Improving SCA Tool through User-Centered Design and Prototyping

MASTER THESIS

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Declaration of Originality

I confirm that the submitted thesis is original work and was written by me without further assistance. Appropriate credit has been given where reference has been made to the work of others. The thesis was not examined before, nor has it been published. The submitted electronic version of the thesis matches the printed version.

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Abstract

This thesis focuses on improving the user experience (UX) and workflows of SCA Tool by employing a user-centered design (UCD) methodology. As open-source software (OSS) becomes more prevalent in software development, tools like SCA Tool are critical for managing OSS security and compliance. Through a detailed UX research process, including interviews and persona development, this thesis identifies key user needs and proposes improvements to streamline workflows and enhance usability. By developing personas such as "The Skilled Adopter" and mapping their user journey, the study provides actionable insights for refining the tool's interface and functionality. The enhancements aim to increase adoption, satisfaction, and workflow efficiency, contributing to a more intuitive and effective SCA Tool.

Contents

List of Figures

Acronyms

OSS Open Source Software

SBOM Software Bill of Materials

SCA Software Composition Analysis

UX User Experience

UI User Interface

CLI Command-Line Interface

CI Continuous Integration

HCI Human-Computer Interaction

UCD User-Centered Design

ORT Open Source Software Review Toolkit

1 Introduction

1.1 Background

In today's software development landscape, open-source software (Open Source Software (OSS)) has become an integral part of many projects. The widespread adoption of OSS is driven by its numerous advantages, including cost savings, faster innovation cycles, and the ability to tap into a large and diverse community of contributors. However, the use of OSS also introduces several challenges, especially in areas such as security, compliance, and license management. Organizations are often tasked with ensuring that the software components they use comply with legal and regulatory requirements while maintaining the integrity and security of their systems.

To address these challenges, specialized tools like SCA Tool have emerged. These tools enable organizations to identify and manage OSS components within their codebases, track associated licenses, detect vulnerabilities, and ensure compliance with internal and external policies. Despite its powerful capabilities, SCA Tool faces certain usability challenges, which can impact its overall effectiveness for diverse user groups.

1.2 Problem Statement

While SCA Tool is effective for managing OSS components, its user experience (User Experience (UX)) can sometimes fall short of fully meeting the needs of diverse user groups. Users such as developers, project managers, and legal experts have distinct needs and levels of expertise. A tool designed to support these users must not only provide robust technical functionality but also deliver an intuitive and accessible user experience. Addressing these UX challenges is key to maximizing the effectiveness and adoption of SCA Tool.

1.3 Objectives

The primary objective of this thesis is to enhance the user experience of the existing SCA Tool by adopting a user-centered design (User-Centered Design (UCD)) approach. This involves:

1. Conducting user research to understand the needs, goals, and pain points of different user personas.
2. Designing and prototyping improved workflows and interfaces based on the insights gathered.
3. Evaluating the prototypes to validate the effectiveness of the proposed improvements.
4. Documenting the findings and providing recommendations for implementing the enhanced UX in SCA Tool.

1.4 Research Questions

This thesis seeks to answer the following research questions:

- What are the main usability challenges faced by users of SCA Tool?
- How can a user-centered design approach improve the user experience of an SCA Tool?
- How do the proposed UX improvements impact the efficiency and satisfaction of users?

1.5 Methodology

To achieve the objectives, this research follows a structured methodology comprising the following steps:

1. **Literature Review:** Reviewing existing research on UX design, SCA Tools, and best practices in OSS management.
2. **User Research:** Conducting surveys with potential users to gather qualitative and quantitative data on their experiences, expectations, and challenges.
3. **Persona Development:** Creating detailed user personas based on the data collected to guide the design process.
4. **Prototyping:** Developing prototypes of the improved UX for SCA Tool.

5. **Usability Testing:** Evaluating the prototypes to detail benefits and drawbacks.
6. **Analysis and Documentation:** Analyzing the results and provide recommendations for implementing the improvements in SCA Tool.

1.6 Significance of the Study

This research contributes to the fields of UX design and software management by demonstrating how user-centered design can be applied to improve the usability of technical tools like SCA Tool. The findings and recommendations can help organizations reduce the cognitive load on their teams, and increase the adoption and effectiveness of SCA Tool.

2 Motivation

Introduction

In the rapidly evolving landscape of software development, the use of open-source software (OSS) has become a widespread practice due to its cost-effectiveness, flexibility, and community-driven innovation. However, integrating OSS into products and projects brings significant challenges, particularly around security, compliance, and managing the complexity of licenses. These challenges necessitate tools that can effectively manage OSS usage while ensuring safety and compliance. SCA (Software Composition Analysis) Tool is one such solution, designed to help organizations manage their use of open-source components efficiently. Despite its powerful capabilities, the current user experience (UX) and workflows within SCA Tool have room for improvement, particularly in making the tool more intuitive, accessible, and aligned with the needs of its users.

The Need for Enhanced User Experience

The success of any software tool heavily depends on its usability and the user satisfaction it delivers. For SCA Tool, improving UX is not just about making the interface more visually appealing but about enhancing the entire user journey—from initial engagement to daily usage—ensuring that the tool meets users' expectations and needs efficiently. Users of SCA Tool often include developers, project managers, and legal experts, each with distinct goals and challenges. A tool that does not cater effectively to these varied personas risks becoming underutilized, despite its technical capabilities.

Rationale for a User-Centered Design Approach

To address the challenges in UX, a user-centered design (UCD) approach is proposed. UCD is a design philosophy and process that places the user at the center of the development process, ensuring that the final product meets the actual

needs of its users rather than the assumed needs. By conducting thorough user research, including surveys and persona development, SCA Tool can be tailored to provide a seamless, efficient, and enjoyable user experience. This approach is crucial for identifying and prioritizing features that genuinely benefit the users, thereby increasing adoption and satisfaction.

Objective of the Thesis

The primary objective of this thesis is to enhance the user experience and workflows of SCA Tool by employing a user-centered design methodology. This will involve conducting interviews with potential users to identify key user personas, selecting one persona to focus on, and documenting associated use cases and user journeys. By creating wireframes and prototypes, the thesis aims to visualize and test enhancements that address the identified needs. The ultimate goal is to implement these improvements in a way that aligns with the users' expectations, thereby making SCA Tool more effective and user-friendly.

Impact and Contributions

The expected outcome of this thesis is a set of practical, user-centered improvements to SCA Tool that can be directly implemented to enhance its UX. These enhancements will not only make the tool more accessible and enjoyable to use but will also contribute to more efficient workflows, reducing the cognitive load on users and helping them achieve their goals with greater ease. By documenting the process and findings, this thesis will also provide valuable insights into the application of user-centered design principles in the context of software tools for managing open-source software, potentially serving as a reference for future projects in this domain.

Conclusion

The motivation behind this work stems from the critical need to improve the usability and effectiveness of tools that manage open-source software, such as SCA Tool. By adopting a user-centered design approach, this thesis aims to deliver enhancements that not only meet the technical requirements but also resonate with the users' real-world needs, ultimately driving greater adoption and satisfaction.

3 Related Work

3.1 Historical Context and Evolution of Human-Computer Interaction (HCI)

Human-Computer Interaction (Human-Computer Interaction (HCI)) has a rich history marked by significant milestones that have shaped modern computing. According to Myers (1998), HCI research has been pivotal in the development of major interaction technologies. For instance, the graphical interface used by Microsoft Windows 95 can trace its lineage back to early research at Xerox PARC and Stanford Research Laboratory. This history underscores the importance of university research in advancing HCI technologies, which in turn have profoundly impacted commercial products. Myers' comprehensive review details how fundamental interaction styles, such as direct manipulation and the use of the mouse, evolved through decades of research supported by various funding sources (Myers, 1998).

Understanding the evolution of HCI is essential for this thesis as it highlights the necessity of creating intuitive and user-friendly tools, particularly for non-expert users like developers. As software development increasingly integrates tools for tasks such as Software Composition Analysis (SCA), ensuring these tools are accessible and easy to use becomes critical. The shift left paradigm, which moves processes like license compliance earlier in the supply chain to developers, further emphasizes the need for HCI principles in the design of such tools.

3.2 User Experience (UX) Research: Methods and Challenges

User Experience (UX) research has been critical in understanding how users interact with digital interfaces and services. Various methodologies have been employed to enhance UX, including both quantitative and qualitative approaches.

Surveys are one of the most widely used tools in UX research, offering a struc-

tured way to gather large amounts of data from users. According to Sauro and Lewis (Sauro & Lewis, 2012), well-designed surveys can capture a broad spectrum of user sentiments and behaviors, providing valuable quantitative insights. However, while surveys offer quantitative data, qualitative methods such as interviews, focus groups, and usability testing provide deep, contextual insights crucial for understanding the nuances of user experiences. Lazar et al. (Lazar et al., 2017) emphasize that qualitative data analysis can uncover hidden issues that quantitative methods might overlook, leading to more comprehensive UX improvements.

In the context of this thesis, the importance of UX research is particularly relevant when considering the design and implementation of SCA Tool. Given that the tool will often be used by developers rather than legal experts, understanding user needs and behaviors is critical for creating a tool that integrates smoothly into the development workflow. This makes UX research methodologies not just relevant but necessary to ensure that SCA Tool are both effective and user-friendly.

Recent research highlights the benefits of integrating quantitative surveys with qualitative data analysis. It was (Kaplan & Duchon, 1988) demonstrated that combining survey data with qualitative interviews led to a more nuanced understanding of user needs and preferences. However, integrating these methods presents challenges, such as the potential for data misalignment. Instead, the best approach is to use multiple research methods, so the limitations of one method are mitigated by data from another source. This approach of applying multiple research techniques is called triangulation (Nielsen Norman Group, 2021)

For this thesis, such integrated methods could provide deeper insights into how developers interact with SCA Tool, revealing potential pain points and areas for improvement that might not be evident through quantitative data alone.

3.3 UX Tools and Techniques: Usability Testing, User Stories, and User Journeys

Various UX tools and techniques play a significant role in improving user experience. Usability testing is a popular methodology where a researcher observes a participant's behavior as they perform tasks using a specific interface. This method provides direct insights into how real users interact with a product, revealing usability issues and areas for improvement (Nielsen Norman Group, 2019).

Understanding the difference between user stories and user journeys is essential for effective UX design. A user story is a concise description of a task from the user's perspective, focusing on specific users and their individual needs. In contrast, a user journey describes a series of steps that show how a typical user

interacts with the web app being designed, often including dynamic scenarios that apply to a broad range of users (Mathieu Allouche, 2022). Additionally, user journeys and user flows are both tools that capture how people accomplish goals with certain products or services. While user journeys describe a user's holistic experience across channels and over time, user flows zoom in to describe specific interactions that make up a common user pathway through a product (Nielsen Norman Group, 2023).

In the scope of this thesis, these UX techniques are particularly valuable for designing wireframes for SCA Tool that aligns with the shift left paradigm. By focusing on user stories and journeys, the design process can ensure that the tool meet the real needs of developers, integrating smoothly into their workflows without adding unnecessary complexity.

