Optimising Design Tokens for Accessibility in UI Design

Design Tokens as Accessibility Tools: Evaluating Architecture, Naming, and Documentation in Design Systems

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Design tokens are increasingly used in design systems to promote consistency and scalability, yet their potential to support accessibility remains underexplored. This study investigates how a design token system can be structured to support WCAG 2.1 Level AA contrast compliance while evaluating the usability of token naming conventions and documentation. Using a Design Thinking framework and a mixed-methods approach, the research involved an accessibility audit, usability testing, and a System Usability Scale (SUS) questionnaire to evaluate a token system in Figma. The results demonstrate that embedding accessibility logic into the token architecture and naming structure enables designers to produce accessible outcomes without manual testing. A 100% contrast compliance rate and a SUS score of 86 highlight effectiveness and usability. The findings show that clear naming, structured documentation, and onboarding can significantly improve token selection accuracy and confidence, especially in non-standard UI components. This research proves accessible and scalable design systems can be achieved through thoughtful token design and guidance.

CCS CONCEPTS • Human-centered computing • Accessibility • Accessibility design and evaluation methods

Additional Keywords and Phrases: Design tokens, Accessibility, WCAG, Design systems, UX Design, UI Design

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1 INTRODUCTION

Since the mid-2010s, design systems have become essential to delivering scalable, consistent, and accessible digital products. At the foundation of design systems are design tokens. Design tokens abstract design decisions, such as colour, spacing, and typography, into reusable values. While they are widely used to promote visual consistency and efficiency, their potential to support accessibility compliance, particularly with Web Content Accessibility Guidelines (WCAG), remains underexplored.

This research investigates how a design token system can be structured to support accessibility by default. It focuses specifically on WCAG 2.1 Level AA contrast compliance and explores how token naming conventions and supporting documentation influence designers' ability to apply tokens correctly and confidently. The study addresses three research questions centred on accessibility compliance, naming usability, and documentation effectiveness.

A Design Thinking framework guided the project through exploratory research, system design, and evaluative testing. A mixed-methods approach was adopted, combining an accessibility audit, usability testing, and a System Usability Scale (SUS) questionnaire.

The outputs include a structured token system comprising the overall architecture, semantic naming convention for colour, typography, and spacing tokens. These were applied across a custom component library in Figma and supported by structured documentation and an onboarding video to guide usage.

The following sections present the literature and practice review, research methodology, design implementation, results, and critical discussion. The study concludes with reflections on its impact, limitations, and future opportunities to expand accessibility in design systems through design tokens.

2 LITERATURE AND PRACTICE REVIEW

Design systems have become essential in delivering consistent, scalable, and accessible user experiences across digital products. At the core of these systems are design tokens. Design tokens are reusable variables that abstract design decisions into scalable design properties. As their adoption increases, so does the need to understand how effectively design tokens contribute to accessibility, mainly as global regulations like the European Accessibility Act introduce legal requirements for compliance.

This section reviews existing literature and practices on design systems, design tokens, and accessibility. It also identifies critical gaps in how designers categorise, document, and use design tokens, particularly when creating non-standard components. The section outlines the research problem and questions guiding this study.

2.1 Design Systems

Design systems are structured collections of principles that express the system's vision, design elements, and reusable components that ensure consistency across digital products. Rose et al. [22] noted that design systems typically include colour palettes, typography, spacing, and components. These are critical for creating user interfaces across an organisation's products. Design systems provide a consistent user experience across products, enabling companies to deliver faster while maintaining quality and brand integrity [5].

In frontend development, design systems provide a library of user interface (UI) components, such as buttons, input fields, and menus, which can be reused across different areas of an application. These libraries are often built with development frameworks like React, Vue, and Angular. As well as components, design tokens like colour, spacing, and typography are in the library to ensure consistency. These libraries reduce manual styling efforts, speed up development, and ensure changes to the design system are propagated across applications [7].

The adoption of design systems has accelerated in response to challenges such as inconsistent user experiences and the demand for faster product delivery. Edelberg and Kilrain [5] emphasise design systems help deliver intuitive and cohesive digital experiences by serving as the source of truth for design and development teams. Design systems became essential in digital product development during the mid-2010s.

Notable early design systems in Table 1 include Google's Material Design, Salesforce Lightning Design System, and IBM's Carbon Design System.

Table 1 Notable early design systems.

Company	*Design System*	*Year*	*Description*
Google	Material Design	2014	Introduced a comprehensive design language focused on visual consistency, motion, and interaction across platforms [15].
Salesforce	Lightning Design System	2015	Popularised the concept of design tokens, which transform design properties into reusable values [14].
IBM	Carbon Design System	2015	Focused on accessibility and scalability, providing a robust framework for enterprise applications [9].

These design systems in Table 1 address the need for consistency, scalability, and accessibility, making it easier for design and development teams to work together efficiently.

2.1.1 *Role of Design Systems in Product Development*

Design systems are crucial in product development, enabling organisations to deliver products fast.

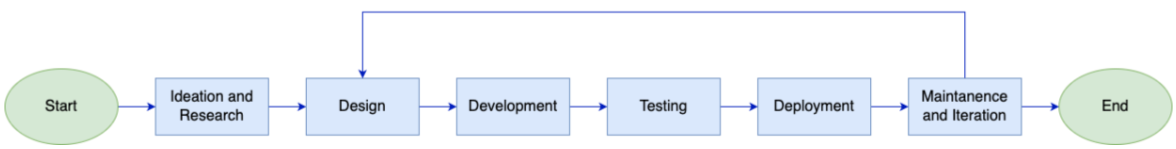

Figure 1 A flowchart of a design system's product development phases.

The flowchart in Figure 1 illustrates how design systems are integrated into each product development phase, from initial design to deployment and maintenance. It outlines the following key stages:

- **Ideation and Research:** Identifies product requirements and user needs.
- **Design:** Designers create wireframes and prototypes using the design system library.
- **Development:** Developers implement the designs using the frontend design system library.
- **Testing:** The application is tested for functionality, consistency, and accessibility.
- **Deployment:** The product is released to users.
- **Maintenance and Iteration:** Improvements and updates are made to the design system and are integrated into the products.

2.1.2 *Design System Examples*

Table 2 highlights some of the most popular design systems. Some design systems are open-source and used in other organisations' design and development of different products and services.

Table 2 Design system examples.

Company	*Design System*	*Use Cases*	*Key Features*	*Marketplaces/Access*
Google	Material Design	Creating Android apps, web apps, and multi-platform products.	Customisable themes, consistent UI components, motion guidelines, and typography tailored for Android and non-Android devices.	Material.io
IBM	Carbon Design System	Enterprise-level applications focusing on accessibility and scalability.	Accessibility-first approach, extensive components, and data visualisation libraries.	Carbon Design System
Atlassian	Atlassian Design System	Designing tools like Jira, Confluence, and Trello for collaboration and productivity.	Patterns for navigation, forms, tables, and collaboration-based interactions.	Atlassian Design System
Salesforce	Lightning Design System	Building Salesforce applications with reusable components and a scalable architecture.	Design tokens, accessibility guidelines, and responsive grid systems.	Lightning Design System
Shopify	Polaris	Developing Shopify storefronts, merchant tools, and extensions for e-commerce platforms.	E-commerce-focused components, responsive design, and brand consistency tools for merchants.	Polaris
Adobe	Spectrum	Building tools and apps integrated with Adobe Creative Cloud.	Consistent experiences across creative tools, scalable components, and accessibility focus.	Spectrum

The design systems listed in Table 2 serve as foundations for their respective and other organisations, each tailored to the needs of their products and users. By understanding these examples, designers and developers can gain insights into best practices for creating scalable, efficient, and accessible design systems for their projects. Additionally, many design systems highlight the importance of embedding accessibility to ensure products meet user needs and comply with standards like Web Content Accessibility Guidelines (WCAG) [26].

2.2 Design Tokens

Central to the functionality of design systems are design tokens. Design tokens are a way to store and manage the foundations of a design system in a consistent and scalable way.

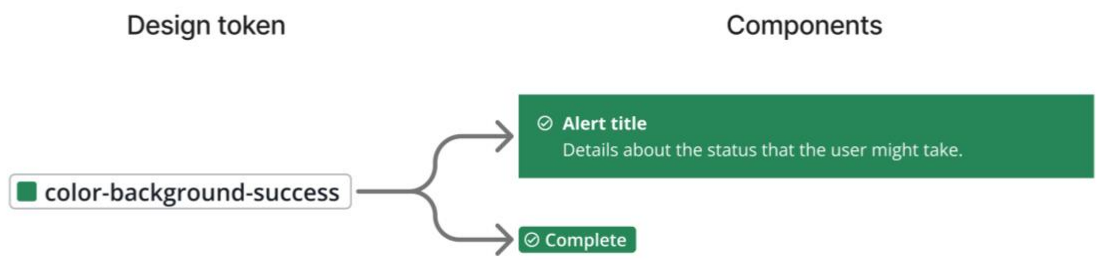

Figure 2 A colour design token reused across several components within a design system.

According to Jina Anne [30], design tokens enable teams to align their design decisions with development by abstracting design properties like colour, spacing, and typography into reusable values. Figure 2 displays a colour design token that can be reused in multiple components within a design system. Design tokens allow teams to maintain a single source of truth for design properties, enabling seamless updates and consistent user experiences.

The concept of design tokens was first introduced by Salesforce as part of their Lightning Design System in 2014. The term was coined by Jina Anne, a design systems advocate and former lead designer at Salesforce, to describe a structured way to manage design properties programmatically across multiple platforms and products. Salesforce's use of design tokens addressed the challenge of maintaining consistency across various interfaces. It ensured that design changes could be efficiently propagated through updates to token values rather than manual adjustments to individual components [14].

The adoption of design tokens has since expanded beyond Salesforce, becoming a best practice in many design systems, such as Asana's Design System, IBM's Carbon Design System, Google's Material UI Design System, and Shopify's Polaris Design System.

However, design tokens are not just about consistency but are also critical to enabling accessibility. Pandey and Dong [20] explain that embedding accessibility standards directly into design systems is key to ensuring that digital products meet Web Content Accessibility Guidelines (WCAG) without requiring manual adjustments.

2.2.1 *How Design Tokens Abstract Design Properties*

Design tokens abstract the foundational elements of a design system, such as colour, typography, and spacing, into reusable variables [23].

2.2.1.1 Design Tokens Examples

Design tokens are design properties stored as variables.

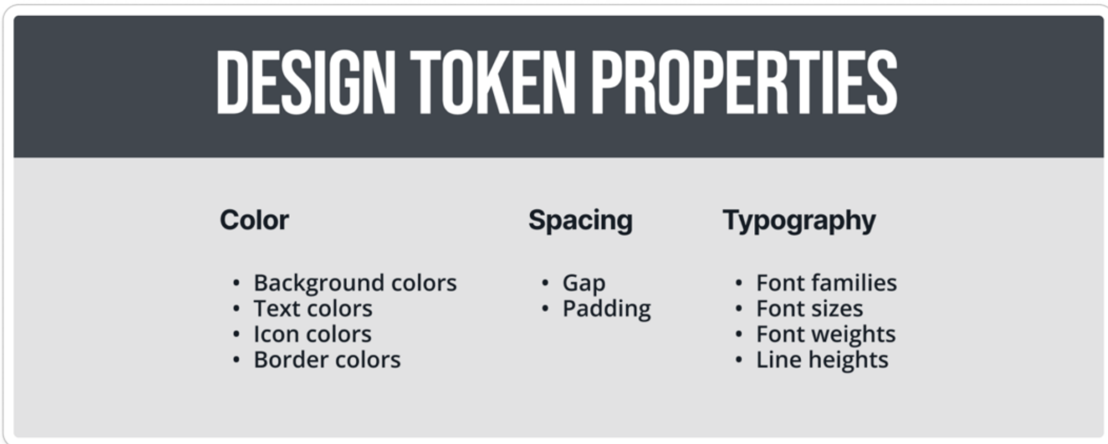

Figure 3 Colour, spacing and typography design property examples.

Design properties such as colour, spacing, and typography can be described as design tokens. Figure 3 displays several examples of the many design properties that can be described as design tokens.

