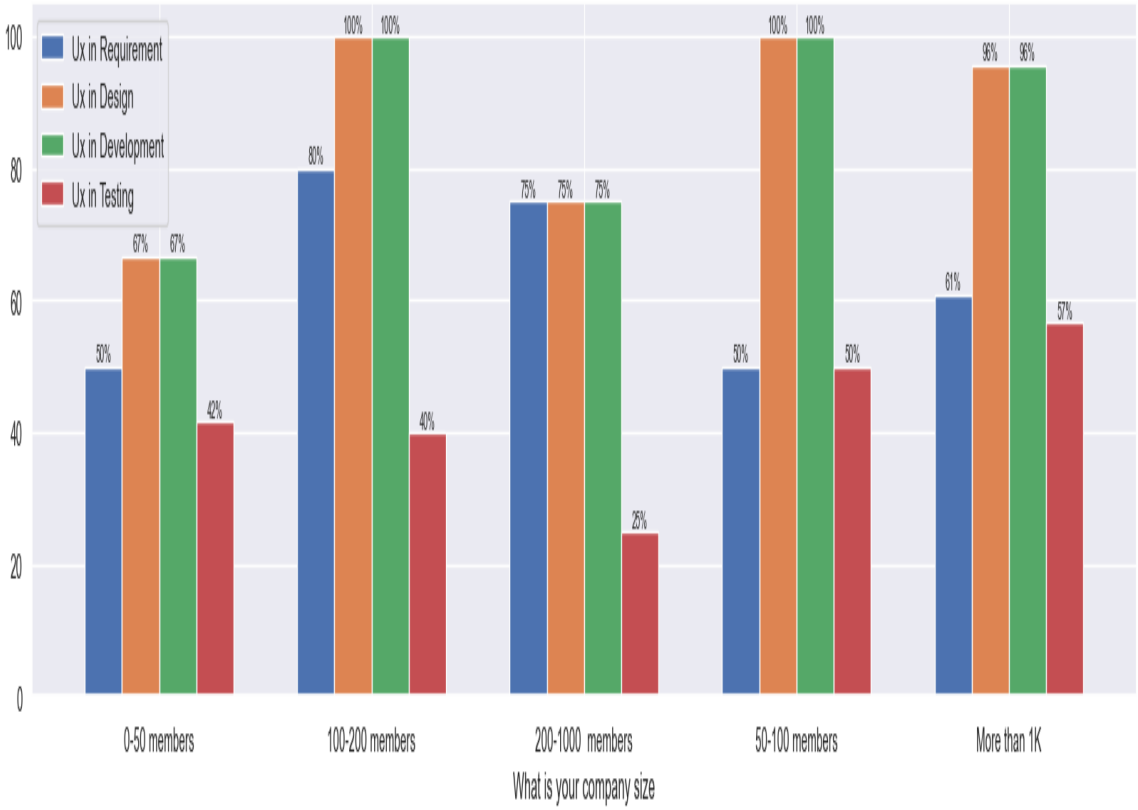


Figure 25: Ux Usage grouped by Company Size

5.2.3 Product Base

When checking across the product user size, the results are consistent that Ux is used across design and development whatever be the size of the product user base. Also, the involvement of Ux is rated as same in requirement and design stage. Requirements and testing consider Ux low, consistently.

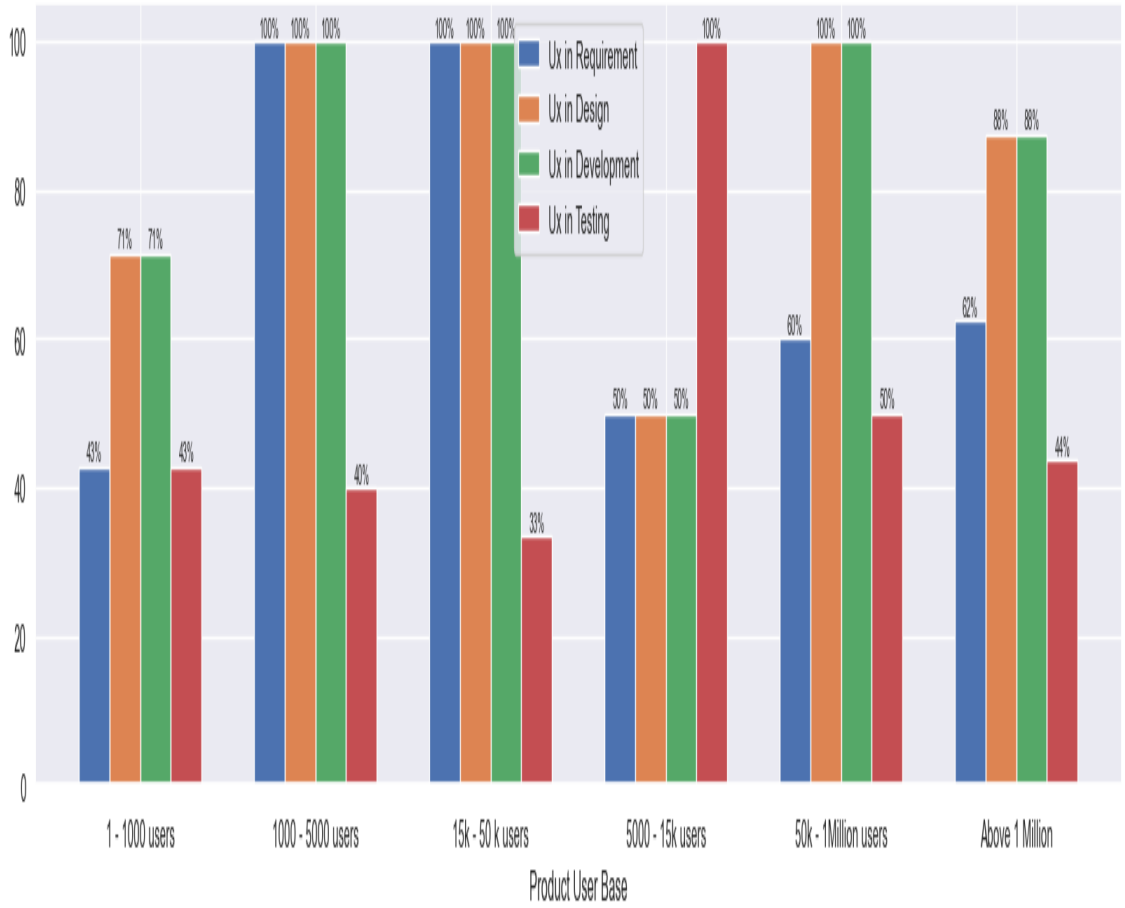


Figure 26: Ux Usage grouped by Product User Base

5.2.4 Roles

Users in different roles, rate the involvement of Ux in design and development high. Requirements is the stage where the Ux is rated high after design and development. However, the CxO, Product Management, Project Management rate Ux high across all stages, while QA, Developers, Ux Designers and Middle Management rate the Ux only for Design and Development. There is a difference on the management perspective vs actual development community here.

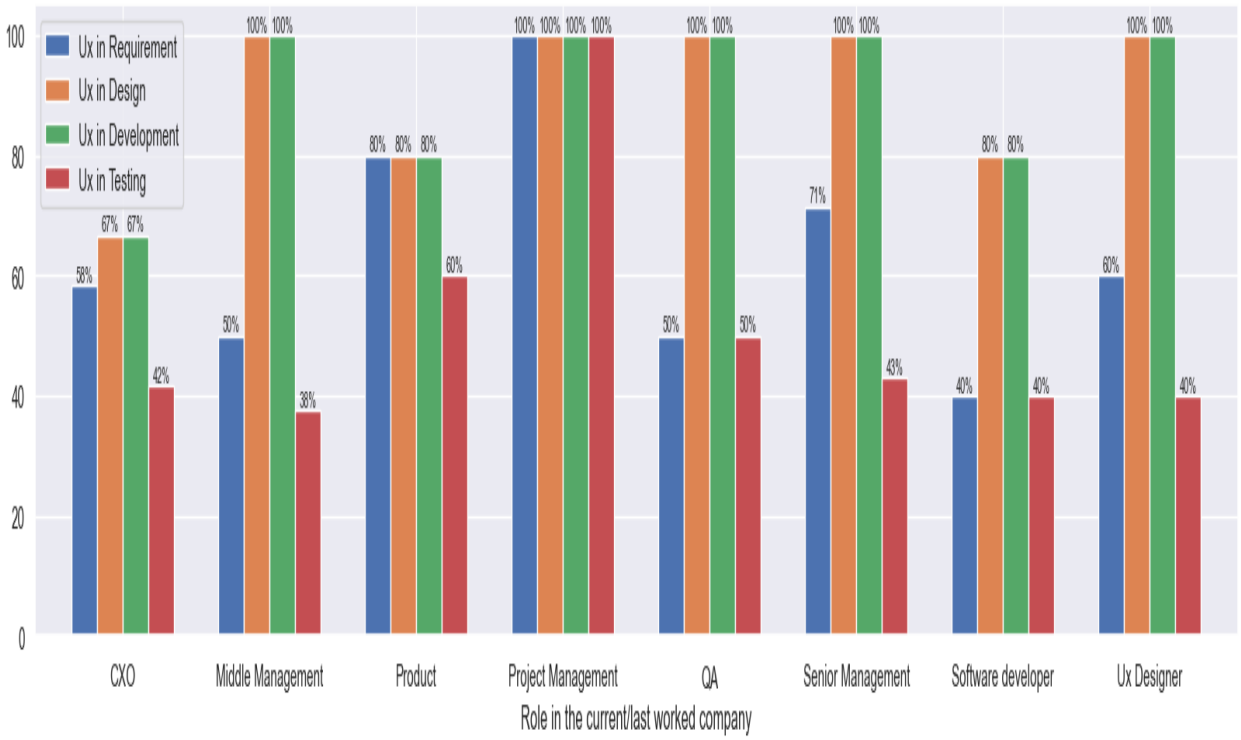


Figure 27: Ux Usage grouped by Role in the Company

5.2.5 Conclusion on RQ1

The overall analysis corroborates with the individual category wise analysis. Design and Development has maximum involvement user experience, followed by the requirements. Influence of the age of companies and product base can be identified. Ux involvement increases as the age of company increases, which could be the result of learnings from the experience. Ux involvement decreases as the product user base increases and this could be related to the increased confidence about the userbase.

5.3 RQ 2 - Understand the extent of current adoption of GenAI

The analysis of responses across the company size, age, and product user base help us understanding the consistency of the responses. It also gives perspective on how different groups look at the adoption from various perspectives when it comes to adoption of Gen AI in their workplaces.

5.3.1 Company Size

Evaluation of the Gen AI usage across user base shows that it is consistently used in development. Requirements and design stage also uses the Gen AI. The usage however does not have any relation on the company size as the proportion is almost consistent among how the usage is rated across different categories for each stage.