3.4 Personas in User Experience Design

Personas are a fundamental tool in user experience (UX) design, facilitating a user-centered design approach by embodying the characteristics, needs, and behaviors of a product's target audience. The concept of personas is rooted in the broader principle of user-centered design (UCD), which emphasizes designing products around the users rather than forcing users to adapt to the product. A well-crafted persona represents a fictional yet realistic archetype of the target user, created based on extensive user research. This approach allows designers to cultivate empathy for users and to make decisions that better reflect the needs and goals of real people (Nielsen Norman Group, 2015).

The use of personas is crucial for tailoring SCA Tool to the actual users—primarily developers rather than legal experts. By developing personas that accurately reflect the behaviors, needs, and challenges of developers, the tool's design can be optimized for usability and effectiveness, ensuring that it meets the demands of the shift left paradigm.

3.4.1 The Role and Importance of Personas

Personas serve as a bridge between user research and design implementation. By distilling research data into concrete, memorable characters, personas help product teams maintain a focus on the user throughout the design process. This focus ensures that the end product is not only functional but also aligned with the user's expectations and needs.

Personas are typically created early in the design process, as they help inform key design decisions from the outset. According to Nielsen Norman Group, personas should be based on real data derived from user research activities such as

interviews, surveys, and field studies. This ensures that the personas accurately reflect the behaviors, needs, and goals of actual users rather than hypothetical or idealized versions of users (Nielsen Norman Group, 2015).

3.4.2 Developing Effective Personas

The process of creating effective personas involves several critical steps. First, user research must be conducted to gather data on the target audience. This data is then analyzed to identify patterns and trends, which are used to define the characteristics of the personas. Key elements of a persona typically include the user's goals, pain points, behaviors, and relevant demographic information.

One of the significant challenges in persona development is avoiding bias. Traditional demographic information such as age, gender, and location can sometimes introduce biases that may skew the design process. Modern approaches to personas advocate for focusing on the user's goals, behaviors, and motivations rather than demographic stereotypes. This shift helps designers create more inclusive and effective products by concentrating on what users do and why they do it, rather than who they are demographically (Dahekar, 2023).

In the context of this thesis, avoiding bias in persona development is crucial. Since SCA Tool will be used by a diverse group of developers, focusing on behaviors and motivations rather than demographics will help in creating a tool that is universally accessible and user-friendly.

3.4.3 The Benefits of Using Personas

Personas offer several ongoing benefits throughout the UX design process:

- **Design Direction**: Personas provide clear guidance on what features and functionalities should be prioritized. By understanding the needs and pain points of the personas, designers can focus on developing solutions that will have the most significant impact on user satisfaction ('A Guide to User Personas in UX', n.d.).
- **Stakeholder Alignment**: Personas help ensure that all stakeholders—designers, developers, marketers, and business leaders—are aligned on who the target users are and what they need. This alignment reduces the risk of miscommunication and helps maintain a user-centered focus throughout the project ('A Guide to User Personas in UX', n.d.).
- **Empathy and Understanding**: Personas foster empathy within the design team by providing a human face to the user data. This empathy is crucial for creating designs that truly resonate with users and address their real-world challenges (Nielsen Norman Group, 2015).

- **Improved Usability Testing**: Personas can also be used to recruit participants for usability testing, ensuring that the test subjects closely match the target audience. This approach leads to more relevant and actionable feedback during the testing phase (Dahekar, 2023).

In this thesis, using personas will help ensure that SCA Tool is not only functional but also aligns closely with the actual needs and workflows of developers, thereby enhancing its effectiveness and adoption.

3.4.4 Challenges and Limitations of Personas

While personas are widely used in UX design, they are not without their criticisms. One of the main critiques is that personas can sometimes oversimplify the user base, leading to designs that cater to a narrow set of needs. Additionally, if personas are not regularly updated with fresh data, they can become outdated and less effective. To address these challenges, it is essential to treat personas as living documents that evolve based on ongoing research and user feedback

3.4.5 Conclusion

Personas are a powerful tool in the UX designer's toolkit, providing a user-centered framework for making design decisions. By creating detailed, research-based personas, design teams can ensure that their products are tailored to meet the real needs of their users, ultimately leading to better user experiences and greater product success. For SCA Tool, the use of personas helps identify and address the unique challenges faced by its diverse user base, enabling the design of more intuitive workflows and interfaces.

3.5 Best Practices in UX Design: Principles and Cognitive Load Considerations

Creating a good user experience involves following proven UX best practices. These practices are critical in building an e-commerce website or app that converts well. UX influences the entire customer journey, from the moment the user clicks on the homepage to the final order confirmation. Ignoring best practices can interfere with a seamless user experience and lead to lost sales. Consistently applying these principles can improve conversion rates and create a user experience that keeps visitors and customers returning ('The Best Practices and Key Principles of UX Design', n.d.).

Moreover, considering cognitive load in UX design is crucial. Cognitive load refers to the amount of mental resources required to operate a system. In UX, it is important to minimize cognitive load to ensure that users can efficiently

navigate a site without becoming overwhelmed (Nielsen Norman Group, 2013). Designers must understand and accommodate these cognitive limits to create effective and user-friendly interfaces.

3.6 Conclusion

The related work chapter highlights key principles and methodologies that inform this thesis. The historical evolution of Human-Computer Interaction (HCI) emphasizes the importance of intuitive design, particularly for tools like SCA Tool, which aim to simplify complex compliance processes. Insights from UX research, combining quantitative and qualitative methods, guided the creation of personas and user journeys, ensuring the tool addresses real user needs.

Additionally, best practices in UX design, such as minimizing cognitive load and adopting user-centered approaches, were integral to designing the proposed prototypes. These principles provided a strong foundation for enhancing the tool's usability and aligning it with the workflows of its diverse user base. The findings from this chapter support the thesis objective of improving SCA Tool's user experience.

4 Data Collection

This chapter outlines the methodology and procedures for data collection, focusing on user surveys. The survey was designed to gather both qualitative and quantitative data to better understand user behavior, preferences, and challenges. The following sections provide an overview of the survey design, participant sampling and data collection method.

4.1 Survey Overview

The survey was developed to capture insights from a diverse set of users regarding their experience with specific tasks and tools. It consisted of multiple sections, each targeting a specific aspect of the user journey, including demographic information, task performance, and satisfaction levels.

Key objectives of the survey included:

- Understanding user experience levels across open source management.
- Identifying common challenges faced during task execution.
- Evaluating the effectiveness of SCA Tool and its workflows.

The survey employed a mix of open-ended and closed-ended questions. While closed-ended questions provided quantifiable data, open-ended responses offered deeper qualitative insights into user experiences.

To ensure a comprehensive analysis participants were selected from various user groups, ensuring representation across different levels of experience and familiarity with the tool.

4.1.1 Demographics

The participant pool included:

- Users with varying experience levels, from beginners to advanced users of software management tools like SCA Tool.

- Users with diverse backgrounds in Software Bill of Materials (SBOM) (Software Bill of Materials) creation and legal compliance tasks.

4.2 Data Collection Methods

Two primary methods were used for data collection:

1. Surveys: The surveys were created using Google Forms and distributed via email.
2. Usability Testing: Unmoderated remote usability tests were conducted to allow users to perform specific tasks in their natural environment, without direct observation.

4.3 Data-Driven Insights

The following figures illustrate key aspects of the collected data, including user demographics, experience levels, and task-specific insights.

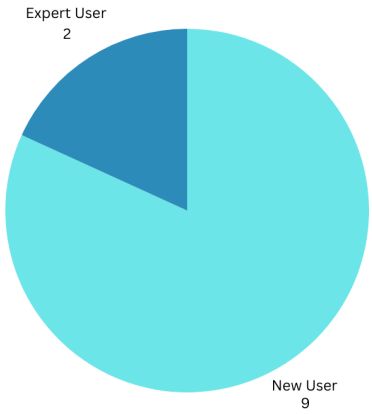

Figure 4.1: User Experience Levels

Data from the survey revealed that the majority of participants were new to using SCA Tool. This insight is particularly valuable for the thesis as it highlights the importance of understanding the unique needs and challenges faced by novice users. By identifying their requirements, the study can propose tailored features and workflows that enhance user onboarding and improve the overall user experience. Catering to new users also ensures broader adoption of the tool, fostering a more inclusive and user-friendly design.

Fig: 4.2 indicates that out of 9 participants, 3 indicated no previous experience creating a Software Bill of Materials (SBOM). Among those who had, SBOMs

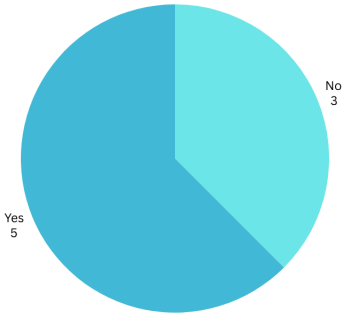

Figure 4.2: SBOM Creation Experience

were produced using tools like Open Source Software Review Toolkit (ORT) and FOSSology, while others relied on manual methods. This mix of manual and automated approaches highlights varying levels of experience and tool usage, suggesting a need for streamlined, user-friendly SBOM generation processes which users of different experience levels can easily adopt.

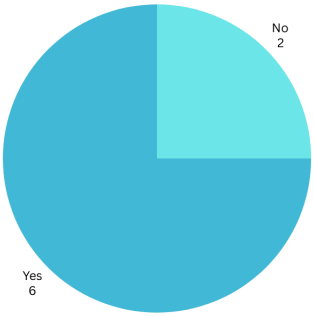

Figure 4.3: Third Party Legal Notices Experience

Among the eight participants referenced in Figure 4.3, experiences with creating Third-Party Legal Notices varied significantly. While some respondents had never engaged in this process, others utilized a combination of tools such as ORT, FOSSology, and ScanCode, supplemented by manual efforts. In more complex cases, participants often relied on legal teams for support, particularly when dealing with intricate dependency hierarchies. These findings highlight the critical need for more efficient tools and streamlined processes to ensure the accurate and compliant generation of legal notices across projects.

Participants expect SCA Tool to streamline and automate processes related to vulnerability management, license compliance, and third-party legal notice generation. Continuous Integration (CI) Key expectations include automating tasks such as generating licenses in CI pipelines and third-party legal notices via Command-Line Interface (CLI), improving software security and compliance, and providing a user-friendly interface to reduce manual errors. Additionally, users value features that enhance data security and make licensing more accessible, especially for newcomers and students. This feedback is crucial for my thesis as it highlights the core user needs and expectations, which will guide the design and development of a more intuitive and efficient UX for the tool, ensuring it aligns with user requirements and improves usability across various user groups.

First impressions of SCA Tool were mixed. While some participants appreciated its potential and found the idea of combining various functionalities appealing, others noted that the user interface could be more intuitive. For those who hadn't used the tool, the concept sounded promising, with expectations of user-friendliness and robustness for improving software security and license validation. Overall, the tool is seen as useful but with room for User Interface (UI) improvements to enhance the user experience.