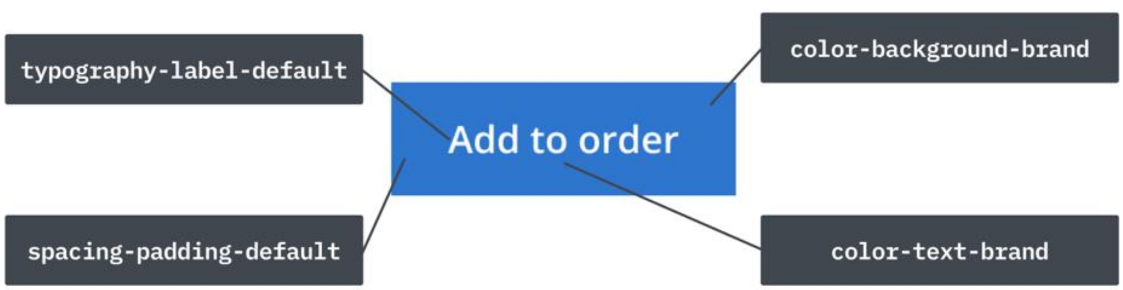

Figure 4 A button component example displaying the design tokens applied to it.

Figure 4 displays an example button component with several design tokens applied to it. Colour, spacing, and typography design properties are stored as design tokens used to build this component. By referencing tokens, design systems maintain a single source of truth for design properties. This allows seamless updates that propagate changes across all instances where the tokens are applied.

2.2.2 Design Tokens in Practice

According to Saari [23], real-world implementations provide valuable insights into how tokens are applied to solve design challenges and streamline collaboration between designers and developers. In practice, two prominent examples of design tokens are Asana's Design System and IBM's Carbon Design System. These systems highlight the practical benefits of design tokens, such as centralised design decisions, theme management (e.g., light and dark modes), and embedded with accessibility practices.

2.2.2.1 Asana Design System

Asana, a work management platform, demonstrated in 2021 how design tokens are pivotal in implementing dark mode into their product [31]. Dark mode is a user interface (UI) design with a dark background, light-coloured text, and UI elements. In a survey conducted by the Neilson Norman Group, one-third out of 115 mobile users use dark mode because it reduces eye strain and improves accessibility for those with visual impairments [10]. Their design system uses design tokens to streamline the management of theming.

Figure 5 A button component's colour tokens in light mode.

Figure 6 A button component's colour tokens in dark mode.

Figures 5 and 6 demonstrate the structure of the design token system in both dark and light modes. The system reuses the same design tokens across modes, such as `default-background` and `default-text`. The design token's value will change depending on which mode.

Asana's approach to implementing theme management using design tokens highlights several key advantages. It ensures flexibility and scalability, as the design system can modify tokens globally to affect changes across the system without altering individual components. Secondly, Asana utilises tokens to manage colour and contrast to ensure light and dark modes with Web Content Accessibility Guidelines (WCAG) standards. According to WCAG 2.1 Level AA, the success criterion for contrast ratio must be at least 4.5:1 for text [28]. Asana ensures that their design tokens are pre-programmed to meet this standard.

2.2.2.2 Critical Analysis

Asana's token naming convention takes a semantic approach. This approach refers to how design tokens are used in the user interface (UI). Asana's use of token names like "selected-text-hover" and "warning-background-strong" offer a simplistic and generic approach to token naming. While this simplicity can provide a broad token application across various contexts, it may lead to token name clarity and accessibility challenges. Without token names that indicate specific use cases, designers and developers may face uncertainty about which tokens to use in particular scenarios, for example, when combining two colour tokens for background and text to meet WCAG contrast standards [5, 12]. This is a key usability issue for designers and developers who use design tokens in their workflows and a key focus of this research study.

This matter becomes more apparent when designers design beyond the design systems' predefined library. For instance, a designer creates a new component specific to a product that is not available as a component of the design system, and the component requires a background and text colour token. The designer wants to maintain consistency and use the design system's tokens to build their custom component. The designer could select a background colour token such as `brand-background-strong` but be unsure which text colour token is appropriate and meets WCAG standards for contrast against the background colour token. This would add more effort and time for the designer as they would need to check manually whether their selected token pairings pass for accessibility.

2.2.2.3 Proposed Improvements

To mitigate these challenges, Asana could benefit from adopting more descriptive semantic token names, such as `color-background-warning-high` or `color-text-default-on-warning-high`, that provide more context about their intended usage. These token names could help designers intuitively understand which token pairings to use for specific UI elements, reducing the risk of inaccessible designs. The adoption of semantic tokens that clearly describe their purpose has been highlighted in the literature by Pandey and Dong [20] as a more effective way to guide designers in creating accessibility-compliant designs.

Additionally, including detailed guidelines and documentation highlighting accessible token pairings and best practices would empower designers to make informed design decisions. This is a key gap that this research study addresses.

2.3 Accessibility in Design Systems

In digital product design, accessibility refers to creating interfaces and experiences that people of all abilities can use. Organisations must follow a set of guidelines to make products accessible. This includes ensuring that digital products are perceivable, operable, understandable, and robust, aligning with standards from Web Content Accessibility Guidelines (WCAG) developed by the World Wide Web Consortium (W3C). WCAG is structured around four core principles: Perceivable, Operable, Understandable, and Robust [27]. The four principles help ensure digital content is accessible to all users. This research study focuses on the Perceivable principle, evaluating how design tokens can help maintain sufficient colour contrast to ensure visual information is distinguishable by all users.

Additionally, design tokens also have the potential to support other WCAG principles. Tokens that define spacing and target sizing can contribute to the operable principle by ensuring interactive elements are easier to access and navigate.

Beyond WCAG, this work aligns with Universal Design and Inclusive Design frameworks. Universal Design promotes "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialised design" [3]. Similarly, Inclusive Design focuses on designing for diverse human experiences, recognising that one-size-fits-all approaches often exclude users with specific needs [17]. While this study's scope focuses on contrast, the underlying structure of the design token system reflects the principles promoted by these broader design frameworks.

While accessibility is necessary to ensure digital inclusivity for individuals, it also represents a significant business advantage, especially as global regulations become stricter. The European Union's (EU) Web Accessibility Directive and the European Accessibility Act have legally required companies to develop accessible digital products, with penalties for non-compliance [2, 19].

2.3.1 Adopting Accessible Design Systems

WebAIM (Web Accessibility in Mind) offers expertise in web accessibility. In the 2023 WebAIM Million report, WebAIM conducted an accessibility evaluation of the home pages for the top 1,000,000 websites. 96.3% of home pages failed to meet WCAG standards, with the most common failure being low-contrast text found on 83.6% of pages [29].

This widespread issue highlights organisations' ongoing difficulty in implementing accessible design at scale. These findings validate this research's need to explore how design tokens, when embedded with accessibility considerations such as contrast-safe pairings, can reduce such failures. By shifting accessibility into the foundational layer of design systems, tokens offer a scalable, proactive solution to one of the most persistent WCAG issues.

2.3.1.1 Accessibility and Carbon Design System

IBM's Carbon Design System is a comprehensive open-source design system emphasising accessibility by integrating design tokens to enforce consistent and inclusive design practices. Carbon uses design tokens to manage design properties, ensuring these elements adhere to Web Content Accessibility Guidelines (WCAG).

Each colour token in Carbon's systems is defined to meet or exceed WCAG 2.1 requirements for contrast [28]. For example, text colour tokens such as `text-01` are paired with background colour tokens like `interactive-01` to ensure a minimum contrast ratio.

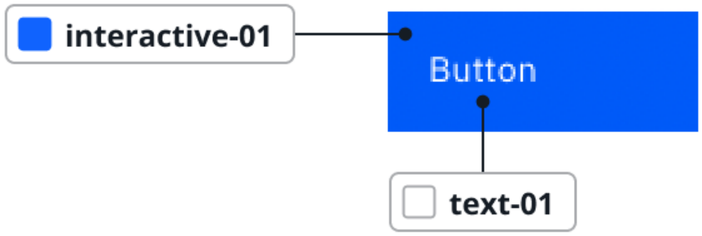

Figure 7 Carbon design system's button component and the colour tokens applied to it.

Figure 7 illustrates the colour token pairings applied to Carbon's button component. These tokens meet WCAG 2.1 compliance for contrast.

2.3.1.2 Critical Analysis

IBM's Carbon Design System is a prime example of a design system that integrates accessibility with design tokens. Carbon ensures that products maintain consistency, scalability, and accessibility. However, particular areas present challenges and gaps that highlight opportunities for improvement.

While Carbon's tokens are effective, tokens, such as `interactive-01` and `text-01`, are generic and may need more clarity for a designer who may not be very familiar with the system. This could confuse designers when using tokens in their designs, increasing the risk of accessibility issues. More descriptive names could enhance usability and reduce errors, and this research focuses on making tokens more usable by improving their structure and naming clarity.

Although Carbon's documentation is thorough, it is often more developer-centric. This could create a barrier for designers, particularly those new to design systems, design tokens, or accessibility guidelines. Resources catered to varying experience levels, such as visual examples or simplified guides, could help bridge this gap.

While Carbon integrates design tokens to support accessibility compliance, there is limited research on these tokens' specific impact on achieving and maintaining accessibility in product usage. Without evidence to validate the effectiveness of these tokens, there is uncertainty about whether designers consistently achieve accessibility compliance when applying them. This gap highlights the need to research how designers understand, select, and use design.

2.3.1.3 Proposed Usability Improvements

The following improvements are recommended to enhance the accessibility and usability of IBM's Carbon Design System. Replace generic token names like `interactive-01` with more context-specific names such as `button-color-background-primary` to provide more explicit guidance and reduce uncertainty for designers.

Additionally, developing additional resources tailored for designers, including visual examples, simplified guides, and step-by-step instructions for applying tokens. Expand the documentation to include best practices and examples for using tokens. This enhances accessibility compliance even when designers create components outside the predefined design system library.

2.3.2 Accessibility Testing and Design Tokens

While existing literature highlights the operational benefits of design tokens, there is a notable gap in evaluating the direct impact of design tokens on accessibility compliance.

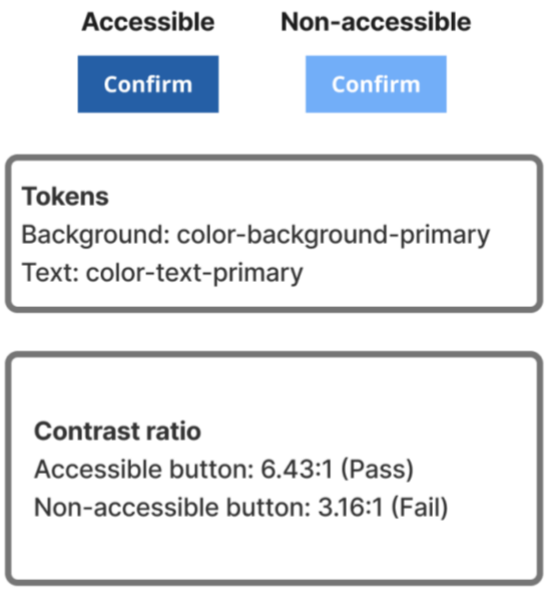

Figure 8 Two button components with colour tokens demonstrating accessibility compliance.

Figure 8 compares two button components using a pair of colour tokens for background and text, illustrating accessibility compliance.

Studies emphasise how design tokens streamline design handoff and maintain consistency across digital products but fail to demonstrate their effectiveness in promoting accessible design outcomes. For instance, while Saari discusses the benefits of abstraction and consistency provided by design tokens [23], the research lacks evidence on whether these tokens prevent accessibility violations. This section explores these gaps in the literature, emphasising the need for further research to understand how design tokens can be leveraged to improve accessibility.

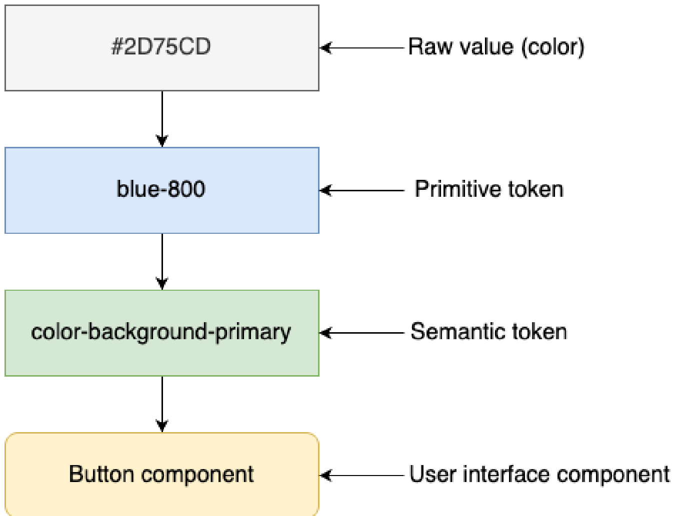

Figure 9 A flowchart demonstrating the abstraction process of design properties into tokens and their application in the UI.