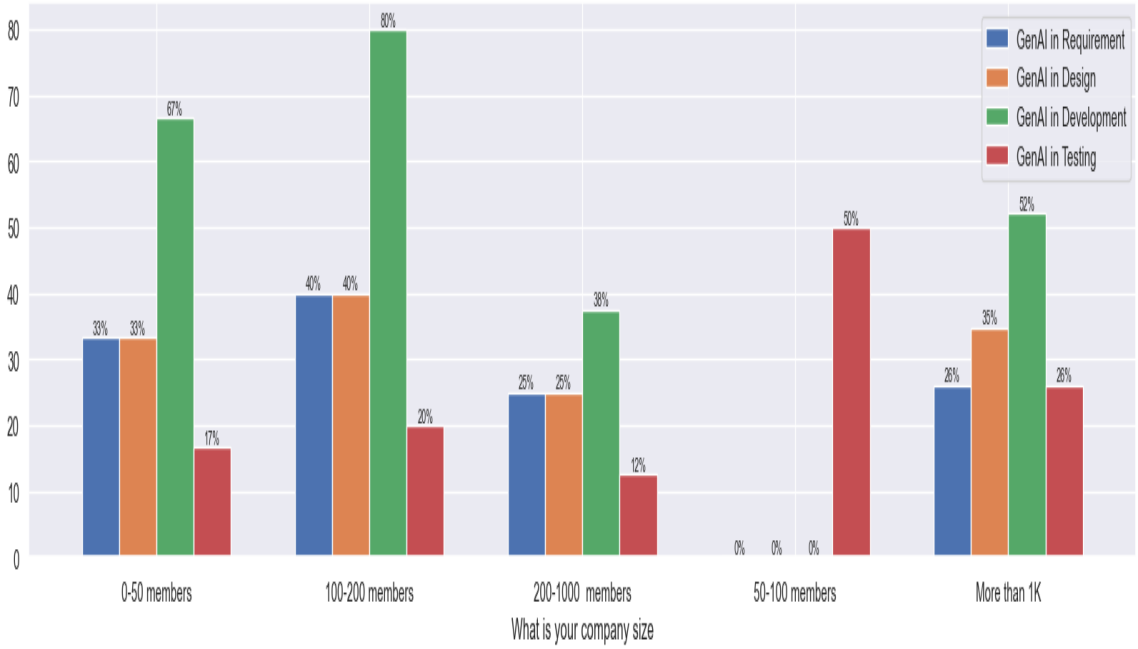


Figure 28: Gen AI usage by Company Size

5.3.2 Product user Base

Analysis of the generative ai usage across user base shows that it is consistently used in requirement design and development. The usage however does not have any relation on the product user base for development stage. Requirements are used heavily as the size moves from 1k to 15k users, but then tapers down. This could be due to the fact the business is being established in this stage, and the companies are trying to optimize here. The bigger the user base, the product is more settled and may be perceived to have limited scope for using GenAI.

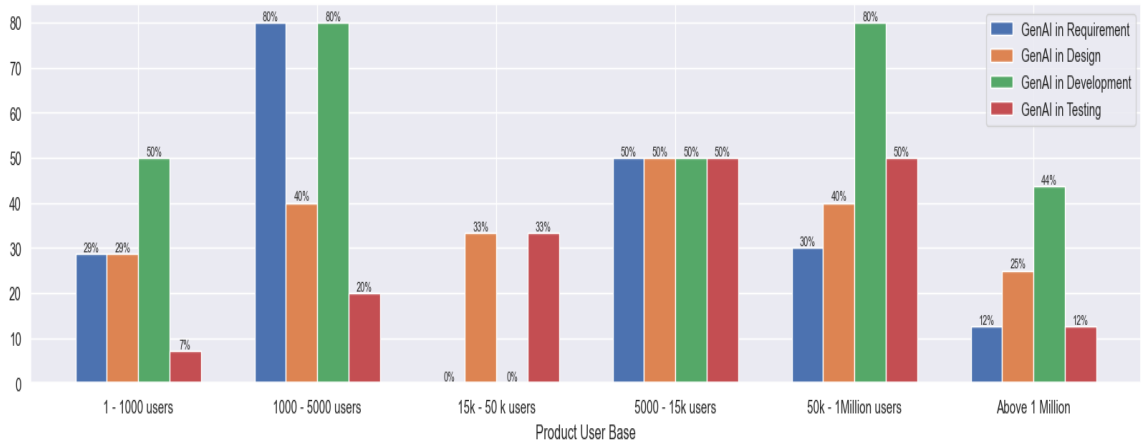


Figure 29: Gen AI usage by Product User Base

5.3.3 Age of Company

Analysis of the Gen AI usage across user base shows that it is heavily used in requirement and development. Gen AI adoption is lower in very young and older companies, while consistently used for development. This could be due to the fact that the companies are either too early stage or have a stronger product base to adapt to Gen AI in their business.

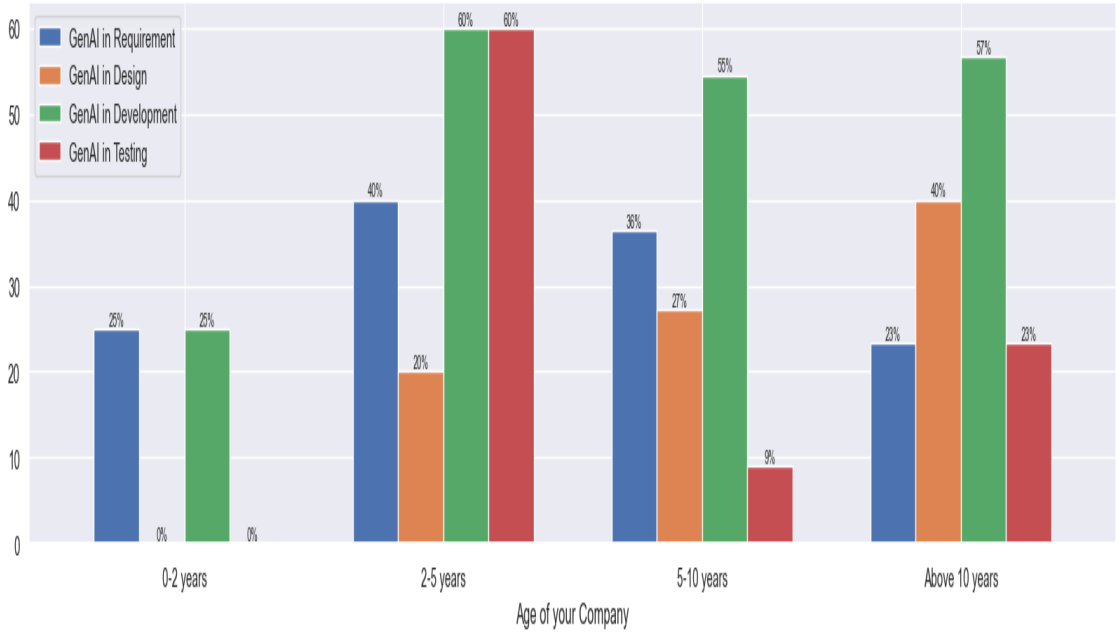


Figure 30: Gen AI usage by Company Age

5.3.4 Roles

Analysis of the generative ai usage across roles shows that it is consistently used in requirement design and development. The usage however does not have any relation on the roles as all roles consistently indicate the usage in design and development. Overall observation is that Gen AI is used for the design and development. It is not correlated to any of the categories considered.

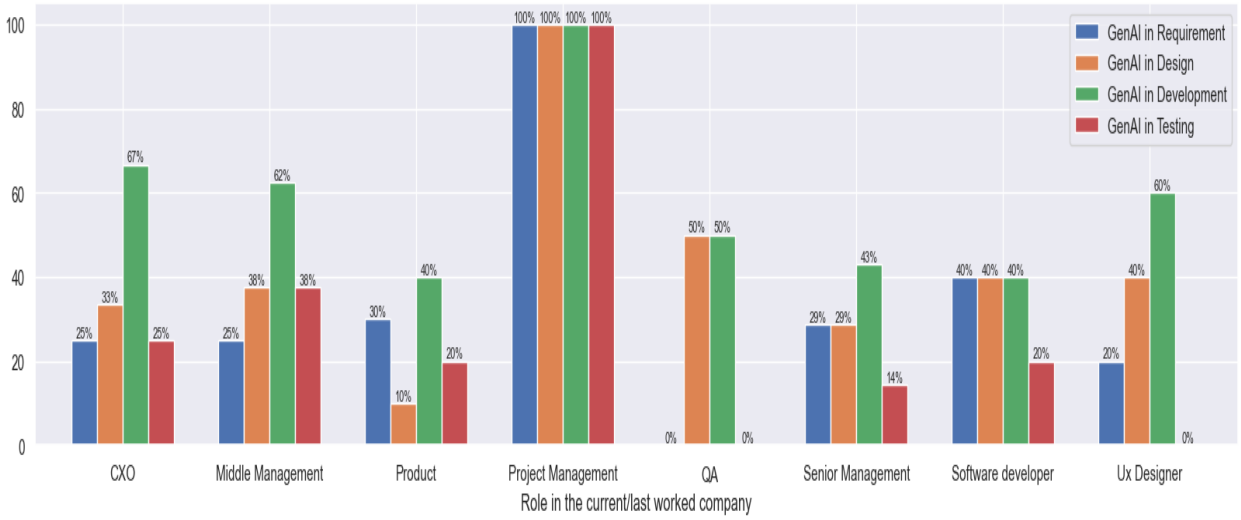


Figure 31: Gen AI usage by Role in the Company

5.4 RQ 3 - Understand the readiness for adopting Ux & Gen AI

Analyzing the company size, product user base, role and age of the company wise analysis of readiness for GenAI, shows an optimistic outlook. However, the outlook is reducing as the company size and age increases. This could correlate to the previous assumption in GenAI usage, that the companies do not find the scope to move to GenAI due to established product design and user base.

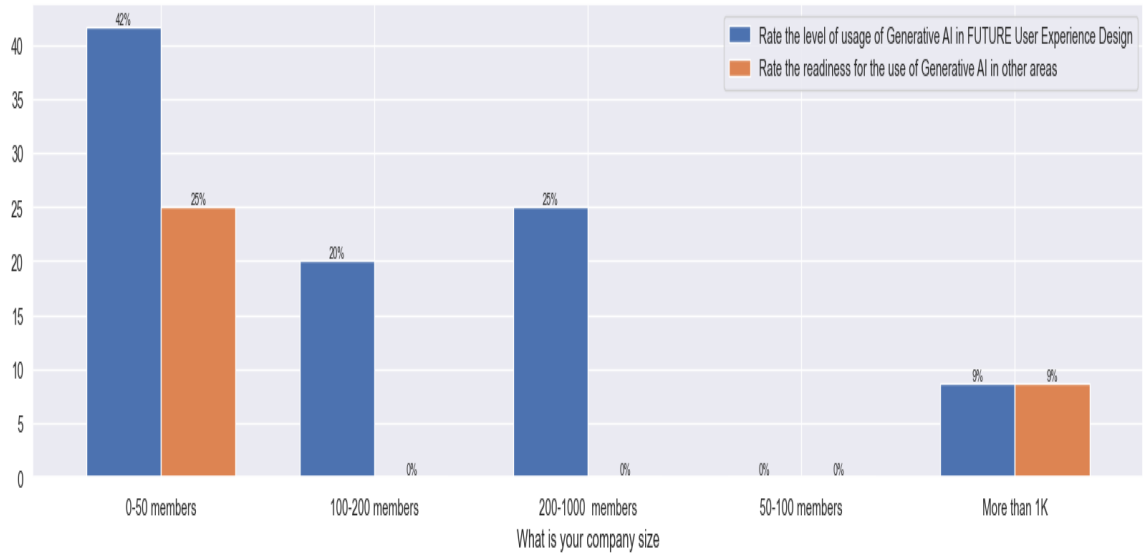


Figure 32: Rate Gen AI Readiness by Company Size

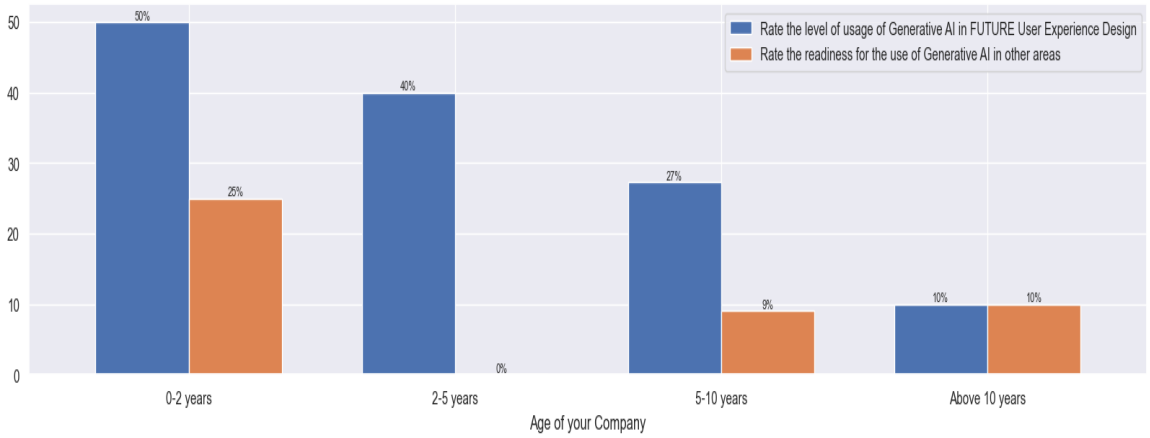


Figure 33: Rate Gen AI Readiness by Company Age

5.5 RQ 4 – Understand the roadblocks in adopting Ux & Gen AI in Startups SDLC

Across different company sizes the major roadblocks are communication, awareness and planning. The same is reflected for different categories in product user base, age of the company and role. There is reduction in awareness as the company ages. The results do not seem to have a pattern based on the size of the company, but the bigger companies (by size, age and user-base) show less

details on roadblocks in GenAI as a part of their SDLC. Capacity seems to be the least roadblock in all categories.