Key factors influencing the adoption of a new product or solution in this space include ease of use, integration with CI pipelines, and pricing. Participants value automation, a streamlined workflow, and features like CLI support for SBOM creation and integration with existing build setups. Additionally, considerations such as data security, scan speed, and the availability of a free or affordable version play a crucial role. Overall, users seek a solution that is simple to adopt, efficient, and cost-effective.

Feedback on whether SCA Tool met initial expectations was mixed. Some users found it effective in addressing core needs like creating legal notices and identifying compliance issues, with one noting its simple and intuitive design. However, others highlighted areas for improvement, particularly in the user experience (e.g., unclear terminology and unintuitive workflows) and the time taken for scans. These insights point to a solid foundation in functionality but reveal opportunities for refining the UX and performance.

Users found the legal notices export, license notice generation, and the one-click solution to be the most useful features. These functionalities simplify critical tasks, highlighting the tool's strength in automation and ease of use for generating essential compliance documents.

Some users found certain aspects of SCA Tool challenging, particularly in setting a data source and creating new projects, which lacked clear guidance. Issues were also noted with the creation of Distribution Units, which was seen as unclear. A "Distribution Unit" is a grouping of code, that is intended to be distributed, and thus needs to be in compliance with the obligations of all licenses of any open source the distribution unit may depend on or include. Additionally, there was some uncertainty around the accuracy of results. Despite these challenges, one respondent found the tool overall intuitive. These insights highlight the need for clearer instructions and improved workflows.

The insights gathered about SCA Tool highlight a mix of strengths and areas for improvement. Users appreciate its core features, such as legal notices export and license generation, which streamline compliance processes. However, challenges related to user experience, such as unclear workflows for data sources, project creation, and distribution units, highlight opportunities for refinement. These insights emphasize the importance of understanding user needs and behaviors in depth. The next chapter, Personas, builds on these findings by exploring the different types of users, their goals, and their pain points to inform more user-centered design improvements for SCA Tool.

5 Personas

Effective user experience (UX) design begins with a deep understanding of the target audience. As discussed in Section 3.4, personas are a critical tool in UX design, providing a user-centered framework that helps design teams empathize with users and tailor products to their specific needs. Personas distill data from user research into fictional but realistic archetypes, capturing the goals, behaviors, and pain points of different user groups. This approach ensures that design decisions are grounded in actual user requirements rather than assumptions.

Building on the data collected in Chapter 4, this chapter presents the personas developed for SCA Tool. These personas were created through a combination of survey responses and usability testing, representing the diverse roles and experience levels of SCA Tool's user base. By focusing on these personas, the design process aims to address the unique challenges and workflows of each user group, ensuring that SCA Tool provides an intuitive and efficient user experience for developers, legal experts, and other stakeholders.

The Experienced Professional

Familiarity with SCA Tool: Expert

Role: Technically skilled professional, possibly a software developer or legal compliance expert.

Tasks and Responsibilities:

- Managing software projects.
- Ensuring OSS compliance.
- Producing vulnerability data.
- Creating third-party legal notices.

Skills and Tools: Proficient with tools like BlackDuck, FOSSology, DejaCode, ORT; experienced in automating compliance tasks and managing OSS vulnerabilities.

Expectations from SCA Tool:

- Streamlining and automating complex workflows, such as generating SBOMs and legal notices.
- Minimizing the time spent on manual tasks.
- Providing stability and reliability in compliance management.

Pain Points:

- High costs and setup overhead with existing tools.
- Unintuitive interfaces that require significant manual intervention.

Decision Factors: Ease of use, cost-effectiveness, workflow efficiency, and tool stability.

The Skilled Adopter

Familiarity with SCA Tool: New User

Role: Technically proficient professional or software developer, with strong technical skills and knowledge, but new to using SCA Tool.

Tasks and Responsibilities:

- Ensuring software security and compliance.
- Integrating OSS management into existing workflows.
- Creating SBOMs and legal notices.

Skills and Tools: Basic familiarity with GitHub's Dependabot, ScanCode, and manual compliance processes.

Expectations from SCA Tool:

- Automating the process of SBOM creation and third-party legal notice generation.
- Integrating smoothly with existing CI pipelines and development workflows.
- Providing a user-friendly interface that guides through the compliance process with minimal manual effort.

Pain Points:

- Only minimal tool support used so far. Much manual work.
- Limited knowledge in creating comprehensive SBOMs etc, leading to reliance on superficial management of first-level dependencies.

- Full transitive closure of dependencies often overlooked, increasing the risk of compliance and security gaps.

Decision Factors: Integration capabilities, automation features, ease of use, and pricing.

5.1 The Student Learner

Familiarity with SCA Tool: New User

Role: Student, possibly studying software engineering, focusing on learning about OSS compliance and software security.

Tasks and Responsibilities:

- Working on academic projects involving OSS.
- Ensuring compliance with OSS licenses.
- Understanding software vulnerabilities.

Skills and Tools: Limited experience with compliance tools; primarily using manual processes or basic tools in academic settings.

Expectations from SCA Tool:

- Simplifying the process of learning and applying OSS compliance and security practices.
- Offering a clear, intuitive interface that is accessible to users with limited experience.
- Providing educational resources or guides to help understand the compliance process.

Pain Points:

- Lack of accessible, affordable tools tailored for educational purposes.
- Complexity of existing tools and the difficulty in integrating them into academic projects.

Decision Factors: Educational accessibility, ease of use, and cost (preferably free or affordable for students).

5.2 Conclusion

The development of personas for SCA Tool, grounded in comprehensive user research, provided critical insights into the diverse needs and challenges of its user

base. By focusing on *The Experienced Professional*, *The Skilled Adopter*, and *The Student Learner*, this chapter demonstrated how user-centered design principles can inform more intuitive and efficient tool functionalities. These personas not only highlighted the unique workflows and pain points of each user group but also guided the design of tailored solutions to enhance the overall user experience.

Moving forward, these personas serve as a foundation for evaluating user journeys and interaction flows within SCA Tool. The next chapter, *User Journey*, builds upon this understanding by detailing the specific pathways *The Skilled Adopter* persona follows when interacting with the tool, providing a deeper analysis of their workflows and identifying opportunities for further UX improvements.

6 User Journey

For SCA Tool, the "Skilled Adopter" stands out as a pivotal persona, blending technical expertise in software development with a foundational understanding of open-source software (OSS) management. However, this user is relatively new to specialized tools like SCA Tool. As discussed in the *Related Work* chapter, effective UX design relies heavily on understanding such transitional users who bridge the gap between advanced and novice user groups. The Skilled Adopter embodies this role, providing insights that are essential for creating a tool that is both powerful and approachable.

This persona is particularly significant because they operate at the intersection of two critical user groups: highly proficient SCA Tool users and those entirely new to both software development and tools like SCA Tool. By focusing on the Skilled Adopter, we gain a comprehensive view of user expectations and challenges across varying levels of expertise. Their need for intuitive onboarding, seamless integration into existing workflows, and advanced functionality highlights the dual challenge of catering to new users while supporting complex use cases for seasoned professionals.

The personas outlined in the previous chapter, developed using insights from the *Data Collection* chapter, provide a structured framework for understanding such users. The Skilled Adopter, in particular, illustrates how user needs evolve as they transition from manual processes to adopting specialized tools. In the following sections, we will delve into specific use cases and user journeys tailored to this persona. These narratives will illuminate key interaction points, potential pain points, and opportunities for enhancing SCA Tool's user experience. This analysis will not only refine the tool for Skilled Adopters but also lay the groundwork for broader design improvements that resonate with all user types.

The Skilled Adopter	Discovery & Setup	Using Core Features	Reflection & Feedback
Goal	Learn about the SCA Tool and integrate it into an ongoing project.	Generate an SBOM, address security vulnerabilities, and generating Legal Notices.	Reflect on the experience and provide feedback for future improvements.
Motivation	The user is looking for a tool to manage OSS components efficiently, ensuring compliance and security.	Ensure all components are documented, security against potential risks and legal compliance with minimum manual work	The user wants to ensure that the tool continues to deliver value over time.
Emotion	Excitement	Satisfaction & Reassurance	Achievement & Engagement

Figure 6.1: User Journey: The Skilled Adopter

6.1 User Journey

6.1.1 User Journey: The Skilled Adopter

Background: A software developer or project manager with significant experience in software development and a solid understanding of open-source software (OSS) management. They are relatively new to specialized tools like SCA Tool but have a strong technical background and are looking to enhance their workflow efficiency.

Motivation: To streamline the process of managing OSS components, ensuring compliance, and addressing security vulnerabilities efficiently within their projects.

Scenario

Integrating SCA Tool into an existing project to manage OSS components, generate SBOMs, and address security vulnerabilities.

6.1.2 Stage 1: Discovery and Setup

Goal: Learn about SCA Tool and integrate it into an ongoing project.

1. Awareness

The user learns about SCA Tool from industry blogs, developer forums, or recommendations from peers.

Motivation: The user is looking for a tool to manage OSS components efficiently, ensuring compliance and security.

2. Sign-Up and Onboarding

The user signs up for SCA Tool, creating an account quickly. They are presented with an onboarding tutorial that highlights key features such as SBOM generation, vulnerability scanning, and legal notice generation.

Motivation: The user wants to get started quickly and understand the tool's capabilities without a steep learning curve.

3. Project Setup

The user imports an existing project from a development environment (e.g., GitHub) into SCA Tool. The tool automatically scans the project for OSS components and provides a quick overview of the components detected.

Motivation: The user seeks to immediately see the tool's value by understanding the OSS landscape of their project.

Emotions

- **Excitement:** The user is eager to see how the tool can improve their workflow.
- **Confidence:** The clear onboarding process reassures the user that they can handle the tool without extensive training.

6.1.3 Stage 2: Using Core Features

Goal: Generate an SBOM, address security vulnerabilities, and ensure OSS compliance.

1. Generating an SBOM

The user navigates to the SBOM generation feature, selects the project, and configures the necessary parameters, such as which dependencies to include. The SBOM is generated quickly, and the user reviews it for accuracy. The user exports the SBOM in a format required by their project's stakeholders.

Motivation: The user wants to ensure that all OSS components are accounted for and properly documented.

2. Vulnerability Management

The user accesses the security dashboard and reviews the list of detected vulnerabilities. They filter vulnerabilities by severity and start with the most critical ones.

Motivation: The user aims to secure the project against potential risks efficiently.

3. Generating Legal Notices

The user selects the legal notice generation feature and allows the tool to compile notices for all OSS components. They customize the legal notices to match the specific requirements of their project or organization. The user reviews and exports the legal notices, integrating them into the project's documentation.

Motivation: The user needs to ensure legal compliance with minimal manual intervention.