The flowchart in Figure 9 visualises the abstraction process through two types of design tokens and is applied to a button component. It explains the role of design tokens in maintaining a single source of truth. The first abstraction takes place when a primitive token is assigned a raw value for colour. Primitive tokens, also known as global or core tokens, are the first level of tokens built into a token system [11]. They define what is available in the design system. After defining the primitive token, they are assigned to a semantic token. The semantic tokens give the primitive tokens a role within the user interface [31]. The semantic token is applied to a button component's background colour in the flowchart.

Furthermore, Saari highlights that design tokens facilitate updates on a global scale. For example, when a colour value is modified, the change propagates automatically across all instances where that token is used [23]. This capability ensures that design changes are consistent and scalable, reducing the potential for discrepancies.

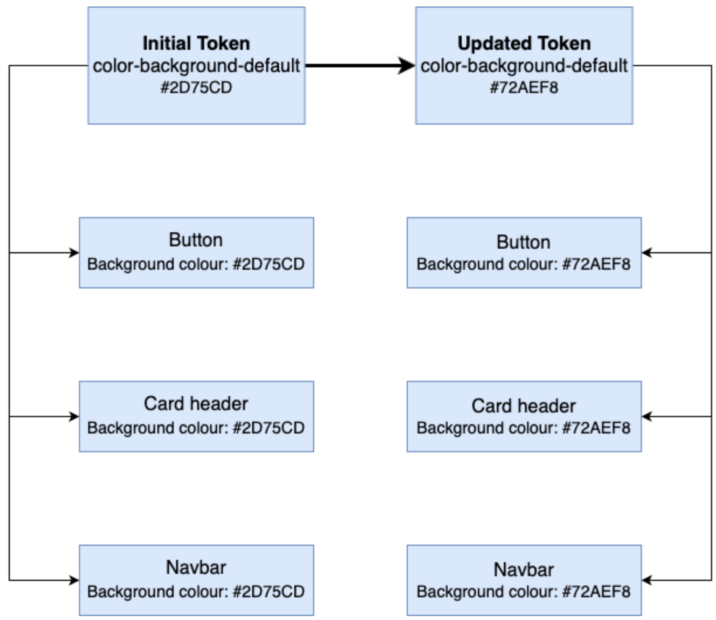

Figure 10 A flowchart demonstrating a colour design token value updating. The update automatically propagates across all components consuming the design token.

Figure 10 illustrates the propagated change to multiple components when the colour value is updated. The token value is changed in one place and is reflected across all components using that token. The literature emphasizes that these changes ensure consistency and reduce manual work in maintaining design updates.

2.3.2.1 Critical Analysis

Despite the operational benefits, the literature reveals a significant gap concerning the impact of design tokens on accessibility compliance. For example, Saari discusses the structure and implementation of design tokens but does not explore how these tokens ensure accessible design outcomes [23]. It is uncertain whether design tokens inherently support accessibility or whether their effectiveness relies on documentation and naming.

Another gap is the lack of research on how designers interact with design tokens to maintain accessibility compliance. This points to a broader usability gap on whether designers can find, understand, and apply them effectively in their work. The effectiveness of design tokens in achieving accessibility may depend on the clarity of the naming, documentation, and guidelines. Without comprehensive documentation on accessible use cases, designers may accidently misuse tokens, leading to accessibility violations such as insufficient contrast or poor legibility.

2.4 Research Problem

Despite the increasing adoption of design systems and design tokens, a significant gap exists in understanding their direct impact on accessibility compliance. While existing literature highlights the benefits of design tokens for consistency, scalability, and efficiency, few studies evaluate how these tokens contribute to meeting Web Content Accessibility Guidelines (WCAG) standards in practice.

One problem generates from generic or unclear token naming conventions, making it difficult for designers to select the appropriate tokens for accessibility compliance. While the literature is limited in explicitly identifying naming as an issue, usability concerns around token naming and selection have emerged in practice. For example, the 2022 Design Systems Survey by Sparkbox found that poor documentation and difficulty distinguishing between outdated, broken, or upcoming components were among the top challenges faced by design system users [25]. These findings suggest broader issues around clarity, guidance, and confidence when working within a design system. Designers may struggle to apply tokens correctly when insufficient documentation or naming conventions are not intuitive. This could lead to accessibility failures, even when the system contains accessible design tokens, indicating that usability is critical in achieving accessibility compliance.

This research study addresses these challenges by investigating three key areas: the effectiveness of design tokens in ensuring accessibility compliance, the influence of token naming conventions on usability, and the role of documentation in supporting the creation of accessible designs.

2.4.1 Research Questions and Hypotheses

Research Question 1: How effective are design tokens in ensuring accessibility compliance with accessibility standards, particularly in maintaining sufficient contrast?

- **Hypothesis 1:** If accessible attributes such as appropriate contrast are embedded into design tokens, designs produced using these tokens will consistently meet or exceed WCAG 2.1 Level AA contrast requirements.

The hypothesis will be evaluated through an accessibility audit measuring compliance pass rates.

Research Question 2: How does the clarity of design token naming conventions impact the system's usability, specifically the designers' ability to identify and apply tokens correctly?

- **Hypothesis 1:** Clear and intuitive token naming will improve the usability of the design token system, enabling designers to identify and apply the correct design tokens more accurately.

Although accessibility compliance is not directly evaluated under Research Question 2, the analysis will explore how improved usability, through clear and intuitive token naming, may indirectly contribute to correctly applying WCAG-compliant tokens (RQ1).

Research Question 3: How effective are improvements in design token documentation in helping designers create accessible, non-standard components?

- **Hypothesis 1:** Documentation that provides clear guidelines on token usage will enable designers to create non-standard components that comply with WCAG 2.1 standards.
- **Hypothesis 2:** Designers will find the documentation effective and easy to use, as measured by the System Usability Scale (SUS).

Hypothesis 2 also supports evaluating overall system usability linked to Research Question 2.

2.5 Conclusion

The literature and practice review has established the importance of design systems and tokens in supporting consistent and accessible digital products. While the use of design tokens is widespread, key usability and accessibility challenges remain. Industry examples demonstrate token adoption and potential for accessibility, but gaps persist in how tokens are named, understood, and applied in workflows.

Most notably, there is little evidence evaluating whether designers can consistently use tokens to achieve WCAG compliance or whether naming and documentation provide enough guidance. The literature also highlights that accessible design should not be retroactive fixes and embed accessibility from the beginning. This is an approach increasingly supported in both WCAG and inclusive design principles. This gap informs the rationale behind this study. It frames the following research questions, which investigate how the design and structure of tokens and supporting documentation can enable designers to create accessible interfaces more confidently and effectively.

3 METHODOLOGY

This section outlines the research methodology to investigate how a design token system can support accessibility compliance for contrast. It describes the activities using the Design Thinking Framework, a user-centred and iterative process that guided the study. A mixed methods approach was followed, combining qualitative and quantitative techniques to capture measurable outcomes and user insights. Methods included a survey, semi-structured interviews, usability testing with observation and post-task questions, a System Usability Scale (SUS) questionnaire, and an accessibility audit. Each method was aligned with the research questions and designed to evaluate aspects of naming conventions, documentation usability, and accessibility compliance.

3.1 Overview of Activities

This study followed the Design Thinking Framework as the overarching structure, supporting a user-centred and iterative approach to exploring, designing, and evaluating a design token system for accessibility [21]. The framework was chosen because it emphasises user-centred, iterative problem-solving, which aligns with the project's focus.

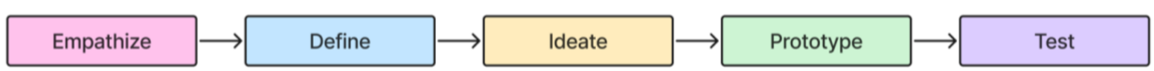

Figure 11 Design Thinking Framework

The framework in Figure 11 includes five key stages: Empathize, Define, Ideate, Prototype, and Test. Activities were carried out iteratively, with insights from one stage continuously informing and shaping decisions in others.

3.2 Research Study Design

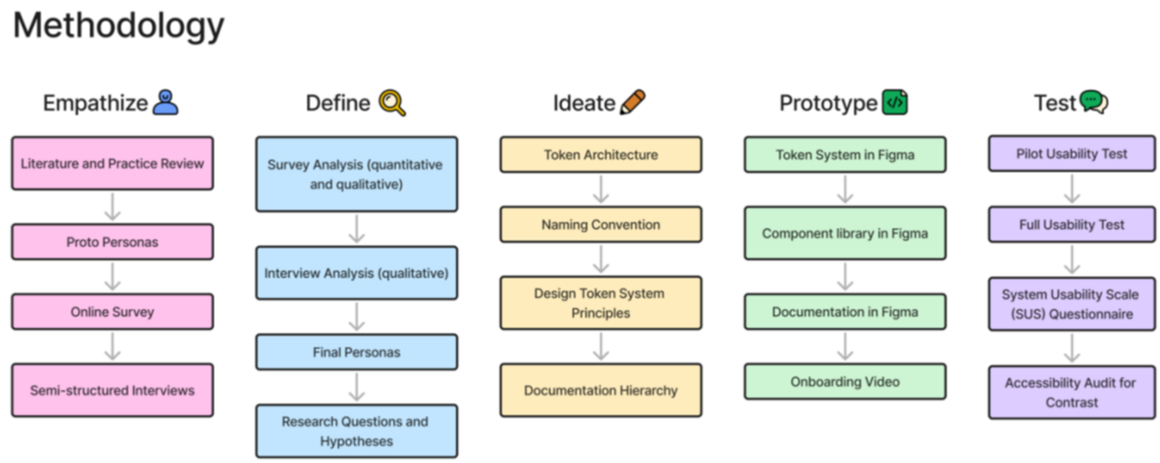

Figure 12 Overview of the research study design and the methods used.

Figure 12 illustrates the structure of the research process using the Design Thinking framework, mapping key activities across each stage. Iteration loops are also visible between the Empathize and Define stages, where findings from the survey and interviews informed the refinement of initial proto-personas into more accurate personas. This structure enabled a flexible and responsive approach. Each chosen method was aligned with the study's research questions and hypotheses to ensure relevance.

3.3 Mixed Methods Approach

This research adopted a mixed methods approach, combining quantitative and qualitative methods. Table 3 outlines the methods used and whether each method was qualitative, quantitative, or both.

Table 3 Methods used, and type of data collected.

Method	*Type*
Survey	Quantitative and Qualitative
Semi-structured Interviews	Qualitative
Usability Test Post-Task Questions	Qualitative
System Usability Scale (SUS) Questionnaire	Quantitative
Accessibility Audit for Contrast	Quantitative

3.4 Methods Used

3.4.1 Survey

The online survey aimed to gather early insights from designers and developers working with design systems and design tokens to understand their usage, challenges, and impact on accessibility. This helped validate the research problem and informed the exploratory research phase.

23 participants completed the survey, all of whom had varying levels of experience. The survey was distributed online and included quantitative and qualitative questions. It measured perceptions of design token clarity, usability, and documentation support. At the end of the survey, participants could opt to participate in an interview. The survey provided early indicators of naming convention usability and highlighted gaps in documentation, supporting Research Questions 2 and 3.

3.4.2 Semi-structured Interviews

The purpose of conducting interviews was to explore the challenges designers experience when applying design tokens, particularly with accessibility, naming clarity, and documentation.

The researcher interviewed five designers remotely using Microsoft Teams. These participants opted for an interview after completing the survey. Each interview followed a semi-structured guide but allowed for open conversation. The interviews were transcribed and thematically analysed. Qualitative data was gathered regarding token naming issues, documentation gaps, and accessibility concerns. The interviews provided further depth around token naming convention usability and informed documentation requirements. These findings supported Research Questions 2 and 3.

3.4.3 Usability Test

The usability testing evaluated how well participants could identify and apply design tokens using the system. Tasks were designed to test comprehension of naming conventions, token application accuracy, and reliance on documentation.

Eight participants completed the full usability test after completing a pilot usability test with three participants. All participants had design experience and varying familiarity with tokens and accessibility standards. Participants completed three tasks in Figma. The researcher took observation notes and asked post-task questions after each task. Qualitative data was gathered regarding the participants' experience during each task. Usability testing assessed how naming conventions influenced token selection and application. It evaluated how documentation supported designers and observed whether the correct tokens were selected.