5.5.1 Company Size:

Ignoring the company size of 50-100 members where data is minimal to non-existent, the planning is a roadblock that is consistent and capacity is a non-existent impediment. Awareness of Ux is reducing as the company size increases, while communication seems to follow the same trend.

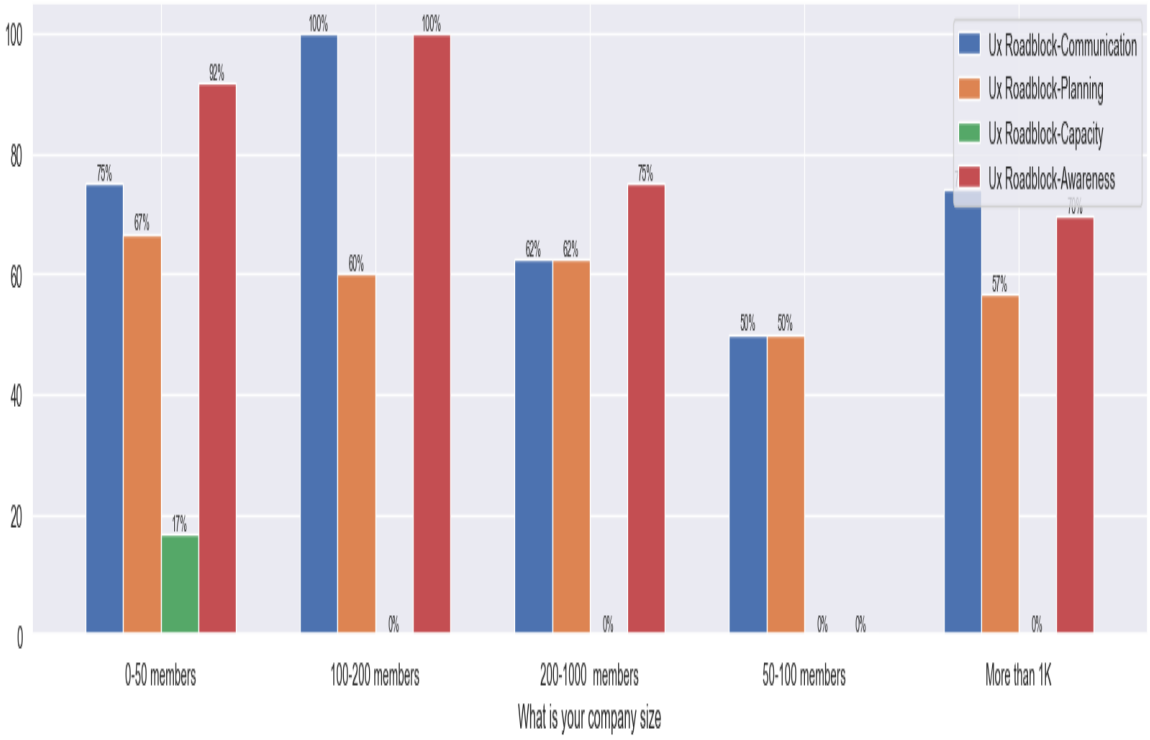


Figure 34: Ux Roadblocks grouped by Company Size

5.6 Product User Base:

Aligning with the overall observation, communication and awareness are the major roadblocks for the companies of any size. The capacity is not a major or very negligible roadblock.

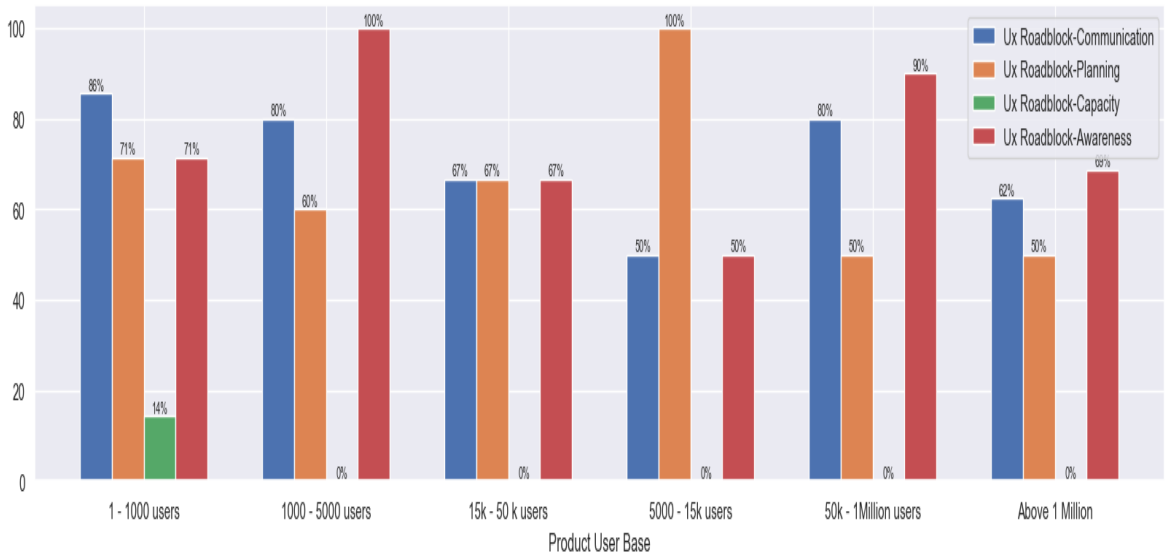


Figure 35: Ux Roadblocks grouped by Product User Base

5.6.1 Age of Company:

Whie the lack of awareness and communication remain consistently the top roadblocks in the companies across all ages, their lack of planning seems to go down as they grow older.

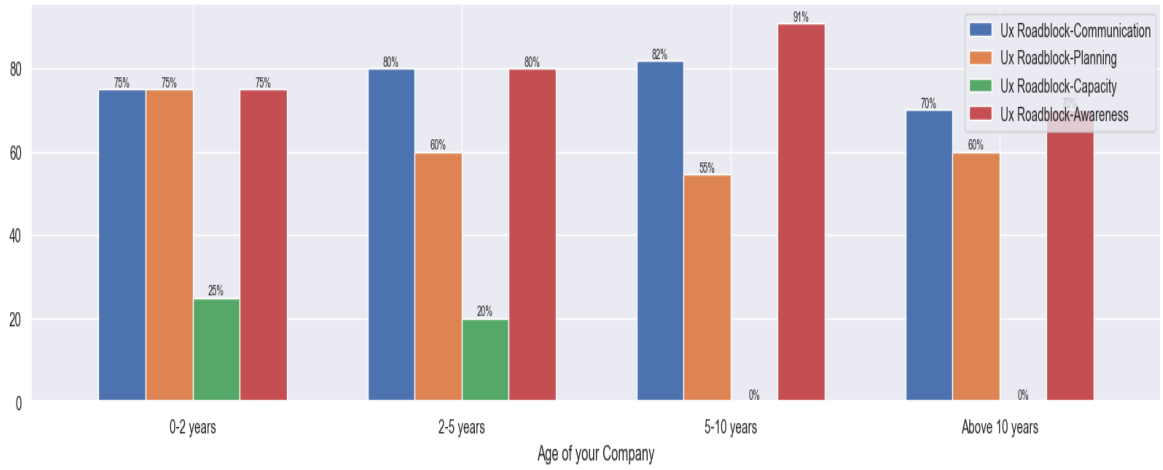


Figure 36: Ux Roadblocks grouped by Company Age

5.6.2 Roles in the company:

When analyzing the responses based on the roles of the responders, the lack of awareness, communication, and planning are still major impediments for Ux integration in the SDLC. Thes

decision makers (CxO, Middle Management and Project or Product management) assume the Lack of planning to be a major roadblock, while Software developers, QA, Ux designers contribute the lack of communication and awareness to be the inhibitors.

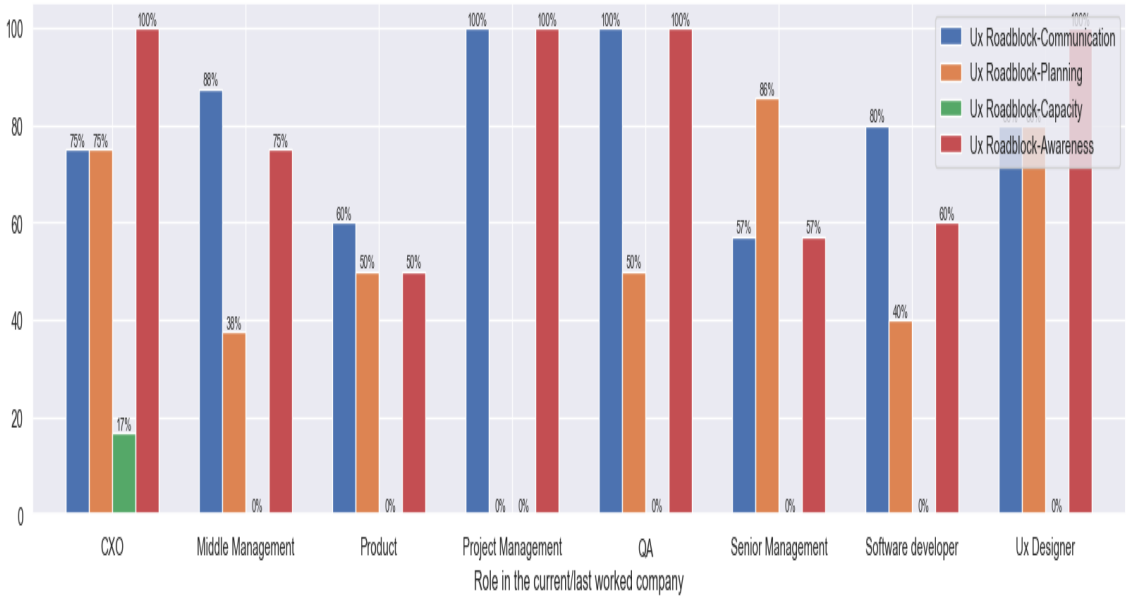


Figure 37: Ux Roadblocks grouped by Company Role

Summary:

The overall summary on the roadblocks is the lack of awareness and communication about Ux is consistently major inhibitors across all the categories of grouping. Capacity is not identified as an inhibitor from any of the groups.

5.6.3 Gen AI Roadblocks

Across the size and age of the company the lack intent to GenAI and infrastructure is the major roadblock across all categories. The two are inter-related, since lack of intent may directly impact the investment for the similar infrastructure. Lack of skill is a negligible roadblock across different categories and groups of the responses.

Company size:

Responses suggest that as the company grows bigger, the lack of intent to use GenAI is reducing, while the investment is increasing. Product design is an impediment for bigger companies, or while starting.