Emotions

- **Satisfaction:** The user feels pleased with the tool's ability to automate and simplify complex tasks.
- **Reassurance:** The accurate SBOM and effective vulnerability management build trust in the tool's reliability.

6.1.4 Stage 3: Reflection and Feedback

Goal: Reflect on the experience and provide feedback for future improvements.

1. Review of Tool's Impact

The user reviews how SCA Tool has impacted their workflow, noting the time saved and the reduction in manual errors. They consider the overall improvement in project security and compliance management.

Motivation: The user wants to ensure that the tool continues to deliver value over time.

2. Providing Feedback

The user is prompted to provide feedback on their experience with SCA Tool. They may suggest new features or improvements, based on their usage and any challenges faced.

Motivation: The user hopes to contribute to the tool's ongoing development, ensuring it continues to meet their evolving needs.

Emotions

- **Achievement:** The user feels accomplished, having successfully integrated and utilized a powerful tool in their workflow.

- **Engagement:** By providing feedback, the user feels a sense of involvement in the tool's development, strengthening their loyalty.

6.1.5 Overall Outcome

The Skilled Adopter successfully integrates SCA Tool into their workflow, significantly improving the management of OSS components, compliance, and security. The user experiences enhanced efficiency, reduced manual effort, and increased confidence in the security and compliance of their project. The positive experience leads to continued use of the tool and active engagement with its development through feedback.

7 User Flow and Prototypes

Building on the personas and user journeys developed in the previous chapters, this chapter focuses on translating user insights into actionable design solutions for SCA Tool. By leveraging the findings from the *Data Collection* chapter and the detailed personas outlined in the *Personas* chapter, this chapter aims to present user flows and prototypes that address the specific needs and pain points of diverse user groups, such as *The Skilled Adopter*. These user flows map out the typical pathways users follow when interacting with key SCA Tool features, ensuring a seamless and efficient experience.

The prototypes in this chapter serve as visual representations of the proposed improvements, providing a tangible foundation for evaluating the tool's usability and effectiveness. They are designed to optimize critical tasks, such as project creation, distribution unit management, and compliance reporting, which were highlighted as areas for improvement during the user research phase. By directly addressing the challenges identified in earlier chapters, this chapter ensures that the design solutions are both user-centered and data-driven.

7.1 Use Case

Below is an explanation of the use case shown in Figure 7.1:

- **Step 1:** Login: The user begins by logging into the web application, likely using their credentials to gain access to the platform.
- **Step 2:** Create a Project: After successfully logging in, the user can create a new project in the application.
- **Step 3:** Set up Distribution Unit: Once the project is created, the user sets up a "distribution unit," which could be a specific release, module, or part of the codebase that the user wants to analyze. This step prepares the application for the actual analysis process.
- **Step 4:** Start Analysis: With the distribution unit configured, the user initiates the analysis. This process could involve scanning the code for

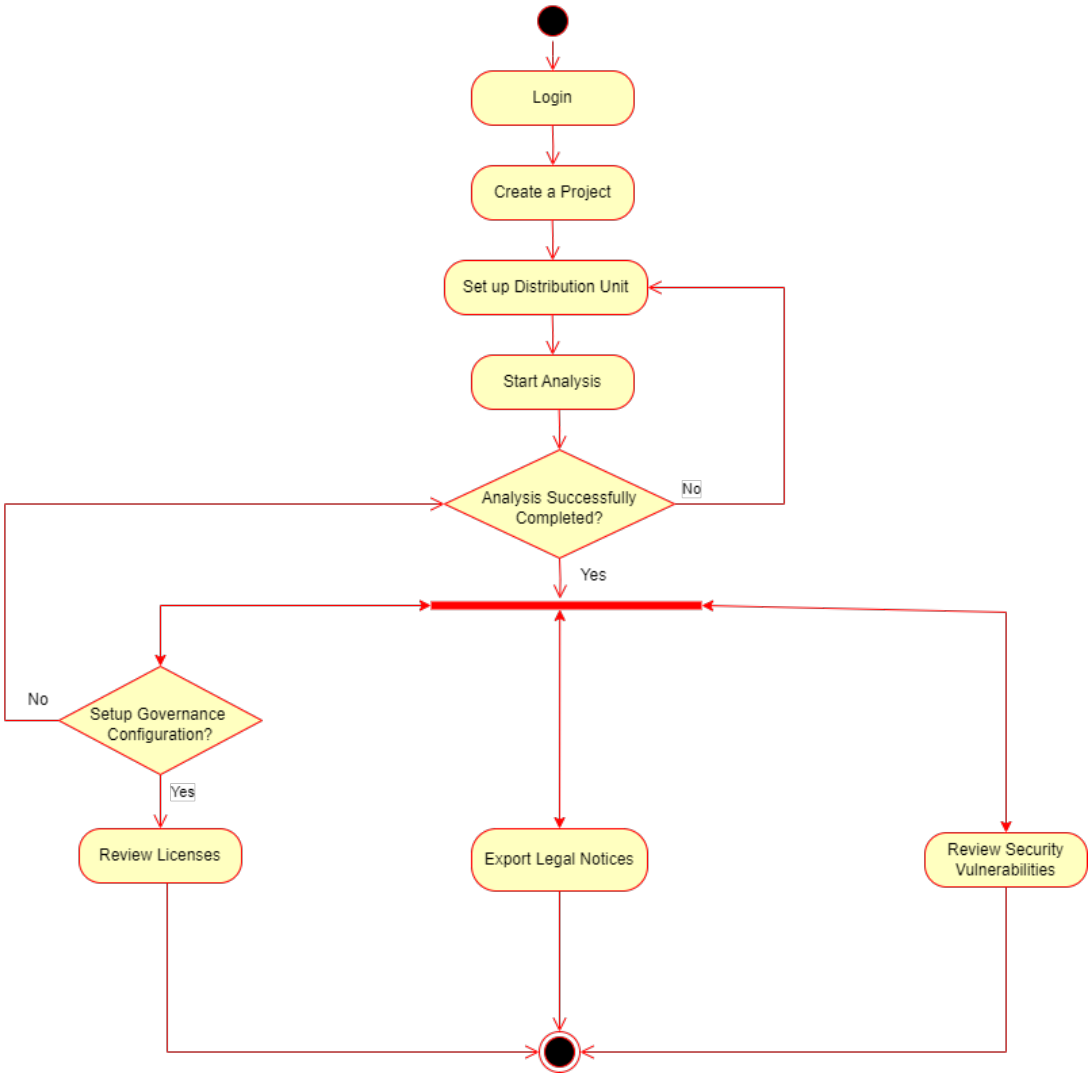

Figure 7.1: SCA Tool Use Case

licensing issues, security vulnerabilities, and governance checks

- **Step 5:** Analysis Successfully Completed?: After the analysis begins, the system checks whether it has been completed successfully. - If No, the flow redirects the user to previous steps, possibly allowing them to correct issues and reinitiate the analysis.
  - If Yes, the workflow continues with additional actions based on user requirements.
- **Step 6:** Setup Governance Configuration?: If the analysis is successful, the user can decide whether they want to configure governance settings (e.g., rules related to licensing, compliance, or security policies).

- If No, the workflow proceeds directly to exporting legal notices.
- If Yes, the user reviews the licenses associated with the project to ensure they are compliant with legal and governance policies.

- **Step 7:** . Review Licenses: If the user opts to set up governance, they will review the licenses used in the project. This could involve checking for incompatible or problematic licenses that violate the organization's governance policies.
- **Step 8:** Export Legal Notices: After successful analysis, the user can export legal notices, which may summarize the findings related to license compliance, attributions, and other legal concerns tied to the project.
- **Step 9:**Review Security Vulnerabilities: As part of the post-analysis process, the user may also review any security vulnerabilities detected during the analysis. This allows the user to take corrective actions to mitigate risks related to software security.
- **Step 10:** End of Process: After reviewing licenses and security vulnerabilities, the process is completed, and the workflow terminates

7.2 User Flows

7.2.1 User Flow: Generating Software Bill of Materials

1. **User Logs In:**
   - The process begins with the user logging into the web application, granting them access to the platform's features related to project creation, analysis, and governance setup.
2. **Landing Page:**
   - After logging in, the user is taken to the landing page, which serves as the main dashboard, offering access to project creation and configuration options.
3. **Click on 'New Project' Button:**
   - On the landing page, the user initiates the workflow by clicking the "New Project" button. This action creates a new project that the user intends to analyze for licenses and other compliance matters.
4. **Click on 'New Distribution Unit' Button:**
   - After creating the project, the user clicks on the "New Distribution Unit" button. The distribution unit refers to a segment or module of the project that will be set up for analysis.

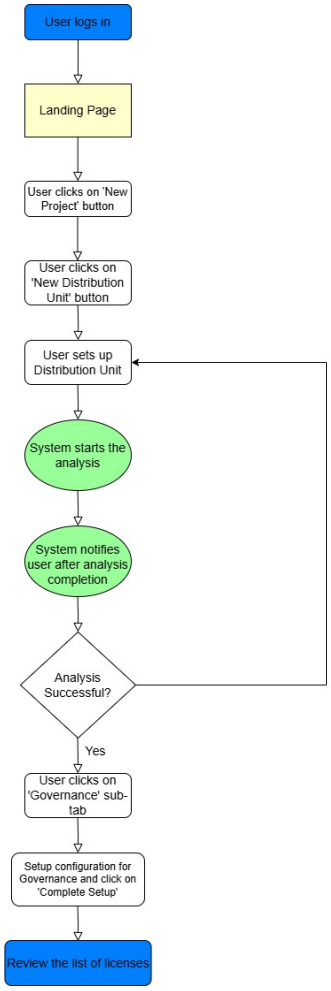

Figure 7.2: User Flow: Generating Software Bill of Materials

5. **User Sets Up Distribution Unit:**
   - The user then configures the distribution unit by providing the necessary details (e.g., selecting files, defining parameters). This setup ensures that the unit is ready for analysis.
6. **System Starts the Analysis:**
   - Once the distribution unit is set up, the system automatically begins the analysis process. This analysis typically includes checking the distribution unit for licensing and governance issues.
7. **System Notifies User After Analysis Completion:**
   - After the analysis is complete, the system notifies the user, indicating that the process has finished, and the results are ready to be reviewed.

8. **Was the Analysis Successful?:**
    - If the analysis was not successful, the user may need to resolve any errors before continuing.
    - If the analysis is successful, the user can proceed to review the results.
9. **User Clicks on 'Governance' Sub-Tab:**
    - After a successful analysis, the user navigates to the "Governance" sub-tab, where governance-related configurations and results are managed.
10. **Setup Configuration for Governance and Click on 'Complete Setup':**
    - In the governance section, the user configures settings related to governance, such as compliance policies or license restrictions. Once the setup is complete, the user finalizes the configuration by clicking the "Complete Setup" button.
11. **Review the List of Dependencies and their Licenses:**
    - After completing the governance setup, the user is able to review the list of dependencies and their licenses used in the project. This list provides details about the licenses associated with various components of the project, helping the user ensure compliance with legal and organizational policies.