3.4.4 System Usability Scale (SUS) Questionnaire

The System Usability Scale (SUS) questionnaire evaluated the overall usability of the design tokens system and documentation. All eight usability test participants completed the SUS questionnaire after completing the tasks. The responses were scored to produce a usability score between 0-100, collecting quantitative data. The questionnaire provided a measurable indication of usability and perceived effectiveness of documentation. It also reinforced findings around the system's overall ease of use. These findings supported Research Questions 2 and 3.

3.4.5 Accessibility Audit for Contrast

An accessibility audit for contrast verified the tokens applied by participants met WCAG 2.1 Level AA contrast requirements. The audit was conducted on the outputs of the eight participants' task completions. Token pairings (background and content) were extracted from Figma and tested using the WebAIM contrast checker. The data collected provided a binary pass or fail result per token pairing. The accessibility audit directly tested the hypothesis regarding embedded token accessibility, ensuring WCAG compliance, as per Research Question 1.

3.5 Conclusion

The methodology combined structured design thinking with a mixed methods approach to explore, build, and evaluate an accessible design token system. Each method specifically addressed the research questions: exploratory methods identified user needs and gaps, iterative prototyping supported system development, and evaluative methods measured usability and accessibility compliance. Integrating qualitative and quantitative data provided a comprehensive view of how design tokens and documentation influence accessibility outcomes.

4 DESIGN

This section outlines the design process behind developing a design token system optimized for accessibility and usability. The system was designed to address key challenges identified by designers, specifically unclear naming conventions, limited documentation, and uncertainty around accessibility compliance based on insights from exploratory research. The section details the architecture and rationale behind the token system, including its naming structure and implementation across colour, spacing, and typography. It also documents how the system was embedded into a Figma design library, supported by structured documentation, and applied through real-world component examples. The section describes how these outputs were prepared for usability testing to evaluate the system's usability.

4.1 Proto Personas

Before conducting exploratory research, proto-personas were developed to clarify assumptions and guide early thinking around designers' interaction with design tokens and accessibility. These personas were based on anticipated experience levels and needed to be related to naming conventions, documentation, and accessibility compliance.

Table 4 Proto personas created before exploratory research.

Name	*Role*	*Needs*	*Challenges*

Alex Rivera	Junior Designer	Clear, easy-to-understand tokens and guidance for accessibility.	Limited experience with design systems and accessible design.
Jame Lee	Senior Product Designer	Efficient workflows, consistent token application.	Frustrated by unclear token names and missing documentation.
Morgan Patel	Accessibility Specialist	Evidence that tokens support WCAG compliance	Requires detailed guidance to ensure compliance for non-standard components.

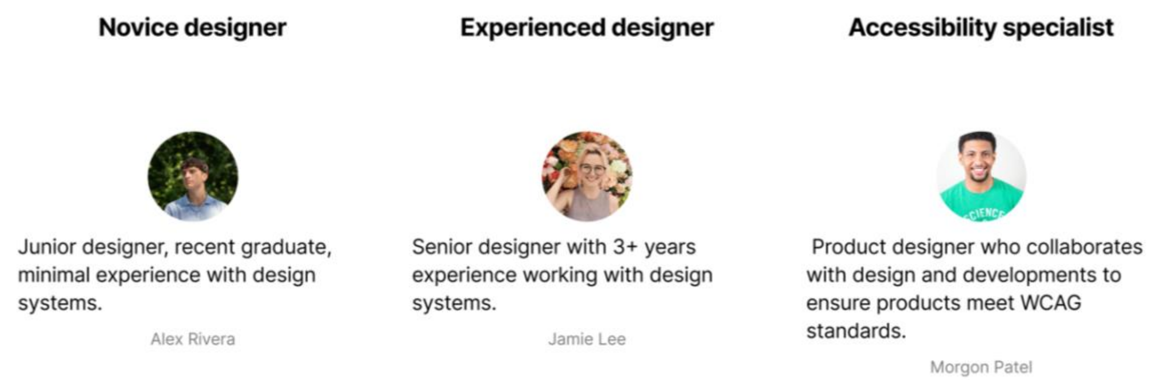

Figure 13 Proto personas created before exploratory research.

Table 4 and Figure 13 describe the proto-personas created before exploratory research. After completing the research with users, the personas were critically reassessed and refined into one final persona.

4.2 Exploratory Research Findings

This section presents the exploratory research carried out during the Empathize and Define stages of the design process. An online survey and a series of semi-structured interviews were conducted to gather insights. The findings from these methods informed the development of the design token system.

4.2.1 Survey Findings: Quantitative

An online survey was sent using LinkedIn to find early insights into how designers and developers interact with design tokens. 23 participants responded, comprising a mix of product designers, UX/UI designers, and front-end developers. Respondents had varying experience with design systems, accessibility guidelines, and tokens. The survey included both quantitative and qualitative questions.

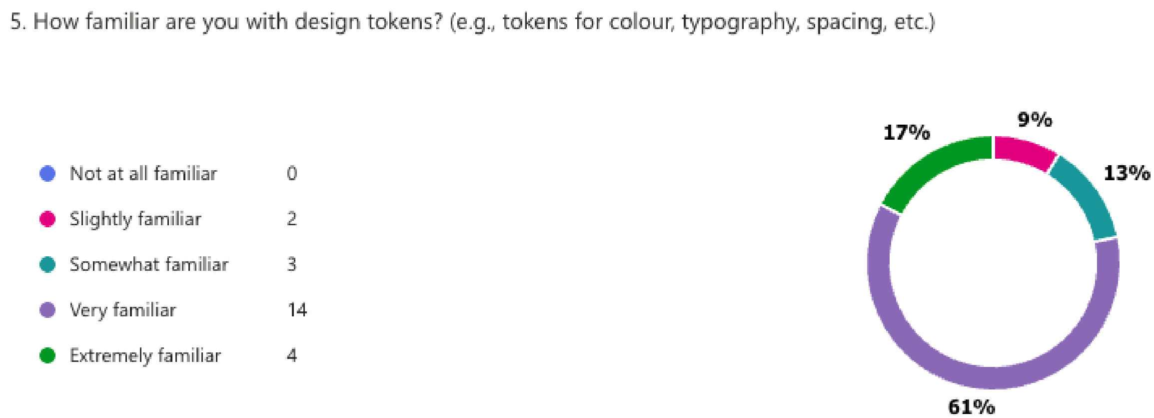

Figure 14 Token familiarity survey responses.

Most respondents rated themselves as either very familiar or somewhat familiar with design tokens, as shown in Figure 14, indicating that the survey reached a relevant audience. This validates the reliability of the feedback.

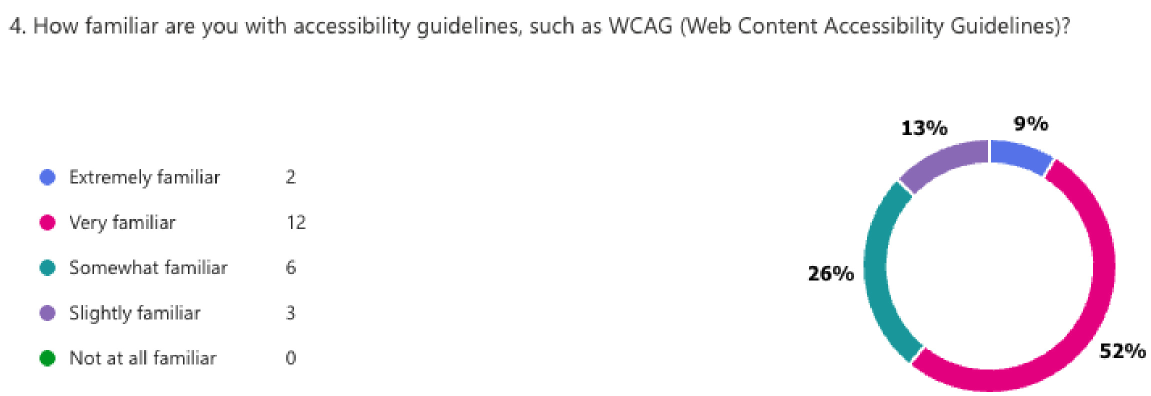

Figure 15 Accessibility guidelines familiarity survey responses.

Most participants reported at least some familiarity with accessibility guidelines like WCAG, though fewer described themselves as very familiar. This suggests a baseline understanding but highlights the importance of providing clear guidance within the design token system to support consistent accessibility compliance.

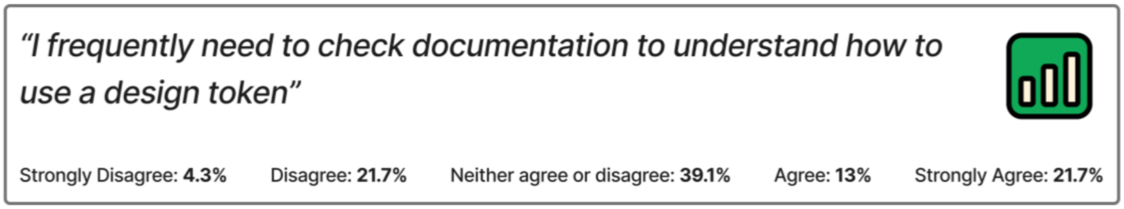

Figure 16 Survey statement responses.

Just under 35% of respondents agreed or strongly agreed that they frequently need to check documentation to understand how to use a design token, while 39% remained neutral. This suggests that while documentation is used, uncertainty persists for many users, pointing to opportunities to improve clarity and reduce reliance on documentation through better token naming or examples.

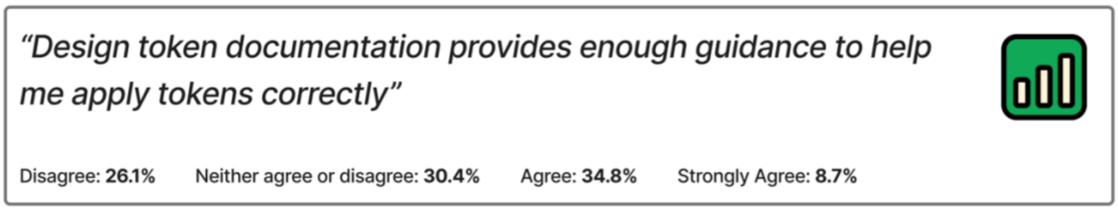

Figure 17 Survey statements responses.

While 43.5% of respondents agreed or strongly agreed that design token documentation provides enough guidance, a combined 56.5% either disagreed or remained neutral. This indicates that documentation may lack clarity for many users, highlighting the need for improved examples, use cases, or more explicit instructions to support accurate token application.

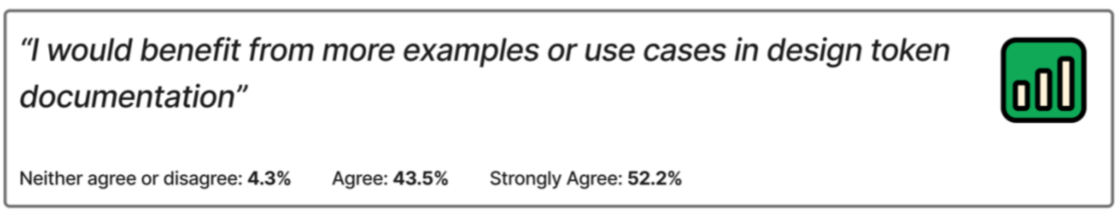

Figure 18 Survey statement responses.

95.7% of respondents agreed or strongly agreed that they would benefit from more examples or use cases in design token documentation. This strongly reinforces the need for practical, contextual guidance, suggesting that existing documentation often lacks actionable content to support confident and correct token usage.

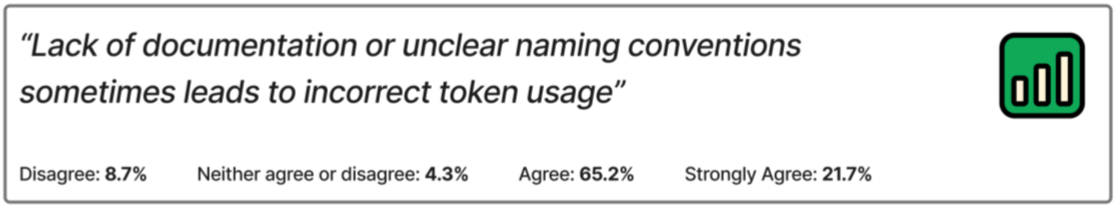

Figure 19 Survey statement responses.

86.9% of respondents agreed or strongly agreed that unclear naming conventions or lack of documentation sometimes leads to incorrect token usage. This highlights a critical usability issue. It highlights the need for clearer naming and better guidance to support accurate token applications and reduce accessibility errors.