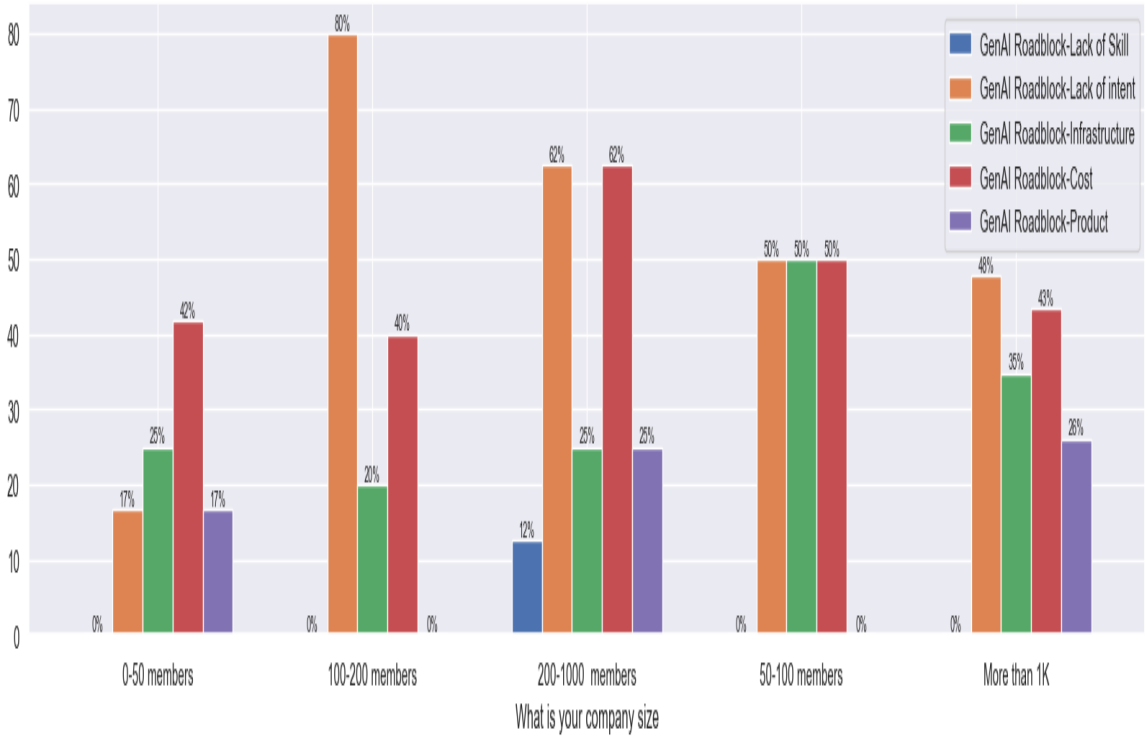


Figure 38: Gen AI Roadblocks grouped by Company Size

5.6.4 Age of Company:

When analyzed across the age of company lack of awareness is increasing as the company grows older. This could be related to the factor of established user base and product model that will reduce the perception to innovate. Lack of Infrastructure seem to increase to some level, and taper down as the company establishes beyond a decade. Cost impact seems to be heavy for older company, which could be an outlier data, or the high cost can be attributed to the increased lack of intent.

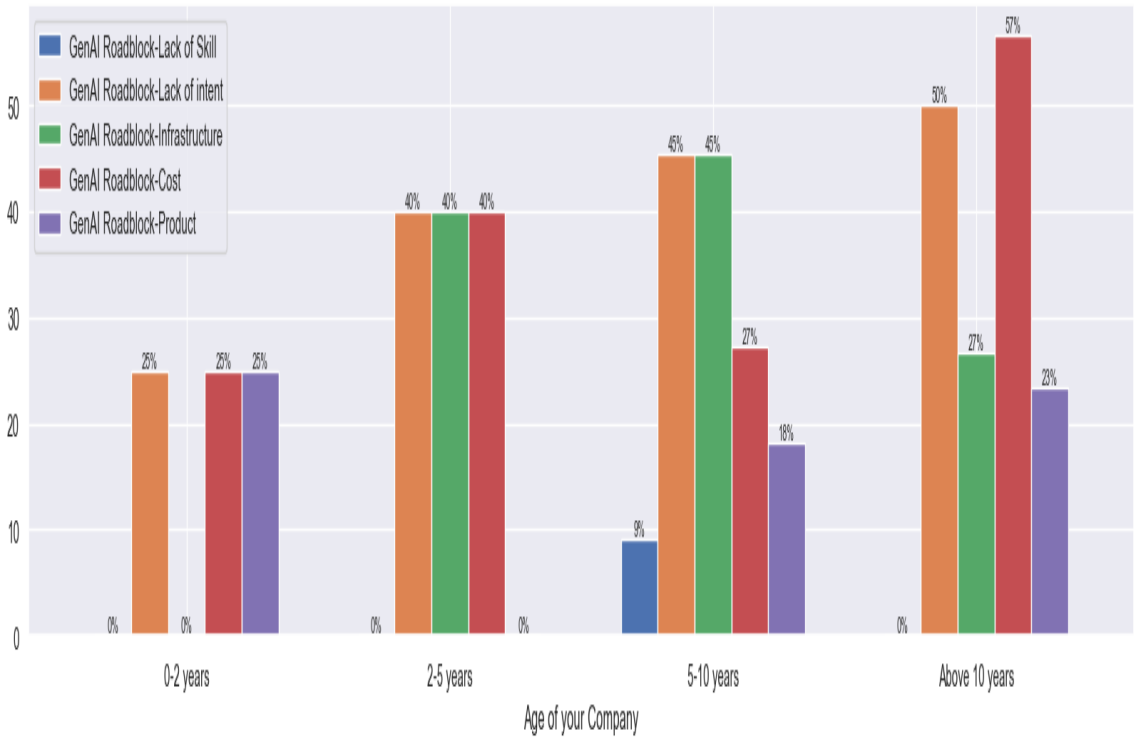


Figure 39: Gen AI Roadblocks grouped by Company Age

5.6.5 Product User Base:

Across all size of product user bases, there is consistent roadblocks of infrastructure or cost. The lack of intent does not show any pattern, while the cost reduces as the user base increases. Product design is identified as roadblock either for early products or at the later stages, showing no dependency to the company size. However, the design seems to be following the same trend as infrastructure wherever data is present.

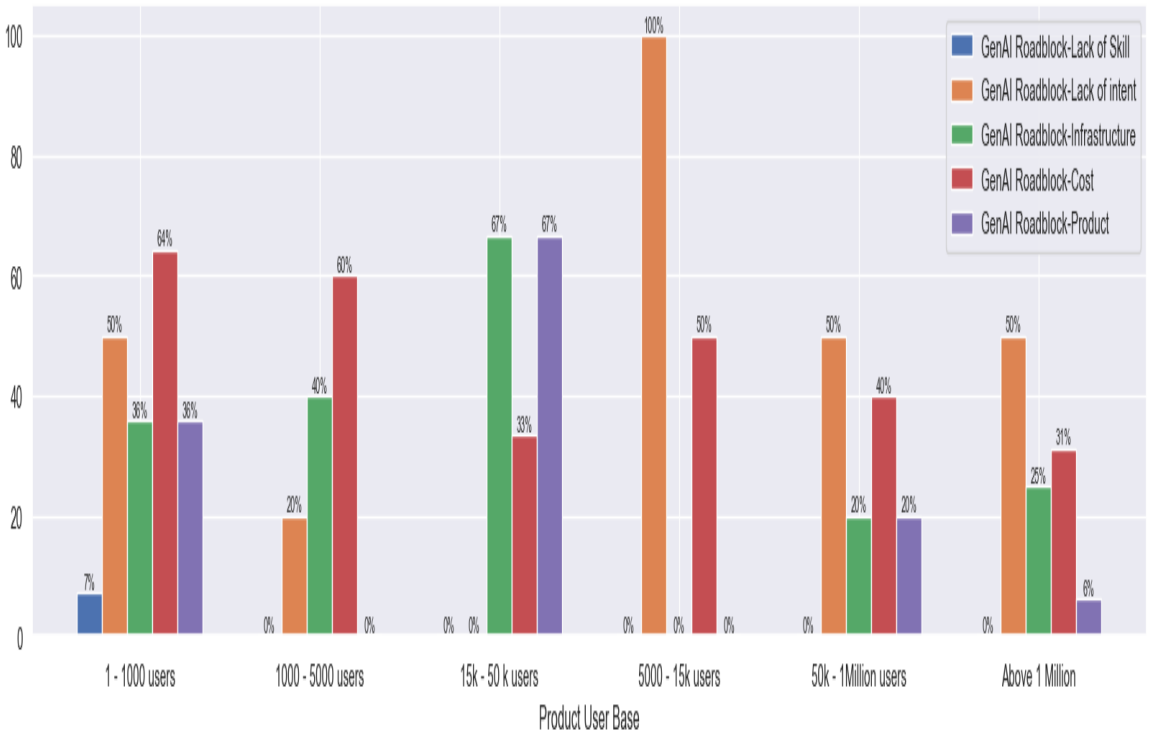


Figure 40: Gen AI Roadblocks grouped by Product User Base

5.6.6 Roles:

Major impediment for Gen AI comes from lack of intent. This is high in all the categories, except software developers and QA who identify cost as a significant factor. Management roles (CxO, Senior Management as well as Product) also put the same as bigger roadblock. Product design is the least consideration for the management, while it is a significant road block for the Software developers, Senior Management and Designers who actually own it. Overall, the lack of skill is not at all identified as a roadblock across any of the roles.

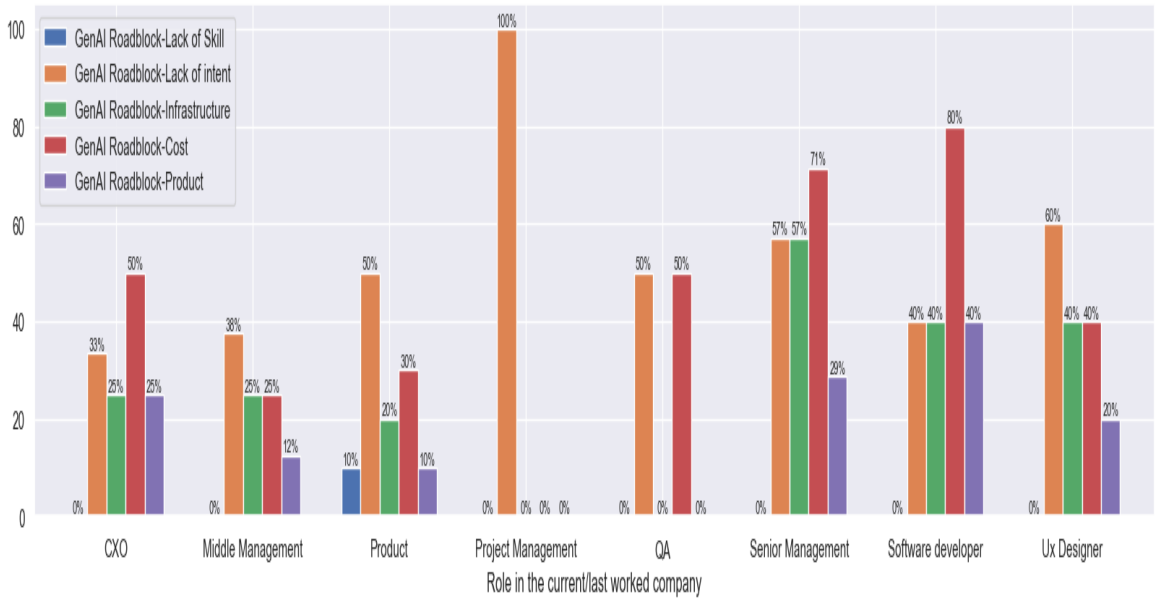


Figure 41: Gen AI Roadblocks grouped by Company Role

Summary:

From the above analysis it can be summarized that lack of intent is a major roadblock for adopting the GenAI in SDLC. It is the root factor that can fix the other roadblocks like infrastructure, and cost. Skill and Product design are not identified as a major blocker, and can be safely ignored for the further analysis.

5.7 RQ 5 - Identify a model for GenAI inclusive SDLC

The next requirement was to identify the model to validate the improvement for the problems identified from the data. The major roadblocks observed from the survey responses are:

1. Lack of Awareness about User Experience
2. Communication issue while integrating User Experience
3. Lack of Intent about using Generative AI

These roadblocks are psychological issues, that can be addressed by showing proof of benefits in using User Experience and Generative in the SDLC. Hence it was identified to use a case-study of the proposed to support the improvements. This required building a model using GenAI at every

stage of SDLC and tracking the Ux as a part of it. Clearly identified metrics will be used to evaluate the improvement that can be achieved by adopting the proposed model.