7.2.2 User Flow: Reviewing Security Vulnerabilities

1. **User Logs In:**
    - The process begins with the user logging into the web application, gaining access to the platform's features, including project creation and security analysis.
2. **Landing Page:**
    - After logging in, the user is directed to the landing page, which serves as the main dashboard for interacting with different application functionalities.
3. **Click on 'New Project' Button:**
    - On the landing page, the user initiates the workflow by clicking the "New Project" button. This begins the process of creating a new project for analysis.
4. **Click on 'New Distribution Unit' Button:**

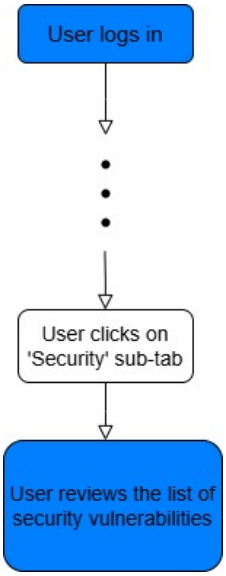

Figure 7.3: User Flow: Reviewing Security Vulnerabities

- After creating a project, the user proceeds by clicking the "New Distribution Unit" button. The distribution unit likely refers to a specific part of the project, such as a software module or version, that will be analyzed.

5. **User Sets Up Distribution Unit:**
   - The user configures the distribution unit, providing any necessary details, such as selecting files or setting parameters, in preparation for the analysis.
6. **System Starts the Analysis:**
   - Once the distribution unit is configured, the system automatically initiates the analysis process. This analysis might involve scanning for security vulnerabilities within the code or project.
7. **System Notifies User After Analysis Completion:**
   - Upon completion of the analysis, the system sends a notification to the user, indicating that the analysis has finished, and results are ready for review.
8. **Was the Analysis Successful?**
   - A decision point checks if the analysis was successfully completed.
   - If the analysis was unsuccessful, the user may need to correct issues and rerun the process.

- If the analysis is successful, the user moves to the next step.

9. **User Clicks on 'Security' Sub-Tab:**
   - After a successful analysis, the user navigates to the "Security" sub-tab, which provides access to the results related to any identified security vulnerabilities.
10. **User Reviews the List of Security Vulnerabilities:**
    - In the Security sub-tab, the user reviews the list of security vulnerabilities identified during the analysis. The user can take corrective action based on the findings to enhance the security of the project.

7.2.3 User Flow: Generating and Downloading Legal Notices

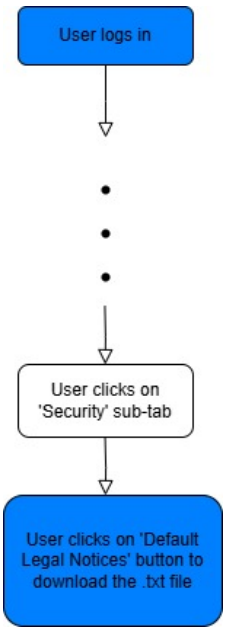

Figure 7.4: User Flow: Generating and Downloading Legal Notices

1. **User Logs In:**
   - The process begins with the user logging into the web application. This step is essential for accessing the functionality of creating projects and generating legal notices.
2. **Landing Page:**
   - Once the user is logged in, they are directed to the landing page. This is the main dashboard or home screen where various options are

presented to the user.

3. **Click on 'New Project' Button:**
   - From the landing page, the user initiates the process by clicking the "New Project" button. This action starts the workflow for setting up a new project in the system.
4. **Click on 'New Distribution Unit' Button:**
   - After creating the project, the user clicks on the "New Distribution Unit" button to define the specific unit of the project they wish to analyze or work with. A distribution unit might refer to a specific release or section of the project codebase that requires analysis.
5. **User Sets Up Distribution Unit:**
   - The user configures the distribution unit, providing the necessary details, such as selecting files or specifying parameters for analysis. This setup is crucial for preparing the system to analyze the project.
6. **System Starts the Analysis:**
   - Once the distribution unit is set up, the system automatically starts the analysis process. This typically involves scanning the code or project to check for issues such as legal compliance, licensing, or vulnerabilities.
7. **System Notifies User After Analysis Completion:**
   - After the analysis is completed, the system sends a notification to the user, informing them that the analysis has finished and the results are available for review.
8. **Was the Analysis Successful?**
   - A decision point determines if the analysis was successful. If not, the user may need to address any errors or issues.
   - If the analysis is successful, the user can proceed with the next steps.
9. **User Clicks on 'Compliance' Sub-Tab:**
   - After a successful analysis, the user navigates to the "Compliance" sub-tab. This section provides the necessary tools for generating compliance-related documentation, including legal notices.
10. **User Clicks on 'Default Legal Notices' Button:**
    - In the Compliance sub-tab, the user clicks the "Default Legal Notices" button. This action triggers the system to generate a .txt file

containing the legal notices based on the analysis results.

11. **Download .txt File:**
    - The user is prompted to download the generated legal notice file, typically containing information related to licensing and legal compliance for the project.

7.3 Prototypes

The effectiveness of any software tool lies not only in its functionality but also in its ease of use and alignment with user needs. In this section, the focus shifts from understanding users to designing solutions that cater to their needs. By leveraging insights from personas and user journeys, three prototypes are proposed for SCA Tool. These prototypes aim to address specific challenges identified during user research, such as streamlining project setup, improving task repetition, and enhancing the visibility of analysis results. Through these design solutions, the section demonstrates how user-centered design principles can be applied to create intuitive, efficient, and satisfying user experiences. Each prototype is evaluated to ensure it meets user expectations, providing a strong foundation for future development and implementation The three prototypes are:

Prototype 1: Quick Start Project and Distribution Unit Creation Streamlines the process of setting up a new project or reusing an existing one, reducing the number of steps required for users.

Prototype 2: Cloning a Distribution Unit Enables users to duplicate an existing distribution unit quickly, minimizing redundant manual input for similar tasks.

Prototype 3: Overview of Distribution Units Provides a compact, accordion-style view of distribution units organized by date, with clear status indicators for completed analyses.

Prototype 4: Guided Tour for First-Time Users Provides a compact, accordion-style view of distribution units organized by date, with clear status indicators for completed analyses.

Prototype 5: Documentation of the Application Provides a compact, accordion-style view of distribution units organized by date, with clear status indicators for completed analyses.

7.3.1 Prototype: Quick Start Project and Distribution Unit Creation

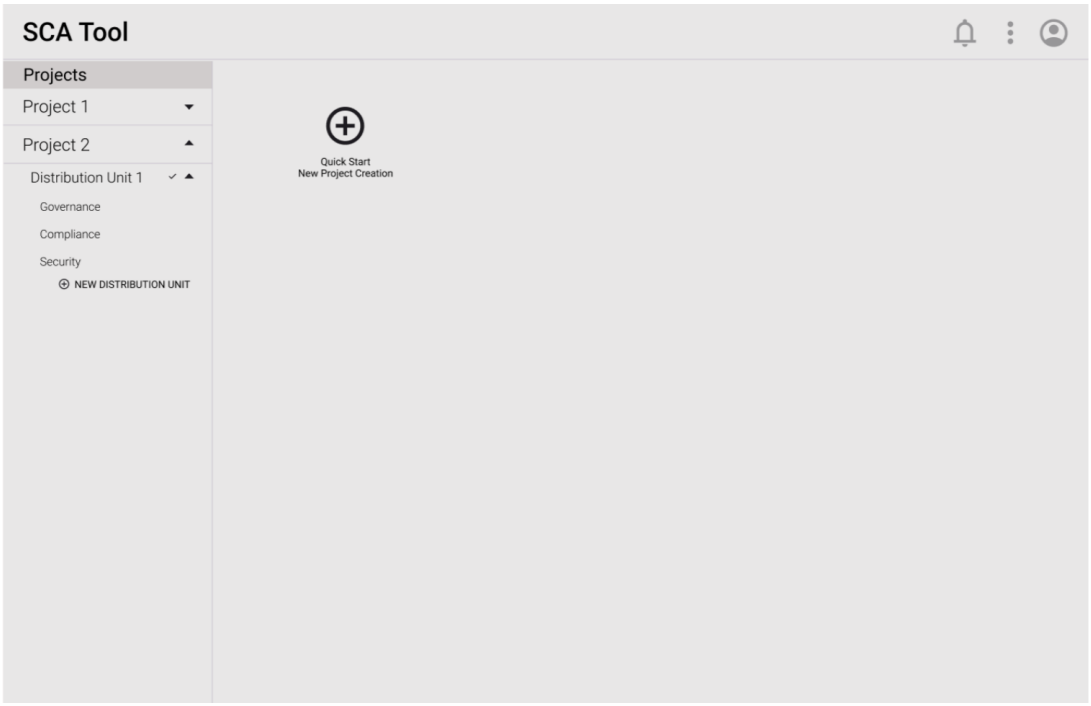

Figure 7.5: Prototype Quick Start Action

Evaluation of the "Quick Start" Button Functionality

Reduction of Clicks

- The button should minimize steps for the user, ideally automating initial setup processes of creating a Project and then a Distribution Unit.
- **Number of clicks reduced in comparison to existing state:**
  - **In Current State:** 8 clicks
  - **As per Prototype:** 5 clicks

Matching and Suggesting Existing Projects

- When a user inputs a new project name, offering suggestions from existing projects that match the input string is crucial. This feature should use predictive text or a dynamic dropdown, displaying relevant options as the user types.
- Ensure the system handles partial matches, typos, and prioritizes frequently used or recently accessed projects.

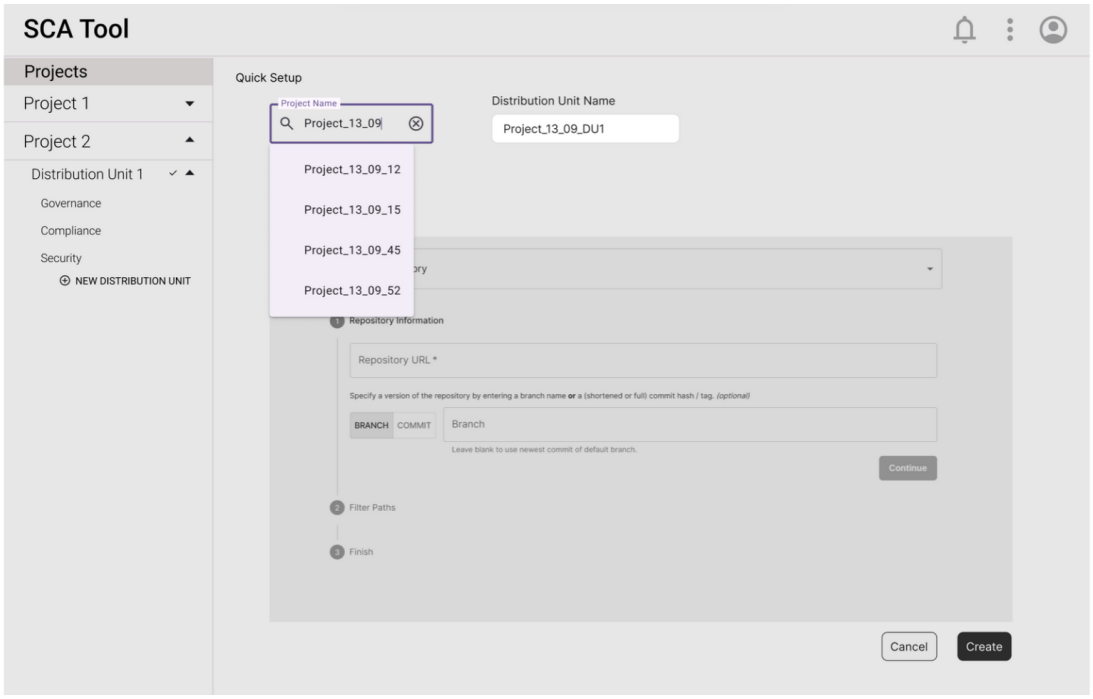

Figure 7.6: Prototype: Quick Start Action Details

User Flow and Intuition

- Test if users can understand the Quick Start button's functionality without explicit instructions. Ideally, it should be intuitive and follow standard design principles.
- The dropdown suggestion mechanism should appear at the right moment, neither too early nor too late, allowing users to feel in control while getting useful assistance.