4.2.2 Survey Findings: Qualitative

The qualitative responses from the survey provided insights into the challenges designers experience when applying design tokens for accessibility. Open-ended questions focused on documentation clarity, naming conventions, and desired improvements. A thematic analysis was conducted to identify pain points, which were then grouped into three key themes, as shown in Table 5. The findings helped inform the token naming structure and documentation.

Table 5 Summary of key themes in qualitative survey responses.

Theme	*Evidence from Survey Responses*
Lack of clear use cases	"More uses cases would be great" "When there is no recommended use cases or guidance"
Unclear or inconsistent token naming	"If tokens were named more intuitively, documentation wouldn't be needed" "Lack of token descriptions"
Need for visual and practical guidance	"Lack of visual aids in documentation that show examples of token combinations" "More visual aids, do's and don'ts, clear examples"

4.2.3 Interview Findings

The semi-structured interviews provided further qualitative insights into the themes identified in the survey. Participants shared experiences with design tokens, offering perspectives on naming conventions, documentation, and accessibility compliance. These findings are synthesized alongside the survey responses under shared themes in Table 6 to provide a holistic view of key design system challenges.

Table 6 Combined survey and interview insights by theme.

Theme	*Survey Insight (Qual)*	*Interview Insight*

Token Naming Clarity	Many respondents reported that unclear or overly generic token names made it difficult to know when and where to apply them.	Interviewees echoed this issue, explaining that token names were sometimes ambiguous and not descriptive enough. Several noted they had to guess or use trial and error when selecting tokens.
Documentation and Support	Participants stated that documentation was either lacking, challenging to navigate, or failed to show practical examples of using tokens correctly.	Interviewees emphasised the importance of strong documentation, particularly visual aids, tables, and example-driven guides. Some said poor documentation increased reliance on guesswork or caused token misuse.
Accessibility Compliance	Several responses highlighted that the current systems lack guidance on how to apply tokens in a WCAG-compliant way. Many participants said they use contrast checkers manually because they don't trust that the token combinations are accessible by default.	Participants discussed how their design systems lacked instructions on accessibility-specific token use. Some mentioned not knowing which content tokens to pair with which backgrounds for sufficient contrast without external testing.
Usability and Cognitive Load	Respondents noted that identifying and applying the right tokens was time-consuming and frustrating without clear names and examples.	Interviewees described the additional mental load when navigating token menus or selecting tokens for new components. They desired more intuitive systems that reduce hesitation and increase confidence.

4.2.4 Persona

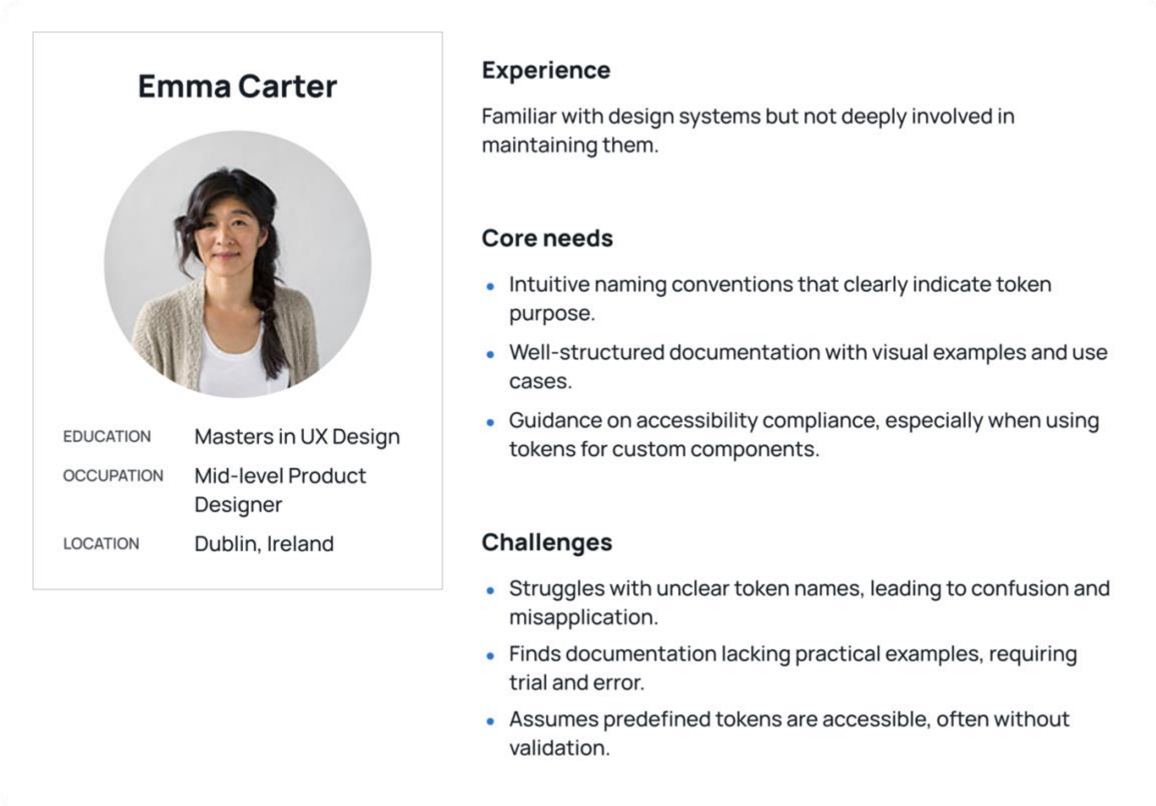

Figure 20 Refined persona after completing primary research.

Figure 20 presents the final persona, Emma Carter, a mid-level product designer who regularly uses design tokens. Based on findings from the exploratory research, Emma has challenges such as unclear naming conventions, limited documentation, and uncertainty around accessibility compliance. Her needs reinforced the importance of intuitive naming, visual documentation with practical examples, and accessibility guidance.

4.2.5 Conclusion

The exploratory research provided clear, actionable insights that informed the implementation of the design token system. The lack of clarity in token naming emerged as a critical usability challenge from the survey and interviews. Designers reported difficulty identifying appropriate tokens for their use case, especially for accessibility, due to overly generic names. This validated the need for a structured naming convention, where tokens show their intended pairing and context of use.

Another finding was the lack of documentation. The survey and interviews highlighted that without examples, visual aids, or guidelines, designers misused tokens or resorted to external tools like contrast checkers. This reinforced the importance of creating structured documentation that outlines intended token applications.

Accessibility compliance was often unpredictable. Participants noted they lacked trust that existing systems supported WCAG 2.1 contrast standards by default. These concerns drove the decision to embed compliance directly into the token naming structure.

These insights shaped the key strategic directions of the project during the *Ideate* and *Prototype* stages. In the Ideate phase, the findings informed the implementation of a token architecture that is the structural foundation of the system, the development of a naming convention that embeds accessibility logic, and the definition of token system principles for colour, spacing, and typography. These decisions ensured accessibility and usability were embedded into the system from the beginning.

The research also guided the architecture of the documentation structure, ensuring content would be easy to navigate and provide practical use cases. During the Prototype phase, these foundational elements were brought through the development of the token system and component library in Figma, the creation of accessible design token documentation within Figma, and the production of a YouTube onboarding video to support self-guided learning. These artifacts formed a cohesive, accessible token system based on user needs.

Additionally, the researcher is undertaking the course “Subatomic: The Complete Guide To Design Tokens” by Brad Frost, a leading expert in design systems [6]. This course provides education on design token implementation, best practices, and scalability, further informing the development of the token system. Materials and results from the exploratory research phase, including the survey, interviews, and thematic analysis, are provided in Appendices A.1 to B.3.

4.3 Design Token System

This section presents the design and implementation of the design token system developed during this study. Informed by the exploratory research findings, the system was created to address common challenges around naming clarity, accessibility compliance, and documentation usability.

4.3.1 Overview of Token Architecture

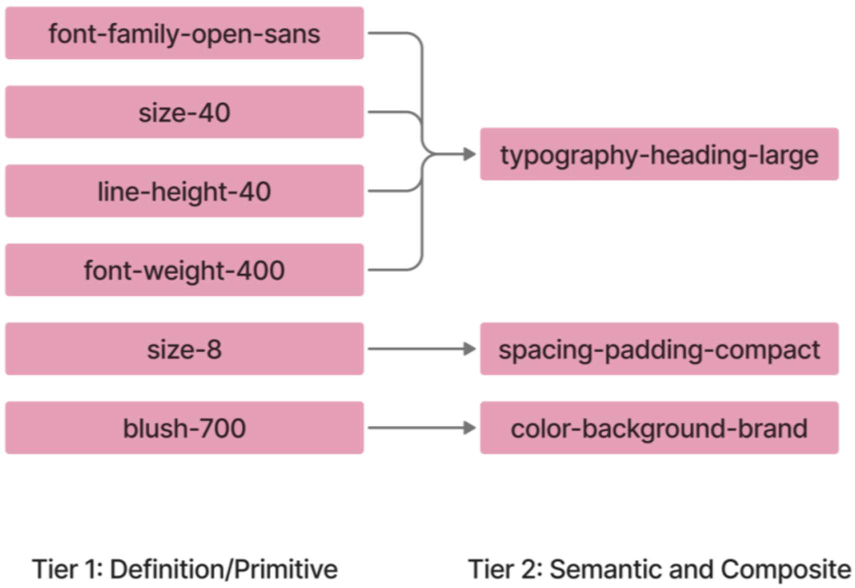

Figure 21 Overview of token architecture.

The token architecture in Figure 21 for this system offers consistency, scalability, and accessibility. Tier one tokens define raw values, such as colours, sizes, and line heights, ensuring a source of truth. Tier two tokens, like semantic and composite tokens, map these values to specific use cases in the interface. This structure enables reusable, accessible design decisions that scale across the system.

4.3.2 Naming Convention

The naming convention follows a semantic structure informed by industry best practices and insights from exploratory research. Its goal is to ensure clarity and usability by embedding purpose, meaning, and accessibility logic directly into each token name. Rather than relying on raw values, designers select tokens based on what they represent in the UI.

Figure 22 Naming convention structure steps (type, role, intention, variant, state).

The structure consists of five possible steps: type, role, intention, variant, and state, as shown in Figure 22. These steps describe what the token does, where it's used, and how it should behave. However, not every token uses every step; tokens only include the elements necessary to communicate their purpose. Table 7 displays examples of token names across colour, spacing, and typography.

Table 7 Token examples.

Token Type	*Example Token Name*
Colour	`color-background-brand`
Colour	`color-content-default-on-brand`
Spacing	`spacing-padding-spacious`
Typography	`typography-label-default`

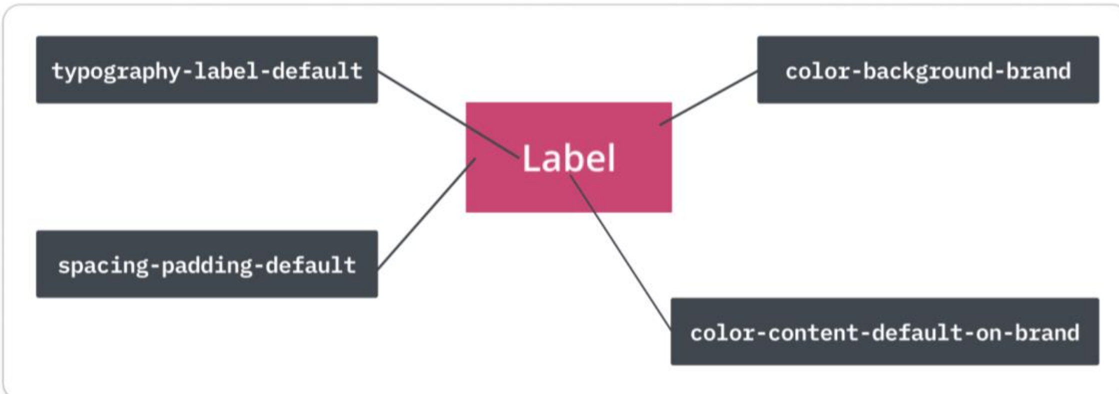

Figure 23 Button component from the library with applied tokens across colour, spacing, and typography.

Figure 23 displays a real example from the component library created during this project, with semantic tokens applied to a button component. This visual illustrates how the naming convention translates into practice.

Relevant insights from the survey and interview findings framed this system. Participants noted that unclear or generic naming created hesitation and reduced confidence when selecting tokens. By using a consistent pattern with predictable terminology, this naming system supports informed and accessible decision-making.