While identifying the model for a GenAI inclusive SDLC, this research considered the GAASD proposed in (Vasuda Kota Voya Services et al., 2023). The steps to consider for each stage, the input, expected output were identified. The model considered clear input and output for each stage of the lifecycle. The metrics were identified clearly for the evaluation.

Table 6: Metrics for the New Model

Stage	Gen AI considerations	Source	Output	Iteration with Human
Requirement Gathering	Requirements are generated with Gen AI	Brief Description of Functionality	Document	Reviews
Design	Design is Generated with Gen AI	Document	Ux + Architecture	Reviews
Development	Development code is generated with Gen AI	Ux + Architecture	Ux	Feedback points
Testing	Test cases are generated with Gen AI	Document	Test Cases	Reviews
Deployment	Deployment setup is generated with Gen AI	Document	Deployment plan	Reviews
Feedback	Evaluation analysis is generated	Production time data and reviews	Analysis report	

Based on the project chosen, it was identified to build react-native application using one of the existing cloud providers.

5.8 RQ 6 - Validate the proposed model with a case study

The two case studies were executed by the same developer using the same technology – React Native Android applications. This was to ensure there are no bias based on the type of product chosen or technology. The estimates were planned for a mid-level developer with programming knowledge using Android application. Identified metrics were effort and cost to show improvement.

For the purpose of this research, we kept the prompts to be specific and did not iterate them for tuning. The prompts were documented as given.

5.9 Case Study Summaries

5.9.1 Talking Tourist

The "Talking Tourist" case study examines the process of using Generative AI for various stages of project development, including requirements generation, design, and UX design. The focus is on the estimates, actual efforts, and final outputs.

Effort Details:

The estimate and actual effort details of the project show a drastic 85% improvement. Requirements, Design were two areas where the effort could be expedited using the GenAI technology. Development took time as there were nuances to be taken care of while implementing and validating the functionality. The identified response was an MVP for the project.

Table 7: Case Study 1 - Metrics

Stages	Approver	Estimated Effort	Actual Effort	Improvement
		Estimate in hours	Total Hours	
Requirements	Supriya	8	2	75.00%
Design	Sowmya	4	2	50.00%
Ux Design	Sowmya & Supriya	0	0	0.00%
Development	Sowmya	32	6	81.25%
Testing	Sowmya	32	2	93.75%
Total Effort		**76**	**12**	**87.5%**

Other Details

Documents that were generated, prompt used for the GenAI are all summarized below. The output was reviewed and corrected before final sign off to ensure the details are covered properly.

Stages	Approver	Source	Output			
			Initial Output	Approved Document	Iteration Count before	Tools used

					Approval	
Requirements	Supriya	Generate requirement document for an application which will allow the user to login based on a QR code. The logged in user sees the current location map. The nearby tourist places are highlighted and pinned. On clicking the pin, the user gets an option to read (with a book icon) or hear (with an ear icon). On clicking the book - it shows the summary of the place from Wikipedia in a new page, with back option to go back to the app. on clicking the ear, it reads out the summary from the Wikipedia with pause, play and stop options.	https://docs.google.com/document/d/1NQV4I6_0kA5vKWpgXa-rOTJwFTWjoqz2vFKBrbuwico/edit	Requirements Document V1	1	ChatGPT
Design	Sowmya	Requirement Document Prompt to generate Arch diagram from first version of Design Prompt to generate Dataflow diagram from Design doc - ChatGPT Figma to generate screenshots using the Design document.	https://docs.google.com/document/d/1jjaT78cWs7aZ12M2CPYTliybHpJ8En0jJvac_QDSUas/edit#heading=h.nevgcdt74t5z	Design Document for Notification Tracking Android Application	2	ChatGPT Figma
Ux Design	Sowmya & Supriya	Design Document + Review comments	Skipped	V2	2	Figma

Development	Sowmya	ChatGPT Prompt - Code for the above	https://github.com/sowmyadhandapani1979/rachanetalkingtouris/tree/master			Android Studio Amplify
Testing	Sowmya	generate tests for the above functionality How to test accessibility for Mobile App generator				

Table 8: Case Study 1 - Details

Key Details

- **Requirements Generation**: Estimated at 8 hours but completed in 1 hour of actual coding and 1 hour of review.
- **Design Generation**: Estimated at 4 hours but completed in 1 hour of actual coding and 1 hour of review.
- **UX Design**: Estimated at 0 hours with no additional coding or review needed.

Main Takeaways

- **Efficiency**: AI significantly reduced the time required for generating documents.
- **Accuracy**: Documents were approved in the first iteration.
- **Human Oversight**: Critical for ensuring quality.
- **Resource Management**: Allowed for efficient allocation of resources.
- **Tools Used**: ChatGPT effectively handled complex tasks.

Generative AI can streamline project workflows by automating tasks, reducing errors, and allowing human resources to focus on strategic activities. However, human oversight is essential to maintain quality and accuracy.

5.9.2 Waiter Calling App

The "Waiter Calling App" case study focuses on the automated workflow from requirements gathering to testing using Generative AI tools. The app aims to show a list of nearby waiters in a restaurant and facilitate communication between customers and waiters.

Effort:

The estimate and actual effort details of the project show a drastic 75% improvement. Requirements, Design were two areas where the effort could be expedited using the GenAI technology. Development took time as there were nuances to be taken care of while implementing and validating the functionality. The identified response was an MVP for the project.

Stages	Approver	Estimated Effort	Actual Effort	Improvement
		Estimate in hours	Total Hours	
Requirements	Supriya	12	2	83.33%
Design	Sowmya	8	2	75.00%
Ux Design	Sowmya & Supriya	8	7	12.50%
Development	Sowmya	32	13	59.38%
Testing	Sowmya	32	2	93.75%
Total Effort		**112**	**26**	**76.79%**

Table 9: Case Study 2 Metrics

Other details:

ChatGPT was the GenAI tool used for generating document and code. The prompts and the related output are mentioned int eh below document. Every output was reviewed and discussed to ensure all details are covered.

Stages	Approver	Source	Output			
			Initial Output	Approved Document	Iteration Count before Approval	Tools used
Requirements	Supriya	We need an android application which can show the notifications about hte list of tables where call has been made. The Notification should be cancelable. There should be a track of time between when the notification came up till it is acknowledged.	Requirements Document V1	Requirements Document V1	1	ChatGPT
Design	Sowmya	Requirement Document Prompt to generate Arch diagram from first version of Design Prompt to generate Dataflow diagram from Design doc - ChatGPT Figma to generate screenshots using the Design document.	Design Document for Notification Tracking Android Application	Design Document for Notification Tracking Android Application	2	ChatGPT Figma

Ux Design	Sowmya & Supriya	Design Document + Review comments	Figma Link	V2	2	Figma
Development	Sowmya	ChatGPT Prompt - "Generate React Native App for Small, Medium Mobile applications based on Kotlin. It should have a banner, with a tile view of 20 buttons arranged as 4 by 5 layout"	https://github.com/sowmyadhandapani1979/rachaneiassist			Android Studio Amplify
Testing	Sowmya	generate tests for the above functionality How to test accessibility for Mobile App generator				
Deployment	Sowmya		Used AWS for deployment			
Evaluation Analysis	Supriya					

Table 10: Case Study 2 – Details

Key Details

- **Requirements Generation**: Estimated at 12 hours but completed in 1 hour of actual coding and 1 hour of review.
- **Design Generation**: Estimated at 4 hours but completed in 1 hour of actual coding and 1 hour of review.
- **UX Design**: Estimated at 0 hours with no additional coding or review needed.

Main Takeaways

- **Efficiency**: AI reduced the time required for generating requirements and design documents.
- **Accuracy**: Documents were approved in the first iteration.
- **Human Oversight**: Crucial for ensuring the quality and appropriateness of the AI-generated content.
- **Resource Management**: Enabled more efficient allocation of resources.
- **Tools Used**: ChatGPT showcased the capability of AI to handle complex tasks effectively.

The case study demonstrates the potential of Generative AI to improve project efficiency by automating document generation and reducing manual effort. The balance between AI efficiency and human validation is key to achieving optimal results.

5.9.3 Main Takeaways combining both the observations

- **Efficiency Gains**:
  - Generative AI tools significantly reduced the time required for generating requirements and design documents in both projects. The actual efforts were consistently lower than the estimates, showcasing substantial efficiency improvements.
- **Accuracy and Quality**:
  - The documents generated by AI were approved in the first iteration in both case studies, indicating high accuracy and meeting quality standards without needing multiple revisions.
- **Human Oversight**:

- Despite the efficiency gains from AI, human oversight played a critical role in ensuring the accuracy and appropriateness of the generated content. Review processes were necessary to validate AI outputs.

- **Resource Management**:
  - The reduction in time for generating documents allowed for more efficient allocation of resources, enabling team members to focus on other critical aspects of the projects.
- **Tools Used**:
  - ChatGPT was effectively used in both projects to handle complex tasks like requirements and design generation, demonstrating the capability of AI tools to enhance productivity.

5.9.4 Summary

The case studies of "Talking Tourist" and "Waiter Calling App" illustrate the transformative impact of Generative AI on project workflows. By automating document generation and reducing manual effort, AI tools can enhance efficiency, accuracy, and resource management. However, the critical role of human oversight in reviewing and validating AI-generated content is essential to maintaining quality and ensuring successful project outcomes. This balanced approach between AI efficiency and human expertise can lead to more streamlined and effective project development practices.

Both the case studies show a significant improvement in preparing the first MVP for the proposed concept in multiple ways. Considering, lack of awareness on Ux, lack of intent to use Gen AI can be resolved by understanding the results of the case studies through benefit in the effort and subsequent cost. The case study also shows that the required iterations with OpenAI is minimal if

it has clear prompts, saving the cost on the model usage. It is significant to note that the case study was done with the free tier limits of all the services. This can be different when in actual production, but the scope of this research is only for the development cycle. Using the GenAI output also reduces the lack of communication as the approved output of one stage automatically helps in building the deliverables for the next.

CHAPTER VI:
SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

6.1 Research

The intent of the research was to understand the current state of practice of Generative AI and User Experience in software development. This is a major area of focus with close to USD 77 billion combined market of Ux and Gen AI that is set to grow at exponential speed. Identification of the advantages and limitations of combining the two technology is critical. The research was focused on identifying existing state of affairs, impediments in the integration, proposing a new model from the learnings and validating it.

The study of the existing literature revealed that the Generative AI and User Experience have been explored independently as integration feature for software development. Hence the current research to combine all the three together and understand the impact will be a new attempt to explore the combined integration of all the three. The research primarily covered data collection through a survey from the industry practitioners on their current state of Ux and Gen AI usage, and their readiness for the future. The responses were part qualitative and quantitative, which was analyzed across different categories. Based on the responses, it was identified that the major blockers for Ux integration was – Lack of communication and awareness. Similarly, the Gen AI integration identified lack of intent of intent and cost as major integration bottlenecks. Combining the learning, it is identifiable that lack of awareness, lack of communication and lack of intent needs to be addressed together for integrating the Ux and GenAI together in the software development cycle.

6.2 Summary

The most obvious solution for the roadblocks is educating stakeholders about the advantages of integrating User Experience, Generative AI in the development lifecycle. The

proposed model and its case study is the next step to highlight the effectiveness of integration. The model proposed a stream of input and output from each stage of the cycle, with clear metrics. The human element is still available through approvals. This approach was validated through case study. This was tried for two different app developments to verify the consistency.

6.3 Implications

Both the cases showed that there is a marked improvement in using ChatGPT to start the requirement and design. There was more than 60% improvement in the time required for building the first workable product. It was clear that usage of the usage of Generative technology allows in bootstrapping the project. The inclusion of the prompts with Ux related requirements, covered most of them in subsequent stages.