Efficiency and Feedback

- The prototype should be evaluated on whether it provides immediate, clear feedback after using the Quick Start button. For instance, if a user selects an existing project, the interface should reflect this choice promptly.

Error Handling

- Consider scenarios where no matching projects exist. The system should handle this gracefully, either by confirming that a new project is being created or providing a suggestion for users to check their input.

7.3.2 Cloning an Existing Distribution Unit

Evaluation of Cloning Functionality

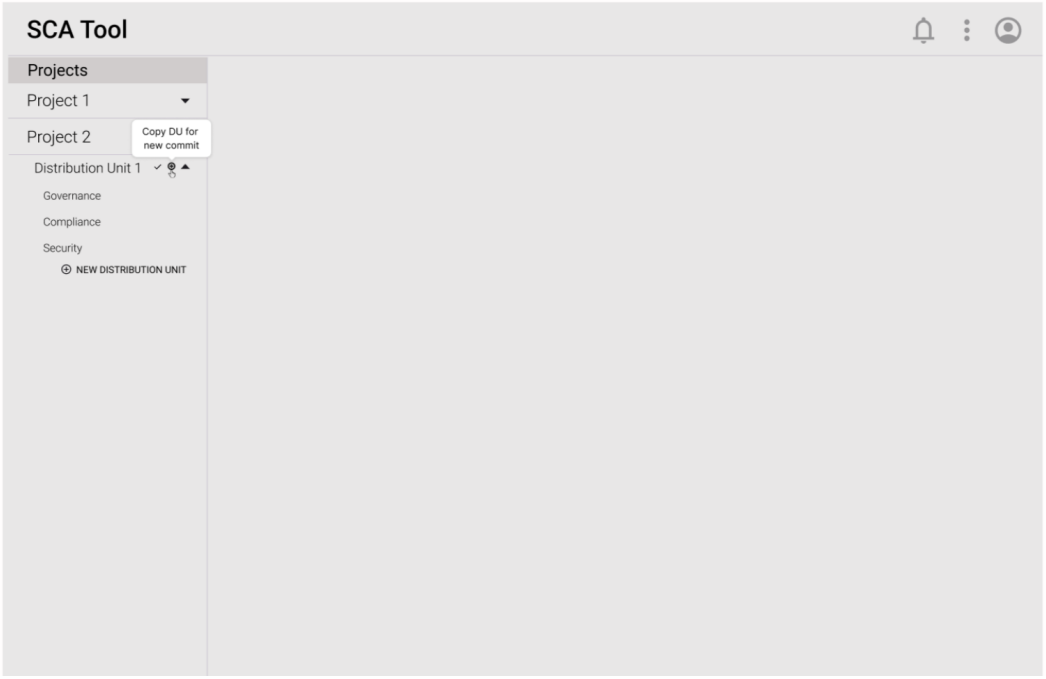

Figure 7.7: Prototype: Cloning a Distribution Unit

Location of the "Copy" Button The second image shows the "+" icon located next to the distribution unit name. Its position is intuitive, as it directly aligns with the distribution unit the user intends to clone. This makes the action easy to understand and execute.

Text on Hover On hover over the '+' icon, users see a help text 'Copy DU for new commit' which provides intuitiveness and guidance to users and help new users pick up the tool more easily.

Cloning Functionality

- By allowing users to clone a distribution unit, the system automatically reduces redundant input, potentially saving significant time, especially for recurring or similar tasks.
- This feature would benefit teams managing multiple projects or distribution units, where only minor modifications are needed between versions.

Input Minimization

- The reduced need for user input after cloning is a big win for usability. In scenarios where the cloned distribution unit has minimal changes, this allows users to focus on the necessary adjustments rather than repetitive data entry.

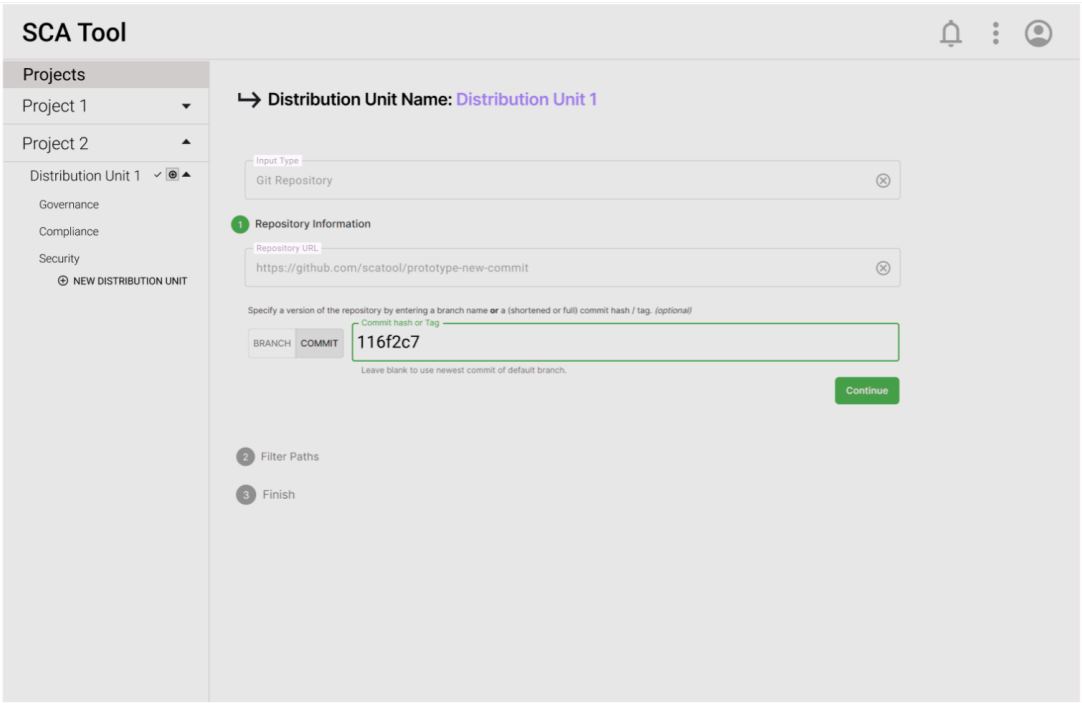

Figure 7.8: Prototype: Cloning a Distribution Unit Details

Continuity in UI Design

- The design remains consistent with the other UI elements (e.g., the "Continue" button and form fields), ensuring that the added feature doesn't disrupt the flow of the user interface.
- The simplicity and cleanliness of the interface are maintained even with the added functionality.

Potential Improvements

- While the cloning feature reduces input time, it would be helpful if there was a visual confirmation or notification that the clone action was successful to assure the user that the new distribution unit is created.
- Additionally, providing an option to review and modify cloned details immediately after cloning might enhance usability further.

7.3.3 Overview of Distribution Units of a Project

Evaluation of Accordion-Based Organization and Status Indicators

Accordion-Based Organization by Date

- The accordion is grouped into logical time periods such as "Past 24 hours,"

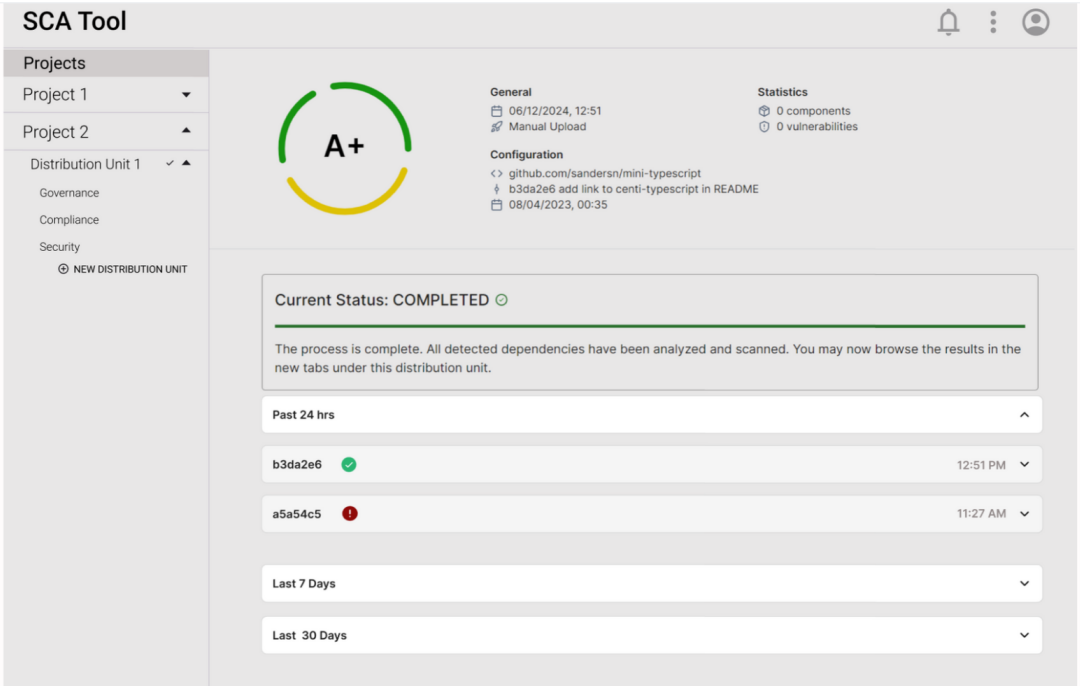

Figure 7.9: Prototype: Overview of Distribution Units of a Project

"Last 7 Days," and "Last 30 Days," which makes it easy to locate and differentiate between records based on their relative dates.

- This approach efficiently handles a large number of records without overwhelming the user. By collapsing older entries, it keeps the view focused on more recent or relevant data.