For example, a token like `color-content-default-on-warning` communicates to the designer that it is a foreground token intended for use on a warning background. This structure embeds accessibility best practices into the system, eliminating the need for manual contrast testing and reducing potential errors.

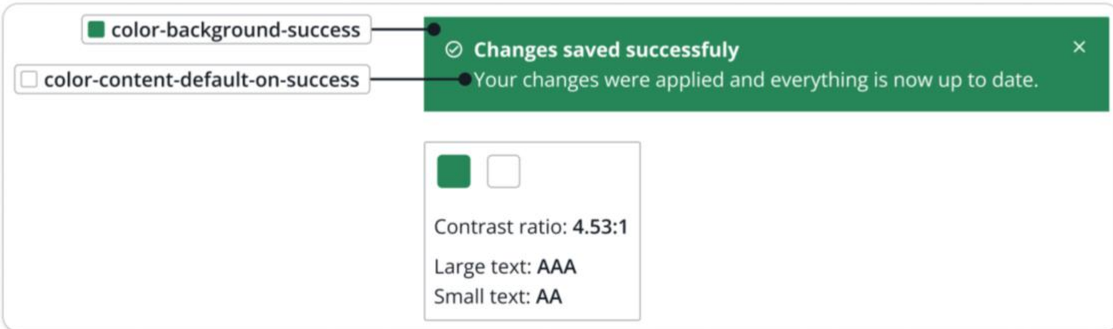

Figure 24 Component example showing token pairing using the on modifier that passes WCAG 2.1 contrast.

The `on` modifier is a special component of the naming system that applies exclusively to content tokens, such as those used for text and icons. It appears at the end of the token name and indicates the background the content token is intended to be placed on. This modifier adds contextual pairing information that supports WCAG-compliant contrast and correct token application, as shown in Figure 24.

This naming logic reduces guesswork, supports accessibility by design, and enables designers to move faster with greater confidence. The structure also aligns with the Design Tokens Format Module (DTCG), ensuring future compatibility with tooling and code-based integration workflows [1].

4.3.3 Colour Tokens

Colour tokens in this system were designed with accessibility at their core. The foundation begins with tier one colour tokens, which define the raw values of colour palettes used across the system. These tokens were generated using the Supa Palette plugin in Figma, enabling an accessible colour palette through structured contrast steps [13].

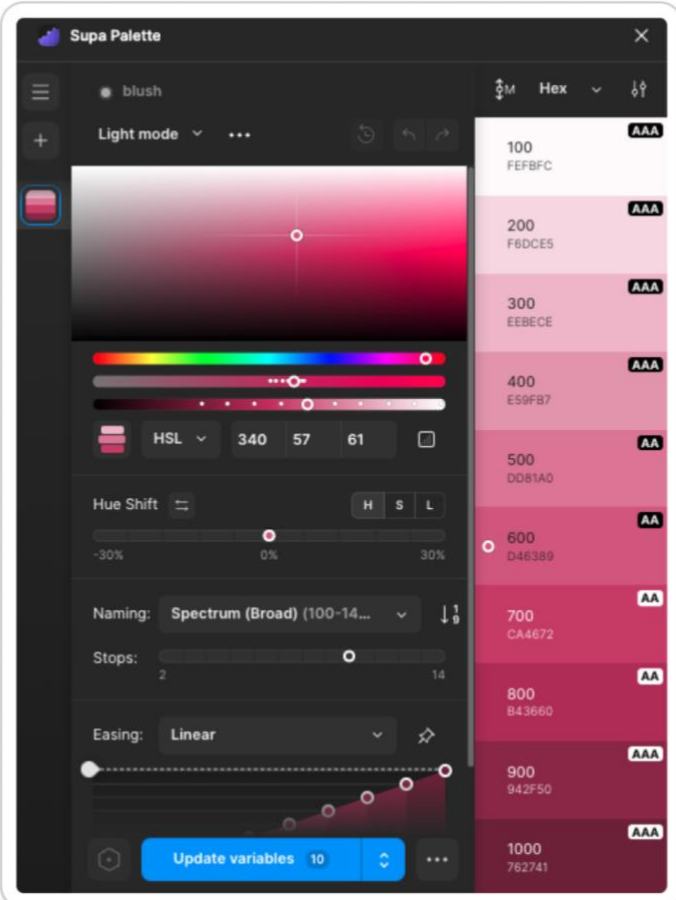

Figure 25 Contrast-tested tier 1 colour palette: blush.

Each step in the palette was evaluated using contrast filters to ensure appropriate lightness levels and meet WCAG 2.1 Level AA contrast standards, as shown in Figure 25.

Tier two colour tokens were created to represent semantic roles in the UI, such as backgrounds, borders, and content. These tokens reference tier one values and are named according to their purpose and context. The system ensures visual consistency while enabling context-aware design choices. Each token was carefully mapped using only pre-validated contrast steps to ensure pairings that meet or exceed WCAG 2.1 Level AA compliance. Table 8 displays examples of the semantic tokens mapped to validated colour values and their usage.

Table 8 Tier two semantic token (colour) examples.

Semantic Token Name	*Maps To (Tier One)*	*Usage*
`color-background-default`	`slate-0`	Use as the default background for the UI.
`color-background-success`	`fenianGreen-700`	Use for backgrounds communicating a favourable outcome.
`color-background-brand-low`	`blush-200`	Use for subtle brand backgrounds.
`color-content-default-on-default`	`slate-1100`	Use for text and icons on default backgrounds.
`color-content-default-on-success`	`slate-0`	Use for text and icons on success backgrounds.
`color-content-brand-on-brand-low`	`blush-900`	Use for text and icons to emphasise brand on subtle brand backgrounds.

4.3.4 Spacing Tokens

Spacing tokens follow a consistent 8-point grid system to support alignment, rhythm, and predictability in UI layouts [4]. Tier one spacing tokens define raw size values. These are mapped to semantic tier two tokens that describe the intended role.

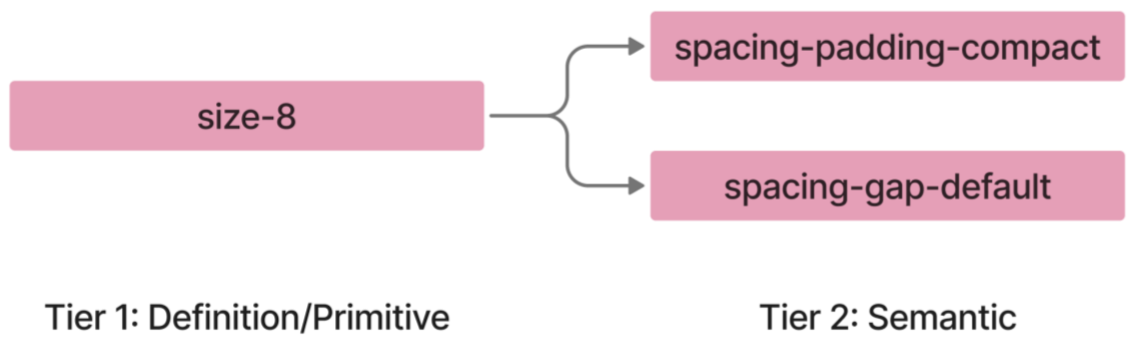

Figure 26 Mapping of tier one size token to tier two semantic spacing tokens.

Figure 26 illustrates how tier one size tokens are mapped to tier two semantic tokens. Table 9 summarises several example spacing tokens, showing how each semantic token references a base size, pixel value, and usage.

Table 9 Tier two semantic token (spacing) examples.

Semantic Token Name	*Tier One Token*	*Pixel Value*	*Usage*
`spacing-padding-default`	`size-16`	16	Use for default padding within components or layouts to maintain consistency internal spacing.
`spacing-padding-xspacious`	`size-32`	32	Use for extra-generous padding in components or layouts.
`spacing-gap-default`	`size-8`	8	Use for default gaps between elements to ensure consistent spacing.
`spacing-gap-spacious`	`size-16`	16	Use for generous spacing between elements.

4.3.5 Typography Tokens

Typography tokens in this system are composite tokens, meaning they group multiple design properties such as, font family, font size, font weight, and line height into a single, reusable token. This approach simplifies consistent text styling across components while ensuring accessibility considerations are embedded by default.

The tokens are built on the Open Sans typeface, selected for its readability and wide availability across platforms [8]. A 1.25 major third scale was applied to determine the size progression for headings and body text [16]. Minimum font sizes and appropriate line heights were established to align with accessibility guidelines: body text maintains a line height of 1.5 for readability, while headings use tighter line heights (1.125–1.25) to maintain visual hierarchy without excessive spacing [26].

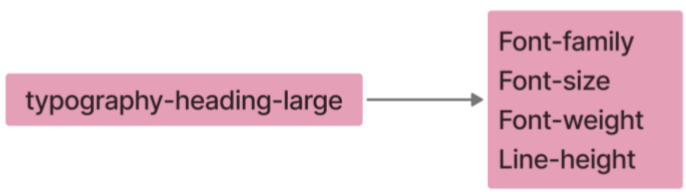

Figure 27 Example of a typography token showing its four design properties.

Figure 27 presents an example of a typography token and the four design properties it encapsulates. Table 10 summarises a set of tokens for heading and body text.

Table 10 Composite typography tokens with properties examples.

Composite Token Name	*Font Family*	*Font Size (Maps Tier One Size Tokens)*	*Font Weight*	*Line Height*
`typography-heading-large`	Open Sans	`size-40`	600	1.125
`typography-heading-small`	Open Sans	`size-24`	400	1.25

`typography-body-default`	Open Sans	`size-16`	400	1.5
`typography-body-semibold`	Open Sans	`size-16`	600	1.5

4.3.6 Documentation Structure and Strategy

The design token documentation was created directly in Figma to align with the workflows of designers and developers consuming the system. It is structured into three sections: Overview, Token Naming, and Usage Guidelines. Each section was designed to be concise and easy to reference during design work.

Findings from this study's exploratory research informed the documentation's structure and content. Participants preferred visual examples, embedded accessibility guidance, and clarity in naming conventions. These insights shaped how documentation content was presented, prioritizing accessibility and reducing ambiguity when applying tokens.

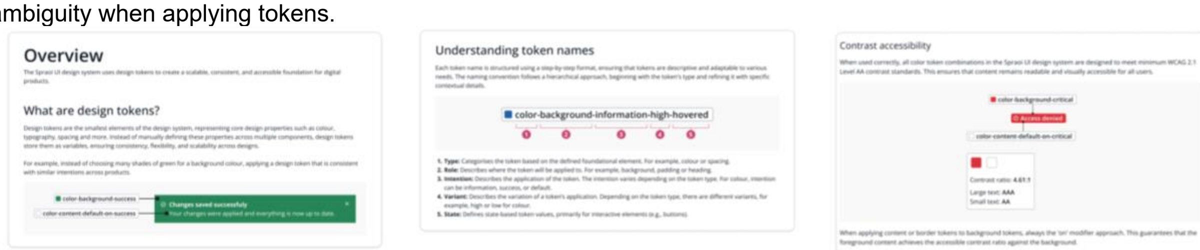

Figure 28 Documentation screens in Figma: Overview, Token Names, and Usage Guidelines.

4.3.7 Visual Summary: Tokens in Use

This section includes an annotated UI example to demonstrate how the design token system is applied in practice. The example uses a card component from the system's component library containing content and layout elements styled using semantic design tokens from the system.

Annotations highlight the relevant tokens applied and explain their purpose. For example, the content text within the card uses `color-content-default-on-default` to ensure sufficient contrast on a default background. Figure 29 summarizes the token library's goals for accessibility, clarity, and consistent application across UI components.

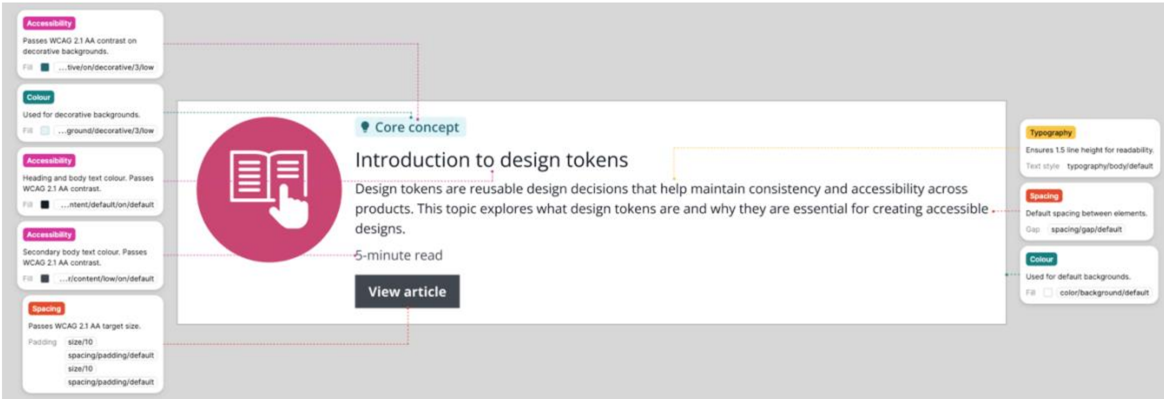

Figure 29 Annotated card components showing applied semantic tokens with accessible rationale.