6.4 Limitations

One of the learnings from the case study is that the customization after the bootstrap will need higher level of expertise. While the bootstrapped setup will help the beginners to have a head-start, customization will require expertise. The current research did not explore the development beyond the most viable product level, and hence leaves it open for further research.

6.5 Recommendations for Future Research

While the data collected enable identification of the new model and case study corroborates with the basic expectation of the proposed model. The observations from the case study open up new areas of exploration. This can be proposed as new lifecycle model and be evaluated in depth to understand the feasibility and impediments in this model. Also, the impact of the customization in this model is also another open area for research.

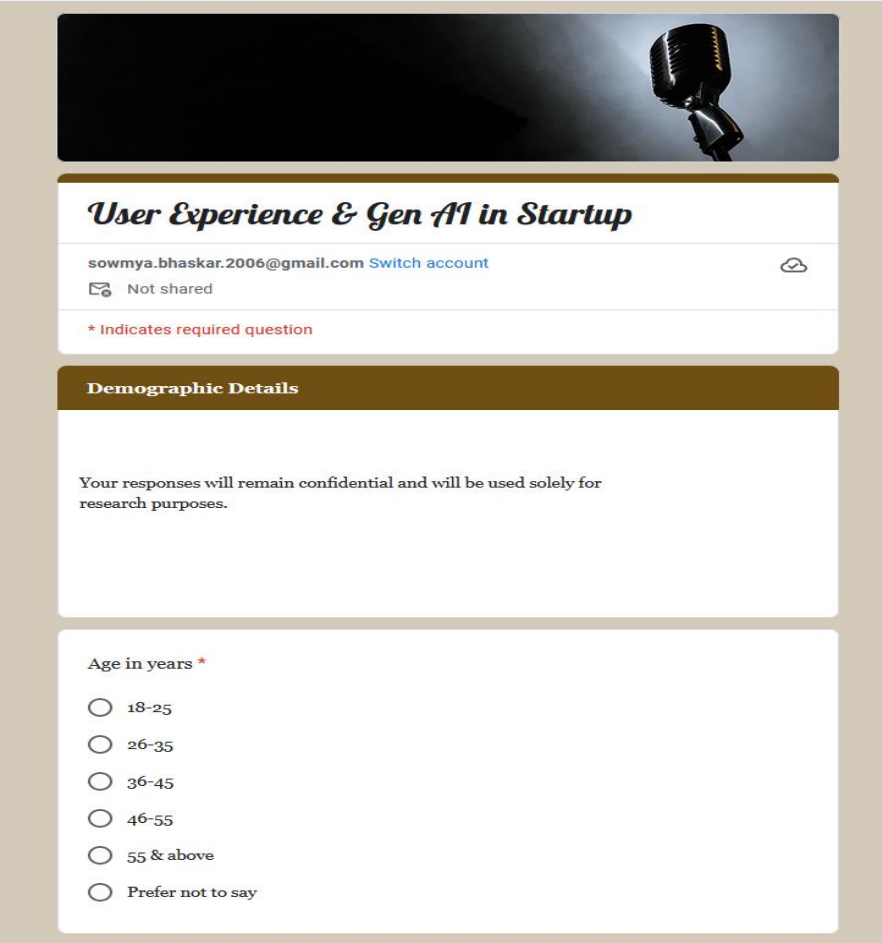
6.6 Conclusion

This research derives that adopting Generative AI is a positive impact in improving the software lifecycle. The data collected through survey and the case study implementation also affirms with the derivations of the research. The effort of documentation and verification is reduced as a part of the use of Generative AI.

APPENDIX A

SURVEY COVER LETTER

Following is the survey that was shared with different users through LinkedIn and direct messages. Actual link - https://forms.gle/rAAoDHvD54ZVopEx6



Sex *

- (●) Male
- ( ) Female
- ( ) Prefer not to say

Nationality

Your answer

Role in the current/last worked company *

- ( ) Product Owner
- ( ) Software developer
- ( ) Ux Designer
- ( ) Middle Management
- ( ) Senior Management
- (●) CXO
- ( ) Other: _____

Age of your Company

- ○ 0-2 years
- ○ 2-5 years
- ◉ 5-10 years
- ○ 10 years and above

Clear selection

What is your company size *

- ○ 0-50 members
- ○ 50-100 members
- ○ 100-200 members
- ○ 200-1000 members
- ○ 1000 & above members

Product User Base *

- ○ < 1000 users
- ○ 1000 - 5000 users
- ○ 5k - 15k users
- ○ 15k - 50 k users
- ○ 50k - 1Million users
- ○ 1 Million & above

User Experience in your company

Understanding the state of User Experience and Software Development in the company

Software Development Life Cycle followed in your company *

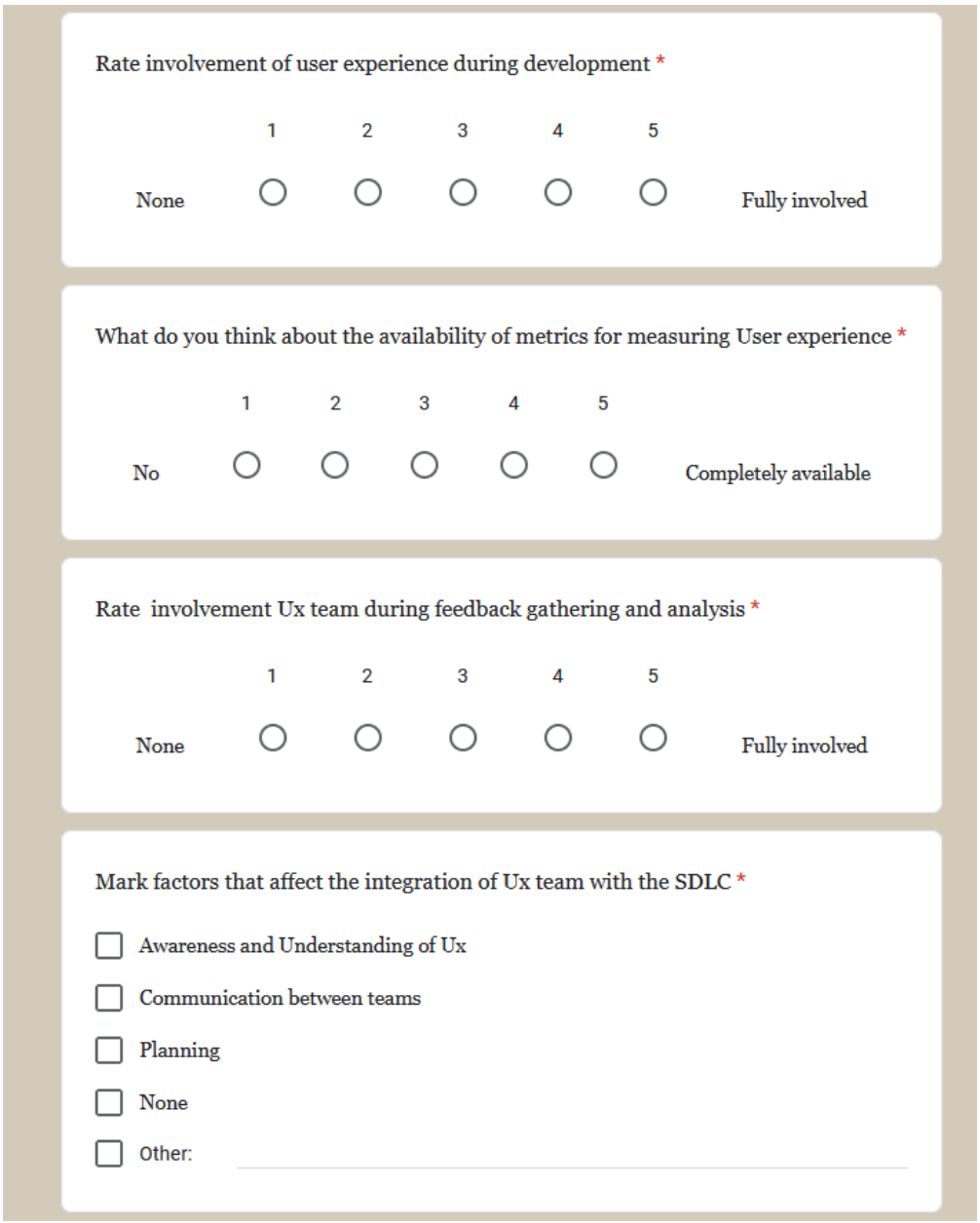
- ○ Scrum
- ○ Kanban
- ○ Lean
- ○ None
- ○ Other: _____

Select the phases of product development where User Experience is integrated *

- ☐ Requirement Gathering
- ☐ Design and Development
- ☐ Testing
- ☐ Feedback and analysis
- ☐ None
- ☐ Other: _____

Rate the involvement of user experience during requirement gathering *

	1	2	3	4	5	
None	○	○	○	○	○	Fully Involved



Generative AI in your company

Understanding the usage of Generative AI in the company

Rate the level of usage of Generative AI in your company *

	1	2	3	4	5	
None	○	○	○	○	○	Fully involved

Generative AI is used in *

- ☐ Requirements Collection
- ☐ Design
- ☐ Development
- ☐ Testing
- ☐ Marketing
- ☐ Analytics
- ☐ Other: _____

Rate the current level of usage for Generative AI in Requirements Gathering *

	1	2	3	4	5	
None	○	○	○	○	○	Fully used

Rate the current level of usage for Generative AI in Ux Design and Development *

	1	2	3	4	5	
None	○	○	○	○	○	Fully used

Rate the level of usage of Generative AI in FUTURE User Experience Design *

	1	2	3	4	5	
None	○	○	○	○	○	Fully used

Rate the readiness for the use of Generative AI in other areas *

	1	2	3	4	5	
None	○	○	○	○	○	Fully Ready

Roadblocks for the use of Generative AI in User Experience Design *

- ☐ Infrastructure
- ☐ Cost
- ☐ Lack of skill
- ☐ Product design
- ☐ Lack of intent
- ☐ Other: _____

APPENDIX II – SURVEY RESPONSE

Details of the responses to the survey are summarized below.

```
Data columns (total 27 columns):
 #   Column                                                                    Non-Null Count  Dtype  
---  ------                                                                    --------------  -----  
 0   Timestamp                                                                 36 non-null     object 
 1   Age in years                                                              36 non-null     object 
 2   Sex                                                                       36 non-null     object 
 3   Nationality                                                               34 non-null     object 
 4   Role in the current/last worked company                                   36 non-null     object 
 5   What is your company size                                                 36 non-null     object 
 6   Product User Base                                                         36 non-null     object 
 7   Software Development Life Cycle followed in your company                  31 non-null     object 
 8   What do you think about the availability of metrics for measuring User experience  36 non-null  int64  
 9   Select the phases of product development where User Experience is integrated  36 non-null  object 
 10  Rate the involvement of user experience during requirement gathering      36 non-null     int64  
 11  Rate involvement of user experience during development                    36 non-null     int64  
 12  Rate  involvement Ux team during feedback gathering and analysis          36 non-null     int64  
 13  Rate the level of usage of Generative AI in your company                  36 non-null     int64  
 14  Rate the level of usage of Generative AI in FUTURE User Experience Design  36 non-null  int64  
 15  Rate the readiness for the use of Generative AI in other areas            36 non-null     int64  
 16  Rate the current level of usage for Generative AI in Requirements Gathering  36 non-null  int64  
 17  Mark factors that affect the integration of Ux team with the SDLC         35 non-null     object 
 18  Generative AI is used in                                                  35 non-null     object 
 19  Rate the current level of usage for Generative AI in Ux Design and Development  36 non-null  int64  
 20  Roadblocks for the use of Generative AI in User Experience Design         34 non-null     object 
 21  Age of your Company                                                       36 non-null     object 
 22  Mention the tools used for UX development in your company (use comma to separate multiple tools)  32 non-null  object 
 23  Mention the type of Generative AI tools used (separated by comma)         31 non-null     object 
 24  Roadblocks for the use of Generative AI in other areas                    35 non-null     object 
 25  Type of GenAI Tools Used                                                  24 non-null     object 
 26  Is UX used in Requirement                                                 0 non-null      float64
dtypes: float64(1), int64(9), object(17)
```

APPENDIX III – CASE STUDY: TALKING TOURIST APPLICATION – CHATGPT RESPONSE

Objective: To analyze the efforts taken and improvements observed in the development of the Talking Tourist App, emphasizing the integration of generative AI tools to enhance productivity and efficiency.