Clear Status Indicators

- Each entry includes clear visual indicators (green check for success, red exclamation mark for errors), allowing users to quickly assess the status of each distribution unit without having to open each accordion section.
- The use of color to denote status provides immediate feedback, improving user experience and making it easier to identify issues.

Detailed Record Information

- The layout presents key information at a glance, such as commit hashes and timestamps, allowing users to quickly understand the context of each distribution unit.
- The expandability of each record suggests that more details can be viewed without cluttering the main screen, keeping the UI minimalist and focused.

Visual Cues for Each Distribution Unit Analysis There are visual cues

in for of a checkmark for successful and an error indicator for failed analysis for users to get a quick overview at a glance.

Current Status Section

- The status banner at the top (e.g., "COMPLETED") provides a quick summary of the latest progress, offering users a high-level view of their project's status before diving into specific records.
- The explanatory text within the status box informs users that all dependencies have been analyzed, adding clarity to the process.

Visual Cleanliness and Consistency

- The prototype maintains a simple and professional design, with ample whitespace that enhances readability and reduces cognitive load.
- The placement of elements follows a logical hierarchy, with important information (status and time periods) presented at the top, and detailed records grouped underneath in a consistent format.

Scalability for Multiple Records

- The accordion design can easily scale to handle many records over time. Users can expand or collapse sections as needed, ensuring they don't have to scroll through endless lists to find relevant data.

7.3.4 Prototype: Guided Tour for SCA Tool

Evaluation of the Guided Tour Prototype

Ease of Navigation for New Users

- **Guided Pointer Effectiveness:**
  - The guided tour prominently highlights the "New Project" button, ensuring that new users can locate the starting point without difficulty.
  - The use of directional arrows enhances clarity, guiding users seamlessly to the next step.

Clarity and Context of Instructions

- **Instructional Content:**
  - The text *"Welcome to SCA Tool! Click on 'New Project' to create your first project"* is concise and clear, making it suitable for first-time users.
  - The instruction bubble provides just enough context without overwhelming the user with unnecessary details.

Figure 7.10: Prototype: Guided Tour for New Users

User Flow Intuitiveness

- **Sequential Guidance:**
  - The prototype suggests a step-by-step progression, starting with project creation. This approach ensures that users are not left guessing about the next step.
  - Feedback mechanisms (e.g., highlighting clickable buttons) is added to confirm the user's action.

Visual Design and Engagement

- **Design Simplicity:**
  - The minimalistic design of the background and callout keeps the user's focus on the task at hand, reducing distractions.
  - The use of bold text and arrows aligns with standard user-friendly design principles.

Error Handling and Alternate Paths

- **Scenario Coverage:**
  - The guided tour currently focuses on the ideal path (project creation).

To improve usability, error handling instructions could be added, such as what happens if the user clicks outside the intended area or skips the guided tour.

- Suggestions like *"Unable to find your projects? Click here to learn more"* can enhance user confidence.

- **Skip/Exit Option:**
  - Adding an option to skip or exit the guided tour helps cater to experienced users.

Potential Improvements

- **Interactive Feedback:**
  - Upon clicking the highlighted "New Project" button, the system could display a confirmation message or animation to reassure users they are proceeding correctly.

Impact on Onboarding

- **Reduction in Cognitive Load:**
  - The guided tour significantly reduces the effort required for new users to figure out the initial steps, making the onboarding process smoother.
  - By directing attention to the primary action, it helps users achieve their first success within the tool quickly, likely improving satisfaction and retention.

7.3.5 Prototype: SCA Tool Documentation Section

Evaluation of the Documentation Prototype

Clarity and Accessibility

- The documentation provides a clear and concise introduction to SCA Tool, with an easy-to-follow structure.
- The "What is SCA Tool?" section gives a brief, informative overview, helping users understand the purpose and functionality of the tool at a glance.
- The high-level bullet points for key features ensure that users can quickly identify the core functionalities of the tool without delving into lengthy paragraphs.

User Flow and Navigation

- **Menu Design:**

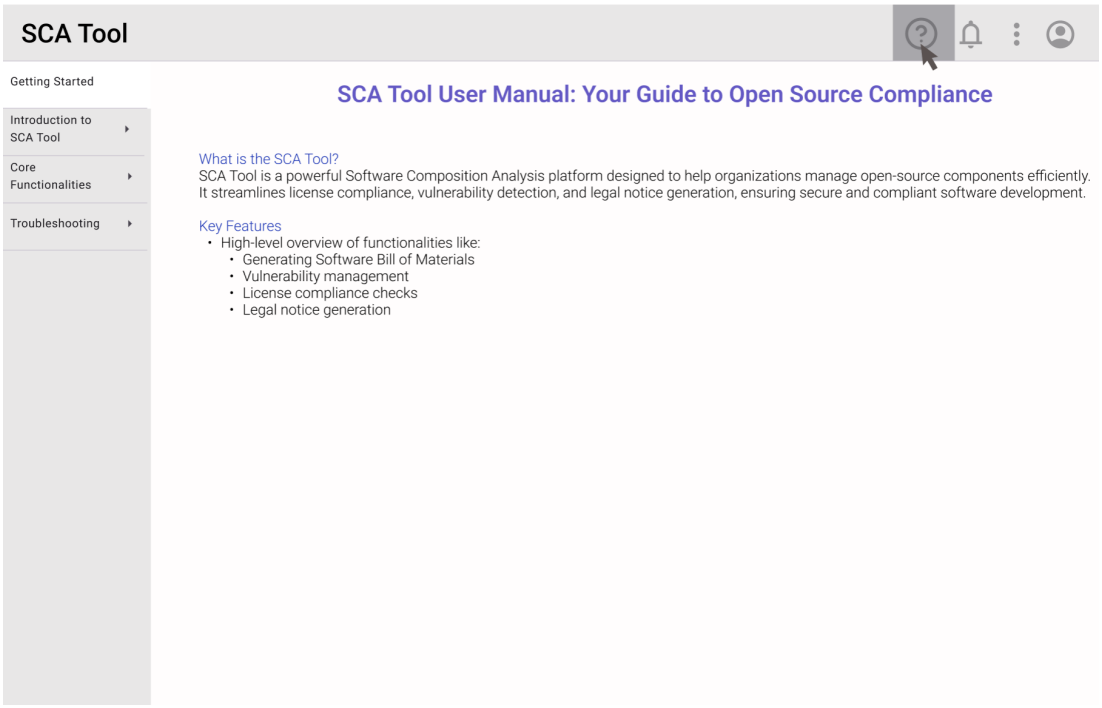

Figure 7.11: Prototype: Documentation Section

  - The left-hand menu categorizes content logically, with sections such as "Introduction to SCA Tool," "Core Functionalities," and "Troubleshooting." This organization aligns with common user needs during onboarding and troubleshooting.
  - The menu structure supports intuitive navigation, allowing users to quickly access relevant sections.

- **Interactive Design:**
  - Clicking on the menu items dynamically loads content without overwhelming the user, making the documentation interactive and user-friendly.
  - The inclusion of a help icon in the header further enhances accessibility, ensuring that users can quickly find assistance from any page.

Content Depth and Relevance

- The content strikes a balance between depth and brevity, focusing on the most critical information for new users.
- The bullet points under "Key Features" provide a functional overview, covering topics such as:

  - Generating Software Bill of Materials (SBOM).
  - Vulnerability management.
  - License compliance checks.
  - Legal notice generation.

Visual Design and Engagement

- The clean and minimalistic design ensures readability and keeps users focused on the content.
- Using a distinct header ("SCA Tool User Manual: Your Guide to Open Source Compliance") sets the tone for the documentation, making it approachable and professional.
- Hyperlinks (e.g., "What is SCA Tool?") encourage exploration while keeping the content interactive.

Potential Improvements

- **Search Functionality:**
  - Adding a search bar within the documentation section would improve usability, enabling users to find specific topics quickly.
- **Inclusion of Visual Aids:**
  - Incorporating diagrams, screenshots, or videos for key functionalities could enhance understanding, especially for complex processes like SBOM generation or vulnerability management.
- **Expandable Content:**
  - Some topics could benefit from expandable subsections to provide more detailed explanations without cluttering the main view.

Impact on User Onboarding

- The documentation serves as a vital resource for onboarding, helping new users understand and utilize the tool effectively.
- The structured layout reduces cognitive load, making it easier for users to learn the tool's features and resolve issues independently.

8 Evaluation of Personas and their Journeys

This chapter evaluates the effectiveness of the personas and user journeys developed for SCA Tool and examines the alignment of these personas and journeys with real-world user interactions. By reflecting on user feedback and usability testing, this evaluation aims to validate the relevance and accuracy of the personas as well as the effectiveness of the designed user flows.

8.1 Persona Relevance and Validation

The personas—*The Experienced Professional*, *The Skilled Adopter*, and *The Student Learner*—were developed based on data gathered through survey responses. They embody distinct user types with varying levels of expertise, goals, and pain points relevant to SCA Tool.

The Experienced Professional Key Findings:
As highlighted in *Chapter 4: Data Collection* and further detailed in *Chapter 5: Personas*, feedback from users closely matching the *Experienced Professional* persona validated the persona's emphasis on efficiency and advanced features. The data collected through surveys and usability testing confirmed that this user group highly values the tool's ability to automate complex workflows, such as generating Software Bill of Materials (SBOM) and legal notices. The focus on *cost-effectiveness* and *workflow efficiency* observed during data collection was well-aligned with the needs and behaviors outlined for this persona in the personas chapter, reinforcing the accuracy and relevance of the developed persona.

Challenges Identified:
Some *Experienced Professional* users noted that while automation was valuable, the tool could benefit from more granular customization options. Additionally, they emphasized the importance of tool stability, as some workflows, like vulnerability scanning, required multiple iterations to refine results.

The Skilled Adopter Key Findings:

Feedback from users representing *The Skilled Adopter* persona revealed that they appreciated the tool's onboarding simplicity and intuitive UI. The ability to set up projects quickly and easily was particularly praised. *Skilled Adopters* highlighted that the tool's ability to integrate into their existing workflows for managing open-source components was essential.

Challenges Identified:
Skilled Adopters encountered minor difficulties with advanced governance features and indicated a need for more guidance or contextual help, particularly around legal notice generation and compliance review. Adding in-app tutorials or help text could help bridge this gap.

The Student Learner Key Findings:
Users matching *The Student Learner* persona responded positively to the tool's clear layout and simplicity. They appreciated the inclusion of educational resources, which helped them navigate compliance workflows that were previously unfamiliar. The student users also valued affordable or free access, aligning with the *Student Learner* persona's emphasis on cost.

Challenges Identified:
The student users expressed a desire for even more guidance in the form of tips or beginner-focused documentation. A potential improvement would be the addition of interactive tutorials that could help users get acquainted with complex compliance concepts.

8.2 Effectiveness of User Journeys

8.2.1 Quick Start Project Creation

The *Quick Start* project creation feature aimed to reduce steps for users setting up a new project or reusing a similar one.