4.3.8 Experiment Design

This section outlines how the design token system was prepared for usability testing. It focuses on how the system and associated components were introduced and presented to participants, ensuring a controlled and consistent testing experience.

An onboarding video was created to support participants before beginning the test. The video introduced the design token system, documentation, and how to navigate the Figma library, as shown in Figure 30.

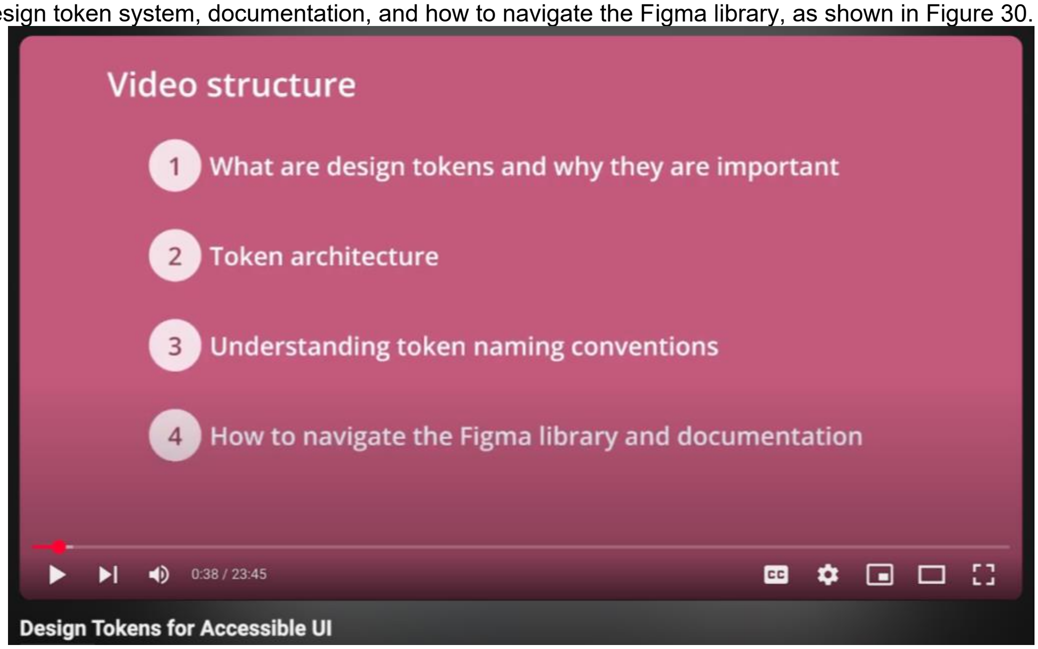

Figure 30 Screen capture from the onboarding video.

All usability testing tasks were completed using UI components and templates explicitly created for this project. Tasks one and two required participants to apply semantic tokens to components, a lozenge, and a card with no tokens applied, as shown in Figure 31. These components were chosen for their relevance to common UI use cases and the need to apply colour, typography, and spacing tokens in a realistic context.

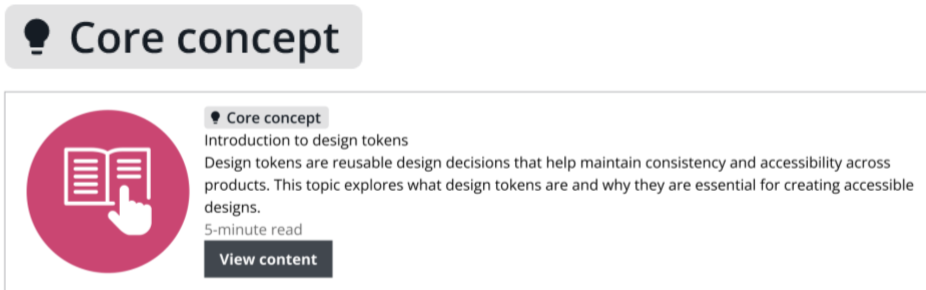

Figure 31 Components used in task one and two before tokens were applied.

Task three extended the system's application into a layout context. Participants were tasked to insert the styled component from task two into a prebuilt web page template, as shown in Figure 32. The researcher also designed this template using the design token system and components, demonstrating how the semantic tokens scale from component-level styling to page-level structure.

Figure 32 Web page templated used in task three, built using the token system and component library.

Designing the tasks, components, and templates ensured complete control over the design environment. This allowed the evaluation to focus specifically on the usability of the token system. The consistency of assets across all tasks also helped maintain the test's internal validity, providing a reliable foundation for assessing naming clarity, accessibility awareness, and documentation effectiveness.

4.4 Conclusion

The token system designed in this study responds to the needs found during exploratory research. By embedding accessibility logic into token naming, a structured architecture, and providing visual documentation with practical use cases, the system supports both WCAG compliance and intuitive use. Each token type was critically designed to ensure consistency, reusability, and alignment with accessibility principles. The components and templates created for usability testing further demonstrated how the system could scale across real interface scenarios. All design artefacts, onboarding resources, and usability testing materials developed in this phase are provided in Appendices C.1 to D.4.

5 RESULTS

This section presents the results used to evaluate the three research questions and their associated hypotheses. Data was collected through three key sources: an accessibility audit measuring WCAG 2.1 Level AA compliance for contrast (quantitative), a System Usability Scale (SUS) questionnaire assessing perceived usability (quantitative), and post-task responses gathered during usability testing (qualitative). These methods present how effectively the design token system supports accessibility compliance, naming clarity, and documentation usability.

5.1 Accessibility Audit Results

An audit was conducted to test whether applied token pairings met WCAG 2.1 Level AA contrast requirements to evaluate the effectiveness of the design token system in supporting accessibility. A token pairing refers to a background and content token combination applied using the system's `on` modifier. Participants applied these combinations during the usability test and reflected the real-world application of the semantic token system.

Across all tasks, participants applied a total of 40 token pairings. Each pairing was tested using the WebAIM Contrast Checker, with the background and content colours extracted directly from the Figma outputs, as shown in Figure 33. The audit found a 100% pass rate, meaning all 40 pairings met or exceeded the WCAG 2.1 Level AA threshold for contrast.

Figure 33 WebAIM contrast checker used to test token pairings applied by participants.

This result provides evidence that the token system's design, particularly the use of the pre-validated `on` modifier, supports accessibility compliance by default. Participants could select appropriate tokens without using contrast checks, suggesting that accessibility considerations were successfully embedded into the token naming.

This outcome supports hypothesis 1 from research question 1, which proposed that if accessible attributes, such as contrast, are embedded into design tokens, the resulting designs would consistently meet or exceed WCAG 2.1 Level AA. The audit confirms that the token system enables accessibility compliance without manual intervention. A summary of selected token pairings from the audit is in Table 11.

Table 11 Sample of token pairings tested for WCAG 2.1 contrast compliance.

Task	*Token Pairing*	*Contrast Ratio*	*WCAG 2.1 Pass/Fail*
1	`color-background-decorative-2-high` + `color-content-default-on-decorative-2-high`	5.68:1	Pass
1	`color-background-information` + `color-content-default-on-information`	4.62:1	Pass
2	`color-background-default` + `color-content-default-on-default`	17.16:1	Pass
2	`color-background-default` + `color-content-low-on-default`	9.39:1	Pass

5.2 System Usability Scale (SUS) Questionnaire Results

Following the usability testing, participants were asked to complete the System Usability Scale (SUS) questionnaire to evaluate the overall usability of the design token system and its supporting resources.

The average SUS score recorded was 86, which is the "excellent" category according to established usability benchmarks [24]. This score indicates that participants found the system easy to use, well-structured, and intuitive.

This outcome supports hypothesis 2 from research question 3, which proposed that designers find the documentation and token system effective and easy to use. These findings suggest that designers confidently navigate the system when clear documentation is paired with a usable token system.

5.3 Thematic Analysis of Usability Testing

Qualitative insights were gathered from participants' post-task questions during the usability test. A thematic analysis was conducted to identify recurring patterns in how participants interacted with the token system, understood the naming conventions, and used the documentation. Six themes initially emerged, but only four were directly relevant to the research questions and are presented in this section. These themes provide further evidence supporting the usability, naming clarity, and documentation effectiveness hypotheses. Table 12 summarizes the key themes alongside representative participant responses.

Table 12 Summary of key themes and supporting quotes from post-task participant responses during usability testing.

Theme	*Evidence from Post-Task Responses*
Documentation Enabled Confident Use	"I went through the table to see which one made the most sense" "The documentation files were easy to navigate and find what I needed" "I checked the table to see what decorative options were available in the library" "The token descriptions are clear and help you choose the right token"
Onboarding Video Improved Understanding	"The video was very informative and helped me learn about the tokens" "The video educated me enough before needing to check documentation in the library"
Token Discoverability and Search Strategies	"When you know part of the name you can just type it and scroll down after refining your search"
Learning Through Naming Structure	"The token names are really scannable. You're reading each step in the name and its quick to find what the next word is" "I had to practice a few times since this is my first time using this system but I would say after a few tries, someone would know it easily and not have to check documentation as much"

5.3.1 *Theme 1: Documentation Enabled Confident Use*

Participants referenced the documentation, particularly the token tables, to confirm their selections. This behaviour was most evident in unfamiliar scenarios, where documentation helped them feel confident when choosing the correct token.

This theme supports hypothesis 1 from research question 3, as participants successfully used the documentation to apply tokens in non-standard components. It also supports hypothesis 2, reflecting that the documentation was perceived as effective and easy to use.

5.3.2 *Theme 2: Onboarding Video Improved Understanding*

Participants described the onboarding video as a helpful introduction to the token system, with several highlighting how it clarified the logic behind the on modifier and naming convention.

This onboarding reduced the need for direct instruction or lengthy documentation reading. This theme supports hypothesis 2 from research question 3, showing that the overall experience, including supporting materials, was usable and clear.

5.3.3 *Theme 3: Token Discoverability and Search Strategies*

Participants used a mix of approaches to find and apply design tokens within Figma.

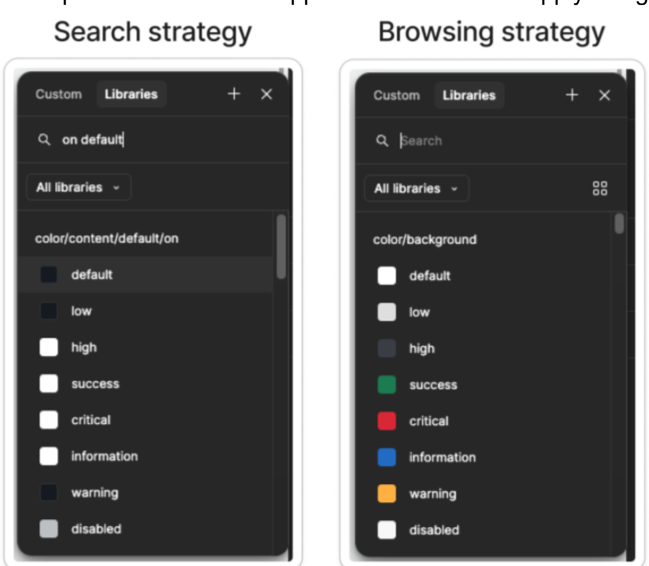

Figure 34 Screen capture of Figma showing search vs. browsing strategy.

Those who understood the naming convention were likelier to search. This theme supports hypothesis 1 from research question 2, stating that clarity of naming enables correct token selection, and hypothesis 2, which led to correct, accessible token pairings.

5.3.4 Theme 4: Learning Through Naming Structure

Some participants reported initial confusion with specific naming patterns, particularly with tokens using the on modifier. However, as the test progressed, their understanding grew through exposure and reinforcement from the documentation.

This theme reflects the effectiveness of the naming structure as a learning tool. It supports hypotheses 1 and 2 from research question 2, showing that a clear, consistent naming convention improved the ability to select WCAG-compliant tokens correctly.