Project Overview:

The Talking Tourist App is an Android application that allows users to log in via QR code, view their current location on a map, see nearby tourist places pinned, and access information about those places through reading or audio options. Summary of the details collected during case study is as below.

Source	**Output**	**Estimate in hours**		Actual		
		Story points	Estimate in hours	**Prompts used**	Coding in Hours	Review in hours
Requirements are generated with Gen AI	Req Doc	2	8	Generate requirement document for an application which will allow the user to login based on a QR code. The logged in user sees the current location map. The nearby tourist places are highlighted and pinned. On clicking the pin, the user gets an option to read (with a book icon) or hear (with an ear icon). On clicking the book - it shows the summary of the place from Wikipedia in a new page, with back	1	1

				option to go back to the app. on clicking the ear, it reads out the summary from the Wikipedia with pause, play and stop options.		
Design is Generated with Gen AI	Design Document	1	4	Requirement Document Prompt to generate Arch diagram from first version of Design Prompt to generate Dataflow diagram from Design doc - ChatGPT Figma to generate screenshots using the Design document.	1	1
UX Design from Design		0	0	Design Document + Review comments	0	
Development code is generated with Gen AI	GitHub	8	32	ChatGPT Prompt - Code for the above	5	1
Test cases are generated with Gen AI	GitHub	8	32	generate tests for the above functionality How to test accessibility for Mobile App generator	1	1
Deployment setup is generated with Gen AI	Google Play	5	20	How to deploy this application in Google Play store	2	

Key Development Stages and Efforts:

Requirement Generation:

- **Task:** Create a document outlining the requirements for the app.

- **Tools Used:** ChatGPT
- **Prompt Used:** "Generate requirement document for an application which will allow the user to login based on a QR code. The logged-in user sees the current location map. The nearby tourist places are highlighted and pinned. On clicking the pin, the user gets an option to read (with a book icon) or hear (with an ear icon). On clicking the book, it shows the summary of the place from Wikipedia in a new page, with a back option to go back to the app. On clicking the ear, it reads out the summary from Wikipedia with pause, play, and stop options."
- **Effort:**
  - Story Points: 2
  - Estimated Hours: 8
  - Actual Effort: 2 hours (1 hour for coding, 1 hour for review)
- **Final Output:** Requirement Document

Design Generation:

- **Task:** Develop the architecture and data flow diagrams, and create UX designs.
- **Tools Used:** ChatGPT, Figma
- **Prompts Used:**
  - "Generate Arch diagram from first version of Design"
  - "Generate Dataflow diagram from Design doc"
  - "Figma to generate screenshots using the Design document."
- **Effort:**
  - Story Points: 1
  - Estimated Hours: 4

        - Actual Effort: 2 hours (1 hour for coding, 1 hour for review)
    - **Final Output:** Design Document

UX Design:

- **Task:** Finalize UX designs and incorporate review comments.
- **Tools Used:** Figma
- **Effort:**
    - Story Points: 0
    - Estimated Hours: 0
    - Actual Effort: 0 hours
- **Final Output:** Design Document + Review comments

Development:

- **Task:** Code the application based on the designs.
- **Tools Used:** ChatGPT, Android Studio
- **Prompt Used:** "Generate React Native App for Small, Medium Mobile applications based on Kotlin. It should have a banner, with a tile view of 20 buttons arranged as 4 by 5 layout."
- **Effort:**
    - Story Points: 8
    - Estimated Hours: 32
    - Actual Effort: 5 hours (for coding)
- **Final Output:** GitHub Repository

Testing:

- **Task:** Generate test cases and ensure accessibility for the mobile app.
- **Tools Used:** ChatGPT
- **Prompt Used:** "Generate tests for the above functionality. How to test accessibility for Mobile App generator."
- **Effort:**
  - Story Points: 8
  - Estimated Hours: 32
  - Actual Effort: 1 hour (for testing)

Deployment:

- **Task:** Set up the deployment environment on Google Play Store.
- **Tools Used:** Google Play Store
- **Prompt Used:** "How to deploy this application in Google Play store."
- **Effort:**
  - Story Points: 5
  - Estimated Hours: 20
  - Actual Effort: 2 hours (for deployment)

Evaluation Analysis:

- **Task:** Conduct evaluation analysis of the project.
- **Effort:**
  - Story Points: Not provided
  - Estimated Hours: Not provided
  - Actual Effort: Not provided
- **Final Output:** Evaluation analysis generated by Supriya

5.9.4.1 Effort Improvement Analysis:

- **Total Estimated Effort:** 96 hours (12 days)
- **Actual Effort:** 12 hours

The integration of generative AI tools like ChatGPT and Figma led to significant time savings across various stages of the project. The automation of requirement generation, design creation, code development, and test case generation reduced manual effort and accelerated the development cycle. These improvements highlight the potential of AI tools in enhancing productivity and efficiency in software development projects.

Conclusion:

The Talking Tourist App development project demonstrates the effectiveness of leveraging generative AI tools to improve effort estimation and actual productivity. The use of these tools not only reduced the overall development time but also ensured higher quality and consistency in the output. This case study serves as a testament to the benefits of incorporating AI-driven solutions in software development processes.

References:

- Requirement Document
- Design Document
- GitHub Repository

APPENDIX IV: CASE STUDY OF WAITER CALLING APPLICATION – CHATGPT RESPONSE

Project Overview:

The Waiter Calling App is an Android application designed to display notifications for table calls in a restaurant. The notifications can be canceled, and the app tracks the time between when the notification appears and when it is acknowledged.

			Regular Estimate		**Actual Effort**			
Tasks	**Prompt**	**Output**	**Story points**	**Estimate in hours**	**Setup effort hours**	**Coding effort in hours**	**Review in hours**	**Gen AI tools**
Requirements are generated with Gen AI	We need an android application which can show the notifications about hte list of tables where call has been made. The Notification should be cancelable. There should be a track of time between when the notification came	Requirements Document V1	3	12	1	1	1	ChatGPT

	up till it is acknowledged.							
Design is Generated with Gen AI	Requirement Document Prompt to generate Arch diagram from first version of Design Prompt to generate Dataflow diagram from Design doc - ChatGPT Figma to generate screenshots using the Design document.	Design Document for Notification Tracking Android Application	2	8	1	1	2	ChatGPT Figma
UX Design from Design	Design Document + Review comments	Figma Link	2	8	5	2	2	Figma
Development code is generated with Gen AI	ChatGPT Prompt - "Generate React Native App for Small, Medium Mobile applications based on Kotlin. It should have a banner, with a tile view of 20 buttons	GitHub	8	32	6			Android Studio Amplify

	arranged as 4 by 5 layout"							
Test cases are generated with Gen AI	generate tests for the above functionality How to test accessibility for Mobile App generator	GitHub	8	32	1			ChatGPT
Deployment setup is generated with Gen AI		AWS	5	20	2			AWS
Evaluation analysis is generated								

Key Development Stages and Efforts:

Requirement Generation:

- Task: Create a document outlining the requirements for the app.
- Tools Used: ChatGPT
- Prompt Used: "We need an android application which can show the notifications about the list of tables where call has been made. The Notification should be cancelable. There should be a track of time between when the notification came up till it is acknowledged."
- Effort:
    - Story Points: 3
    - Estima ted Hours: 12

- Actual Effort: 3 hours (1 hour for setup, 1 hour for coding, 1 hour for review)

- Observations: The use of ChatGPT significantly reduced the time needed to generate a comprehensive requirements document.

Design Generation:

- Task: Develop the architecture and data flow diagrams, and create UX designs.
- Tools Used: ChatGPT, Figma
- Prompts Used:
  - "Generate Arch diagram from first version of Design"
  - "Generate Dataflow diagram from Design doc"
  - "Figma to generate screenshots using the Design document."
- Effort:
  - Story Points: 2
  - Estimated Hours: 8
  - Actual Effort: 4 hours (1 hour for setup, 1 hour for coding, 2 hours for review)
- Observations: Generative AI tools like ChatGPT and Figma facilitated quick creation and iteration of design documents, streamlining the design process.

UX Design:

- Task: Finalize UX designs and incorporate review comments.
- Tools Used: Figma
- Effort:
  - Story Points: 2
  - Estimated Hours: 8
  - Actual Effort: 9 hours (5 hours for setup, 2 hours for coding, 2 hours for review)

- Observations: Using Figma for UX design allowed for efficient design reviews and iterations, improving the overall design quality.

Development:

- Task: Code the application based on the designs.
- Tools Used: ChatGPT, Android Studio, Amplify
- Prompt Used: "Generate React Native App for Small, Medium Mobile applications based on Kotlin. It should have a banner, with a tile view of 20 buttons arranged as 4 by 5 layout."
- Effort:
    - Story Points: 8
    - Estimated Hours: 32
    - Actual Effort: 6 hours (for coding)
- Observations: ChatGPT's ability to generate initial code snippets accelerated the development process, allowing developers to focus on refining and integrating the code.

Testing:

- Task: Generate test cases and ensure accessibility for the mobile app.
- Tools Used: ChatGPT
- Prompt Used: "Generate tests for the above functionality. How to test accessibility for Mobile App generator."
- Effort:
    - Story Points: 8
    - Estimated Hours: 32
    - Actual Effort: 1 hour (for testing)
- Observations: Automated test case generation using ChatGPT ensured comprehensive test coverage and saved significant manual effort.

Deployment:

Task: Set up the deployment environment on AWS.

Tools Used: AWS

- Effort:

- Story Points: 5
- Estimated Hours: 20
- Actual Effort: 2 hours (for deployment)

Observations: AWS provided a reliable and scalable deployment solution, reducing the time required for deployment setup.

Effort Improvement Analysis:

- Total Estimated Effort: 112 hours
- Actual Effort: 25 hours

The integration of generative AI tools like ChatGPT and Figma led to significant time savings across various stages of the project. The automation of requirement generation, design creation, code development, and test case generation reduced manual effort and accelerated the development cycle. These improvements highlight the potential of AI tools in enhancing productivity and efficiency in software development projects.

***Conclusion*:**

The Waiter Calling App development project demonstrates the effectiveness of leveraging generative AI tools to improve effort estimation and actual productivity. The use of these tools not only reduced the overall development time but also ensured higher quality and consistency in the output. This case study serves as a testament to the benefits of incorporating AI-driven solutions in software development processes.