Evaluation of Key Objectives:

- **Reduction of Clicks:** The *Quick Start* button successfully reduced the average number of clicks required for project setup.
- **Matching Suggestions for Existing Projects:** The dynamic dropdown feature provided suggestions effectively, though some users suggested making the dropdown more visually prominent to catch their attention.

8.2.2 Cloning a Distribution Unit

The cloning feature was designed to streamline repetitive tasks. It received positive feedback, particularly from *Experienced Professional* users, who frequently

work on similar distribution units. They noted that this feature saved time and reduced manual errors.

Evaluation of Key Objectives:

- **Usability and Efficiency:** The cloning function was intuitive and easy to use, with the on-hover text providing clear guidance.
- **Potential Improvement:** Users suggested adding a confirmation message upon successful cloning to reassure them that the operation was completed.

8.2.3 Overview of Distribution Units of a Project

The accordion-based organization of distribution units provided a compact and chronological overview of recent activity, helping users quickly identify recent actions and statuses. The visual indicators (e.g., green checkmark for success, red exclamation mark for errors) were especially useful for users to assess project status at a glance.

Evaluation of Key Objectives:

- **Clear Status Indicators:** The status indicators were successful in providing immediate feedback on the analysis results. Users noted that this made error detection more straightforward.
- **Visual Cleanliness and Scalability:** The accordion layout was praised for keeping the interface uncluttered and easy to navigate. However, some users suggested that expanding the sections to show more information upfront could further enhance usability.

8.3 Persona Journey Effectiveness

The personas' user journeys were generally effective in capturing realistic user interactions and needs. Each journey was instrumental in identifying gaps and potential improvements in SCA Tool's design.

Key Observations:

1. **User-Centered Focus:** The use of personas ensured that design choices aligned with actual user needs, such as the desire for time-saving features and intuitiveness.
2. **Journey Flexibility:** By incorporating diverse personas, the user journeys were flexible enough to apply to a broad range of real users, allowing the tool to cater to both highly technical and novice users.

Areas for Improvement:

- **Enhanced Help for New Users:** Based on feedback, providing more in-depth onboarding materials, such as walkthroughs or guided tips, would further support the *Skilled Adopter* and *Student Learner* personas.
- **Advanced Customization for Expert Users:** The *Experienced Professional* users expressed interest in more customization options to fine-tune features to meet complex, high-level needs.

8.4 Conclusion

The personas and user journeys developed for SCA Tool provided a strong foundation for guiding UX improvements and ensuring that the tool met the needs of diverse users. By validating these personas and journeys through user feedback, the design process remained user-centered and grounded in practical needs. Moving forward, the addition of further customization, onboarding support, and interactive tutorials would continue to enhance the tool's alignment with user expectations, driving higher satisfaction and engagement across user types.

9 Limitations

While this thesis aimed to enhance the user experience (UX) of SCA Tool through a comprehensive user-centered design (UCD) approach, several limitations were encountered during the research and development process. These constraints affected the depth and breadth of the study and are outlined below to provide context for interpreting the findings and recommendations.

Sample Size and Diversity One of the significant limitations of this study was the relatively small sample size of participants in the user research phase. While the survey and usability testing covered users from different backgrounds (e.g., developers, students), the sample was not large or diverse enough to represent all potential user groups comprehensively.

- **Impact:** Certain nuances, such as regional differences in user behavior or workflows in niche industries, might not have been captured.
- **Mitigation:** Future studies should involve a larger and more diverse group of participants to enhance the generalizability of the findings.

Time Constraints The timeline for this thesis limited the scope of research activities and the number of iterations for prototyping and usability testing.

- **Impact:** While initial prototypes were developed and evaluated, some features (e.g., advanced customization options for experienced users or interactive onboarding for new users) were not iterated upon as extensively as desired.
- **Mitigation:** Additional rounds of prototyping and testing could further refine the UX improvements.

Contextual Bias in Data Collection The user data was collected predominantly through online surveys and remote usability tests. This approach introduced the following biases:

- **Self-Selection Bias:** Participants who volunteered may have had prior interest or experience with similar tools, potentially skewing the results.

- **Environmental Context:** Remote usability tests lacked controlled environments, meaning that external factors (e.g., distractions, internet connectivity issues) may have influenced user performance and feedback.
- **Mitigation:** Future research should incorporate a mix of in-person and remote testing, as well as efforts to recruit participants with no prior exposure to similar tools.

Incomplete Feature Implementation Some proposed features in the prototypes, such as dynamic onboarding tutorials, detailed error-handling mechanisms, and advanced governance configurations, were not fully implemented or tested due to time and resource constraints.

- **Impact:** The absence of fully functional prototypes limits the ability to validate the usability and feasibility of certain design concepts.
- **Mitigation:** A phased implementation plan should be developed to prioritize and incrementally build these features in future iterations of the tool.

Limited Testing for Scalability While the user flows and prototypes were evaluated for individual usability, the scalability of features, such as the accordion view for managing multiple distribution units or high-volume projects, was not extensively tested with larger datasets.

- **Impact:** The tool's performance and usability under conditions of heavy usage or extensive data (e.g., hundreds of projects or dependencies) remain unvalidated.
- **Mitigation:** Future research should include stress testing and usability evaluation under high data volume scenarios.

Lack of Longitudinal Data This study primarily focused on short-term usability testing and immediate user feedback. Long-term data on how users interact with the tool over time and adapt to its features was not collected.

- **Impact:** Insights into the learning curve, user retention, and long-term satisfaction were not obtained, which limits the ability to assess the sustained impact of UX improvements.
- **Mitigation:** Longitudinal studies should be conducted to evaluate the effectiveness of the design enhancements over time.

Technical Limitations of Prototypes The prototypes were primarily low- to mid-fidelity, focusing on conceptual designs rather than fully functional systems. As a result:

- Certain interactions (e.g., hover effects, error handling) were only mimiced rather than implemented.

- Performance-related aspects, such as response time for generating SBOM or loading distribution units, were not tested.
- **Mitigation:** High-fidelity, interactive prototypes should be developed and tested in future studies to validate the technical feasibility and responsiveness of the designs.

Focus on Specific User Personas While the personas (*The Experienced Professional*, *The Skilled Adopter*, and *The Student Learner*) were instrumental in guiding the design process, they may not capture all potential user types, such as compliance auditors or corporate decision-makers.

- **Impact:** The tool's design may not fully address the needs of secondary user groups or edge cases.
- **Mitigation:** Expanding the persona set and conducting targeted research for less-represented user types could make the tool more inclusive.

Lack of Context-Specific Use Case Testing The evaluation of the prototypes was conducted in generic use case scenarios. Testing in more specific organizational contexts (e.g., enterprise environments with strict compliance policies) was not performed.

- **Impact:** Features like governance configurations or legal notice exports may need further refinement to accommodate specific industry or organizational requirements.
- **Mitigation:** Collaborating with organizations to test the tool in real-world scenarios would provide more actionable insights.

The limitations outlined above provide a framework for understanding the constraints and challenges encountered during this research. While these limitations impacted certain aspects of the study, they also highlight areas for future exploration and improvement. Addressing these constraints in subsequent research and development efforts will further enhance the usability, scalability, and effectiveness of SCA Tool, ensuring it meets the diverse needs of its user base.

10 Conclusion

This thesis explored the application of user-centered design (UCD) principles to improve the user experience (UX) of SCA Tool, a platform designed to manage open-source software (OSS) components effectively. By focusing on the needs of diverse user personas, this study aimed to address usability challenges and enhance workflows for key tasks such as generating Software Bill of Materials (SBOM), vulnerability management, and legal notice generation.

10.1 Key Findings

The research successfully identified and addressed several UX challenges through a structured methodology that included user surveys, persona development, user journey mapping, and prototype testing. Key findings include:

- **Persona-Driven Design:** The development of three personas—*The Experienced Professional*, *The Skilled Adopter*, and *The Student Learner*—provided a robust foundation for user-centered design decisions. Each persona highlighted unique goals, challenges, and expectations, ensuring that the proposed solutions catered to a broad user base.
- **Enhanced User Workflows:** Features such as the *Quick Start* project creation button, cloning functionality for distribution units, and accordion-style views for project overviews demonstrated significant improvements in usability, reducing cognitive load and task complexity.
- **Guided Onboarding:** Prototypes like the guided tour for first-time users and the comprehensive documentation section proved helpful for ideation towards resolving onboarding challenges, particularly for new or less technical users.
- **User-Centered Improvements:** The prototypes effectively addressed pain points identified during user research, including simplifying project setup, improving task repetition efficiency, and providing intuitive status feedback for completed analyses.

10.2 Contributions to UX Design and Open-Source Tools

This thesis contributes to the fields of UX design and open-source management tools by demonstrating the effectiveness of applying UCD principles to technical software. Specific contributions include:

- **Empathy-Driven Design:** The use of personas and user journeys underscored the importance of understanding diverse user needs, enabling the design of features that align closely with real-world workflows.
- **Prototyping for Usability:** The iterative development and evaluation of prototypes showcased the value of low- and mid-fidelity designs in validating UX improvements before full-scale implementation.
- **Scalable Design Principles:** The proposed solutions, such as the accordion-based view and cloning functionality, were designed with scalability in mind, ensuring that they can accommodate increasing project complexity and larger datasets.

10.3 Challenges and Limitations

Despite the successes, this research faced several limitations, including a small and non-diverse sample size, limited time for iterative testing, and the use of low- to mid-fidelity prototypes. These constraints impacted the ability to validate certain features, such as scalability under high data volumes and long-term user engagement. Future studies should address these gaps by:

- Conducting longitudinal studies to assess the sustained impact of UX improvements.
- Expanding user research to include a more diverse and representative participant pool.
- Developing high-fidelity prototypes to validate technical feasibility and performance.

10.4 Final Remarks

SCA Tool represents a critical step toward simplifying OSS management while ensuring security and compliance. By adopting a user-centered design approach, this thesis has demonstrated the potential for UX improvements to transform technical tools into intuitive, user-friendly solutions. The proposed enhancements not only address the immediate needs of users but also lay the groundwork for

future improvements, ensuring that SCA Tool remains a valuable asset in the evolving landscape of software development.

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Appendices

A Raw Survey Data

This section provides access to the raw survey forms that were used for data collection in this study. These forms include responses that informed the development of personas and user journeys discussed in the thesis.

A.1 Survey 1

The first survey aimed to gather insights about user experience with the SCA Tool and their expectations. The raw data can be accessed through the following link:

- Google Sheets: Survey 1

A.2 Survey 2

The second survey collected additional feedback on specific features of the tool, such as vulnerability management and legal notice generation. The raw data can be accessed through the following links:

- Google Sheets: Survey 2 (Part 1)
- Google Sheets: Survey 2 (Part 2)

These hyperlinks allow for detailed review of the raw data, which serves as a foundation for the analysis presented in this thesis.

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