5.4 Conclusion

The results demonstrate that the design token system met its intended goals. All hypotheses were supported: participants produced WCAG-compliant designs using pre-validated token pairings, successfully navigated the naming convention, and reported high levels of usability and clarity. The findings confirm that the system enabled participants to design effectively and accessibly.

6 DISCUSSION

This section critically interprets the study's findings regarding the three research questions and literature. It examines how the design token system supported accessibility compliance, naming clarity, and usability through structured documentation and onboarding.

6.1 Interpreting the Findings by Research Question

6.1.1 Research Question 1: Accessibility Compliance through Tokens

The accessibility audit demonstrated that embedding contrast logic directly into the token system enabled participants to achieve 100% WCAG 2.1 Level AA compliance without manual testing. This outcome validates the effectiveness of the naming structure, particularly the use of the `on` modifier in supporting accessibility by design.

The result contrasts the 2023 WebAIM Million report, which found low-contrast text on 83.6% of home pages [29]. These findings highlight the value of pre-validating token pairings and communicating their usage through descriptive naming.

The structured naming of tokens enabled participants to apply correct combinations confidently. This aligns with WCAG guidance that advocates embedding accessibility into early design decisions. The evidence suggests that integrating accessibility compliance at the token level significantly reduces the chance of contrast failings.

For design system teams, this approach lowers the barrier to accessible design and supports teams with mixed accessibility expertise by embedding guidance directly into design workflows.

6.1.2 Research Question 2: Naming Convention Usability

Usability testing showed that a predictable and descriptive naming convention enabled accurate token selection. Participants used search or browse strategies depending on their familiarity with the naming convention in Figma. Participants who understood the structure navigated the system more efficiently, demonstrating the importance of familiar and learnable naming.

The naming convention had embedded guidance. Tokens like `color-content-default-on-information` communicated both the role and context of use, reducing reliance on documentation.

These findings address the usability gap identified in the exploratory research, where 86.9% of survey respondents agreed that unclear naming or poor documentation led to incorrect token usage. By integrating accessibility logic into the token name, the system reduced uncertainty and improved decision-making.

However, naming alone was not always sufficient. Several participants encountered friction due to Figma's interface constraints, such as truncated token names and limited filtering. These issues affected discoverability, highlighting that clear naming conventions must be evaluated within their environment.

6.1.3 Research Question 3: Documentation and Support

Participants relied on the system's structured documentation and onboarding video to use the token system effectively. These resources reduced hesitation and built confidence.

The onboarding video provided early understanding, introducing the system's structure and logic before the tasks. This reflects earlier survey findings where 95.7% of respondents strongly agreed that more examples or use cases would improve documentation clarity. The success of this onboarding reinforces the value of contextual guidance, especially for new or intermediate users.

The documentation and onboarding video enabled participants to style non-standard components, such as lozenges and cards correctly. This supports broader design system goals around scalability, demonstrating that well-supported token systems can extend beyond predefined component libraries.

The findings show that documentation and onboarding should be integral elements of any design token system. They are essential for enabling adoption and maintaining accessibility compliance.

6.2 Reflection on Design Decisions

The design token system was structured to support accessibility, usability, and scalability across different UI contexts. The naming convention established explicit foreground-background relationships, embedding WCAG compliance directly into the system. This introduced a trade-off: longer token names, sometimes leading to usability friction in Figma due to name truncation.

A similar trade-off was observed in the system's spacing token structure, which separated tokens by functional role, padding, and gap. While this distinction was made to align the system with development practices, some participants expressed confusion about when to use them. Despite this, the separation was purposeful: it supports design-developer alignment and offers scalable spacing tokens.

These decisions demonstrate a commitment to accessibility and system scalability. The system aimed to promote long-term usability, compliance, and confidence among designers.

6.3 Implications for Practice and Research

This study demonstrates that design tokens, when carefully structured and supported, can be a powerful mechanism for embedding accessibility into UI design. Encoding contrast compliance into token naming and architecture enabled participants to apply accessible combinations without external tools or expert-level WCAG knowledge. This supports the principle of accessibility by default. For teams seeking to scale accessible design across products and contributors, this finding is particularly significant.

The token system in this project is transferable. The structure could be adapted to other design systems. While the exact tokens would vary, the architecture offers a replicable strategy for aligning design, development, and accessibility standards.

Critically, this research addresses a significant gap in the Literature and Practice Review: the lack of evidence showing that design tokens lead to accessible outcomes in practice. Limited user research has validated whether designers can use those tokens effectively to produce compliant results. This project contributes practical evidence that structured naming and documentation improve usability and accessibility compliance. It provides a model for how token systems can be evaluated on measurable design outcomes.

Future studies might expand this work by examining how different naming conventions or interface presentations influence designer accuracy and confidence in meeting accessibility standards.

6.4 Limitations

Several limitations should be considered when interpreting these findings. First, the sample size was relatively small, with eight participants completing the full usability test. While this is acceptable within qualitative usability research [18], a more extensive and diverse group of participants would offer broader insights into how the system performs across different levels of experience, team contexts, and accessibility familiarity. To mitigate this, participants were carefully selected to represent a mix of design backgrounds, and tasks were designed to be open-ended, allowing for a range of behaviours to emerge.

The accessibility audit focused on contrast, specifically WCAG 2.1 Level AA compliance. Although this aligns with the study's scope, accessibility has many dimensions, including keyboard navigation and touch target size, which were not evaluated. These areas offer directions for future research.

The usability testing was conducted exclusively within Figma. Some observed friction, such as token name truncation and limited filtering, may not reflect the system's performance in other design tool environments, such as Sketch. While many designers could relate to testing in Figma, the results may differ in systems integrated into web-based documentation platforms. Future testing in different environments could provide a more comprehensive understanding of the interaction.

Despite these limitations, the study employed a mixed-methods approach, combining accessibility audits, usability scores, and qualitative feedback. This provided a robust dataset, helping mitigate the risks associated with each method.

6.5 Conclusion

The findings of this study demonstrate that a structured and well-supported design token system can meaningfully improve accessibility and usability. It also increased confidence among designers, as shown through post-task questions during usability testing, where participants reported applying tokens with minimal hesitation and without relying on external tools. All three research questions were addressed through practical evidence, showing that embedding accessibility logic into token architecture, naming, and documentation can enable compliant and independent design decisions. These insights contribute value to practice and research in scalable, accessible design systems. All evaluation results from the study, including qualitative and quantitative data, are provided in Appendices E.1 to E.5.

7 CONCLUSIONS AND FUTURE WORK

This research project evaluated how a design token system could support accessibility compliance, explicitly focusing on WCAG 2.1 Level AA contrast requirements. The study was guided by three research questions concerning the effectiveness of design tokens in achieving compliance, the role of naming conventions in supporting accurate token use, and the impact of documentation on usability. Using a Design Thinking framework and a mixed-methods approach, the study combined an accessibility audit, usability testing, and a System Usability Scale (SUS) questionnaire to assess a token system in Figma. The results demonstrate that accessibility can be embedded directly into design workflows through the architecture, naming, and documentation of design tokens.

7.1 Summary of Key Findings and Contributions

This study demonstrated that a design token system can support accessible UI design by embedding accessibility logic directly into naming conventions and documentation. The system achieved 100% WCAG 2.1 Level AA contrast compliance, confirming that embedding contrast-safe pairings into token architecture enables compliant outcomes without manual testing. Usability testing showed that a clear and predictable naming convention improved designers' ability to identify and apply the correct tokens, directly supporting accessibility and reducing reliance on external tools. The study also confirmed that structured documentation and onboarding improved usability and supported token applications. These findings address the three research questions and support all associated hypotheses. They provide practical evidence that accessibility, usability, and design system scalability can be achieved through design tokens.

7.2 Impact and Value

This project contributes to ongoing work in design system practice by offering a replicable model for embedding accessibility into a token system. By integrating contrast compliance into the naming convention and supporting it with clear documentation, the study demonstrates how design systems can move beyond consistency and scalability to support inclusive design outcomes. For accessibility workflows, the findings show that accessibility can be operationalized through reusable systems, reducing reliance on manual checks and enabling designers to make compliant design decisions by default. The study also offers value to UX design research, by providing measurable evidence that structured token systems can improve usability and accessibility outcomes.

7.3 Limitations

While the study produced strong results, several limitations informed the direction of future work. The small sample size limits generalisability and the focus on WCAG colour contrast excluded other accessibility areas. Additionally, testing was conducted solely within Figma, where interface constraints affected token visibility and discoverability. These limitations highlight the need to test the system across more diverse teams, accessibility criteria, and environments.

7.4 Future Work

Several opportunities exist to evolve the token system and its supporting materials. While this research focused on colour contrast, future work could expand the system to support other WCAG dimensions, such as spacing for touch target size and typographic legibility. The documentation, currently embedded within Figma, could be developed into a dedicated website to improve navigation, scalability, and access across teams. This documentation site could also incorporate an interactive token picker tool, guiding designers and developers in selecting appropriate tokens. Finally, testing the system with different design tools would provide insight into the system's adaptability and scalability in the long term.

7.5 Reflection

This project has deepened my understanding of how thoughtful systems design can drive accessibility in design practice. It has shown me that embedding accessibility into the foundational layers of a design system can empower designers to create inclusive experiences. This work has deepened my commitment to inclusive design and strengthened my knowledge in systems design. I hope this research encourages others working with design systems to prioritize accessibility from the start and view tokens as enablers of inclusive design.

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APPENDICES

The following appendices contain supporting materials referenced throughout this paper.

A.1 Survey Questions

This folder contains the questions used in the exploratory survey.

Survey questions folder

A.2 Interview Questions

This folder includes the question guide used during semi-structured interviews with selected survey participants.

Interview questions folder

A.3 Participant Interview Consent Forms

This folder contains signed consent forms from interview participants.

Signed consent forms folder

A.4 Interview Recordings

This folder contains video recordings of all interviews.

Interview recordings folder

B.1 Survey Responses

This folder contains responses from the survey.

Survey responses folder

B.2 Thematic Analysis from Survey Responses

This folder includes the coded themes and supporting evidence from the open-ended survey responses.

Thematic analysis from survey responses folder

B.3 Thematic Analysis from Interviews

This folder contains the thematic coding and analysis of interview transcripts.

Thematic analysis form interviews folder

C.1 Primitive Tokens

This folder contains the Figma file used to define the primitive token values for colour and spacing.

Primitive tokens folder

C.2 Semantic Tokens

This folder includes the Figma file, where semantic tokens were created by mapping primitive values to functional design roles across colour, spacing, and typography.

Semantic tokens folder

C.3 Component Library

This folder contains the Figma file of the component library built using the design token system, including UI elements used in usability testing and documentation.

[Component library folder]

C.4 Token Documentation

This folder provides the design token documentation created in Figma.

[Token documentation folder]

C.5 Figma Library Assets

This folder includes supporting assets used across the Figma token library.

[Figma library assets folder]

C.6 Design Token Research File

This folder contains early planning and research exploration related to naming structure, token architecture, and naming logic trials.

[Design tokens research file folder]

C.7 Onboarding Slides

This folder includes the slide deck used to record the onboarding video.

[Onboarding slides folder]

C.8 Onboarding Video

This folder contains the onboarding video that was presented before testing.

[Onboarding video folder]

D.1 Usability Test Plan

This folder contains the task instructions, scenarios, and post-task questions used during usability testing.

[Usability test plan folder]

D.2 System Usability Scale (SUS) Questionnaire

This folder includes the SUS questions presented to participants after testing.

[System Usability Testing (SUS) questionnaire folder]

D.3 Participant Usability Test Consent Forms

This folder contains signed consent forms from participants involved in the usability testing.

[Participant usability test consent forms folder]

D.4 Usability Testing Recordings

This folder contains screen recordings of each usability test.

[Usability testing recording folder]

E.1 SUS Questionnaire Summary

This folder contains a summary of participant responses to the SUS questionnaire.

SUS questionnaire summary folder

E.2 SUS Questionnaire Results

This folder includes the Figma file used to visualise and analyse the SUS questionnaire data collected after usability testing.

SUS questionnaire results folder

E.3 Accessibility Audit Results

This folder contains the results of the accessibility audit, including all token pairings applied by participants and their WCAG 2.1 contrast compliance outcomes.

Accessibility audit results folder

E.4 Thematic Analysis from Usability Testing

This folder includes the thematic analysis from participant post-task questions gathered during usability testing.

Thematic analysis from usability testing folder

E.5 Usability Testing Figma File

This folder contains the Figma file used by participants during usability testing.

Usability testing Figma file folder