APPENDIX VI – OUTPUT OF CASE STUDY

Following are the documents for the case study. The details are stored in the repository - https://github.com/DBA-Study-2024

iAssist – Waiter Calling Service:

Type	Reference
Requirement Document	Requirements Document V1
Figma Link	Captain Notification Design Files
Design Document	Design Document for Notification Tracking Android Application
Code Base	https://github.com/DBA-Study-2024/dba_case_study_waiter_calling_service

Talking Tourist:

All the documents here are available as a part of the GitHub Repository

Type	Reference Document
Requirement Document	Requirement Document for Tourist Information Application
Figma Link	Not Applicable
Design Document	Design Document for Tourist Information Application
Code Base	DBA-Study-2024/dba_case_study_tourist (github.com)

APPENDIX V – CODE FOR SURVEY DATA ANALYSIS

Implementation for the Data Analysis

```
#!/usr/bin/env python
# coding: utf-8


# # Code Implementation for the Survey analysis


# ## This is the actual implementation for the statistics that have been calculated from the survey



#Import
import pandas as pd
import seaborn as sns
import numpy as np
import matplotlib.pyplot as plt
from scipy import stats
from scipy.stats import chi2_contingency
from scipy.stats import ttest_ind
from scipy.stats import boxcox
import math
import research_utils
get_ipython().run_line_magic('matplotlib', 'inline')
sns.set(color_codes=True)
```

```
# #### Data upload


dataset = pd.read_csv("C:/Users/bpath/Downloads/Pandas/Ux Survey-Responses.csv")
ux_roadblock = 'Mark factors that affect the integration of Ux team with the SDLC'
ux_phase = 'Select the phases of product development where User Experience is integrated'
genai_roadblock ='Roadblocks for the use of Generative AI in User Experience Design '
genai_phase= 'Generative AI is used in'
prod_user = 'Product User Base'
age_company = 'Age of your Company'
company_size = 'What is your company size'
role='Role in the current/last worked company'
genType='Type of GenAI Tools Used'



agecols =["Age-Less than 2","Age-2-5 yrs","Age-5-10 yrs","Age-More than 10"]
prodcols = ["1 Million & above","50k - 1Million","50k - 1Million","5k - 15k users","1000 - 5000 users", '0 - 1000 users']
cosizecols = ["1000 & above members", "200-1000 members", "100-200 members", "50-100 members", "0-50 members" ]
uxrblkcols = ['Ux Roadblock-Communication', 'Ux Roadblock-Planning', 'Ux Roadblock-Capacity', 'Ux Roadblock-Awareness' ]
genairblkcols = ['GenAI Roadblock-Lack of Skill', 'GenAI Roadblock-Lack of intent', 'GenAI Roadblock-Infrastructure', 'GenAI Roadblock-Cost', 'GenAI Roadblock-Product' ]
```

```
rolecols = ['Management Role','QA Role', 'CxO Role', 'Product Role', 'Ux Designer Role',
'Developer Role']
uxcols = ['What do you think about the availability of metrics for measuring User
experience','Rate the involvement of user experience during requirement gathering', 'Rate
involvement of user experience during development']
uxsdlccols = ['Ux in Requirement', 'Ux in Design','Ux in Development', 'Ux in Testing']
genaicols = ['Rate the level of usage of Generative AI in your company','Rate the current level
of usage for Generative AI in Requirements Gathering', 'Rate the current level of usage for
Generative AI in Ux Design and Development']
genaisdlccols = ['GenAI in Requirement', 'GenAI in Design','GenAI in Development', 'GenAI in
Testing']
xaxis = 'Product User Base'
genTypeCols = ['TextGen','CodeGen', 'ImageGen','NoGen']
usageMatchCols = ['ReqUsage', 'DesignUsage', 'DevUsage', 'TestUsage']



# #### Data clean up



ds1 = dataset.copy()


ds1["Ux in Requirement"] =np.where(ds1[ux_phase].str.contains('Requirement') , 1, 0)
ds1["Ux in Design"] =np.where(ds1[ux_phase].str.contains('Design') , 1, 0)
ds1["Ux in Development"] =np.where(ds1[ux_phase].str.contains('Development') , 1, 0)
ds1["Ux in Testing"] =np.where(ds1[ux_phase].str.contains('Testing') , 1, 0)
ds1["Ux in Feedback"] =np.where(ds1[ux_phase].str.contains('Feedback') , 1, 0)
```

```
ds1["Ux Roadblock-Communication"]
=np.where(ds1[ux_roadblock].str.contains('Communication') , 1, 0)
ds1["Ux Roadblock-Planning"] =np.where(ds1[ux_roadblock].str.contains('Planning') , 1, 0)
ds1["Ux Roadblock-Capacity"] =np.where(ds1[ux_roadblock].str.contains('Capacity') , 1, 0)
ds1["Ux Roadblock-Awareness"] =np.where(ds1[ux_roadblock].str.contains('Awareness') , 1,
0)

ds1["GenAI Roadblock-Lack of Skill"] =np.where(ds1[genai_roadblock].str.contains('Lack of
Skill'), 1, 0)
ds1["GenAI Roadblock-Lack of intent"] =np.where(ds1[genai_roadblock].str.contains('Lack of
intent'), 1, 0)
ds1["GenAI Roadblock-Infrastructure"]
=np.where(ds1[genai_roadblock].str.contains('Infrastructure'), 1, 0)
ds1["GenAI Roadblock-Cost"] =np.where(ds1[genai_roadblock].str.contains('Cost'), 1, 0)
ds1["GenAI Roadblock-Product"] =np.where(ds1[genai_roadblock].str.contains('Product'), 1,
0)

ds1["GenAI in Requirement"] =np.where(ds1[genai_phase].str.contains('Requirement'), 1, 0)
ds1["GenAI in Design"] =np.where(ds1[genai_phase].str.contains('Design'), 1, 0)
ds1["GenAI in Development"] =np.where(ds1[genai_phase].str.contains('Development'), 1, 0)
ds1["GenAI in Testing"] =np.where(ds1[genai_phase].str.contains('Testing'), 1, 0)
ds1["GenAI in Analytics"] =np.where(ds1[genai_phase].str.contains('Analytics'), 1, 0)

ds1["Age-Less than 2"] =np.where(ds1[age_company].str.contains('0-2'), 1, 0)
ds1["Age-2-5 yrs"] =np.where(ds1[age_company].str.contains('2-5'), 1, 0)
```

```
ds1["Age-5-10 yrs"] =np.where(ds1[age_company].str.contains('5-10'), 1, 0)
ds1["Age-More than 10"] =np.where(ds1[age_company].str.contains('10 years and' ), 1, 0)

ds1["50k - 1Million"] = np.where(ds1[prod_user].str.contains('50k - 1Million'),1,0 )
ds1["1 Million & above"] = np.where(ds1[prod_user].str.contains('1 Million & above'),1,0 )
ds1["50k - 1Million"] = np.where( ds1[prod_user].str.contains('50k - 1Million'),1,0 )
ds1["5k - 15k users"] = np.where(  ds1[prod_user].str.contains('5k - 15k users'),1,0 )
ds1["1000 - 5000 users"] = np.where( ds1[prod_user].str.contains('1000 - 5000 users'),1,0 )
ds1["0 - 1000 users"] = np.where( ds1[prod_user].str.contains('< 1000'),1,0 )

ds1["1000 & above members"] = np.where('1000 & above members' in ds1[company_size],1,0 )
ds1["200-1000 members"] = np.where('200-1000 members' in ds1[company_size],1,0 )
ds1["100-200 members"] = np.where('100-200 members' in ds1[company_size],1,0 )
ds1["0-50 members"] = np.where('0-50 members' in ds1[company_size],1,0 )
ds1["50-100 members"] = np.where('50-100 members' in ds1[company_size],1,0 )

ds1["Management Role"] = np.where(ds1[role].str.contains('Management'),1,0 )
ds1[role].replace(['SDET','Qa'],'QA')
ds1["QA Role"] = np.where((ds1[role].str.contains('QA')),1,0 )
ds1["CxO Role"] = np.where(ds1[role].str.contains('CXO'),1,0 )
ds1["Product Role"] = np.where(ds1[role].str.contains('Product'),1,0 )
ds1["Ux Designer Role"] = np.where(ds1[role].str.contains('Ux Designer'),1,0 )
ds1["Developer Role"] = np.where(ds1[role].str.contains('Developer'),1,0 )

ds1["TextGen"] = np.where(ds1[genType].str.contains('Text') |
ds1[genType].str.contains('All'),1,0 )
```

```
ds1["CodeGen"] = np.where((ds1[genType].str.contains('Code') |
ds1[genType].str.contains('All')),1,0 )
ds1["ImageGen"] = np.where(ds1[genType].str.contains('Image') |
ds1[genType].str.contains('All'),1,0 )
ds1["NoGen"] = np.where(ds1[genType].str.contains('None'),1,0 )



ds1['ReqUsage'] = np.where(ds1['Ux in Requirement'] == ds1['GenAI in Requirement'], 1, 0)
ds1['DesignUsage'] = np.where(ds1['Ux in Design'] == ds1['GenAI in Design'], 1, 0)
ds1['DevUsage'] = np.where(ds1['Ux in Development'] == ds1['GenAI in Development'], 1, 0)
ds1['TestUsage'] = np.where(ds1['Ux in Testing'] == ds1['GenAI in Testing'], 1, 0)




ds1.fillna(0,inplace=True)


ds0 = ds1.copy()


ds2 = ds1.copy()
# ds2.drop( ['Timestamp','Role in the current/last worked company','What is your company
size','Sex', 'Software Development Life Cycle followed in your company', 'Age in
years','Nationality', 'Product User Base', 'Mark factors that affect the integration of Ux team
with the SDLC', 'Select the phases of product development where User Experience is
integrated','Age of your Company', 'Generative AI is used in', 'Roadblocks for the use of
Generative AI in User Experience Design '], axis = 1, inplace=True)
```

```
ds2.drop( ['Timestamp','Role in the current/last worked company','What is your company size','Sex', 'Software Development Life Cycle followed in your company', 'Age in years','Nationality', 'Mark factors that affect the integration of Ux team with the SDLC', 'Select the phases of product development where User Experience is integrated','Age of your Company', 'Generative AI is used in', 'Roadblocks for the use of Generative AI in User Experience Design '], axis = 1, inplace=True)
ds2.drop([ 'Mention the tools used for UX development in your company (use comma to separate multiple tools)','Mention the type of Generative AI tools used (separated by comma)', 'Roadblocks for the use of Generative AI in other areas ','Type of GenAI Tools Used'], axis = 1, inplace=True)



ds2.describe()



# ## MARGIN OF ERROR CALCULATION
#
#
#    M.O.E.= z × sd / √(n)
#
#    where,
#    z denotes the z-index
#    n is the sample size
#    sd is the population standard deviation
#  #### 95% confidence - Z-score 1.96
#  #### 90% 1.645*
```

```
# ### REQ -0 - Profile Information



from scipy.stats import yeojohnson

dd = ds1

sns.kdeplot(dd[age_company].value_counts())
sns.kdeplot(dd[prod_user].value_counts())
sns.kdeplot(dd[company_size].value_counts())
sns.kdeplot(dd[role].value_counts())
print(age_company)
seriesError(dd[age_company])
print(prod_user)
seriesError(dd[prod_user])



# ### Observation
# 1. The Categories to analyse the input are roles, age of the company, product user base and
the size of the company.
# 2. The responses these fields are normally distributed for all the values in the specific column.
# 3. This adds to the confidence of the data used.

# ### REQ -1 - Understand the extent of User Experience Development in Startups
```

```
# Generating samples with UX Columns
# plotsample(ds2[uxcols])
plotDiagrams (uxcols, uxsdlccols)


groupedRoadBlocks(company_size, uxrblkcols)
groupedRoadBlocks(prod_user, uxrblkcols)
groupedRoadBlocks(age_company, uxrblkcols)


# ### REQ-2 Understand the extent of current adoption of Generative AI

# plotsample(ds2[genaicols]/)
plotDiagrams(genaicols, genaisdlccols)


# ### Observations
# 1. Use of GenAI  in development is identified higher.
# 2. Use of GenAI in development is almost on par with requirements.
# 3. Distribution of GenAI cols is same across multiple samples.
# 4. The distribution of GenAI in requirement follows the same as development.

# ### REQ-3  Understand the roadblocks for adopting  Ux in SDLC

groupedRoadBlocks(company_size, uxrblkcols)
```

```
groupedRoadBlocks(prod_user, uxrblkcols)

groupedRoadBlocks(age_company, uxrblkcols)



# #### Roadblocks for UX

# 1. Use of Ux in requirement gathering is identified higher.

# 2. Use of Ux in development is good but not higher than requirements.

# 3. Distribution of Ux Cols is uniform across multiple samples.

# 4. The distribution of Ux in requirement follows the same as overall Ux distribution.


# ### REQ-4 Understand the roadblocks for adopting GenAI in SDLC


# ### Observations

# 1. Gen AI Roadblocks and Ux Roadblocks is also positively dependent on Lack of skill,

Infrastructure, cost.

# 2. Ux Roadblock due to Capacity is also positively dependent on the Lack of GenAI Skill



groupedRoadBlocks(company_size, genairblkcols)

groupedRoadBlocks(prod_user, genairblkcols)

groupedRoadBlocks(age_company, genairblkcols)



plotDiagrams(uxcols, usageMatchCols)
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