



Design Documentation Canvas: A Lightweight Design Rationale Framework for Solo Designers

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Abstract

Background: Design systems have become standard infrastructure in digital product development, yet they often underdocument the rationale behind design decisions. This gap is amplified in resource-constrained startups, where solo designers manage multi-brand, multiplatform products, increasing the risk of knowledge loss during handoffs and onboarding.

Objective: This study designs, implements, and evaluates the Design Documentation Canvas (DDC), a lightweight design rationale and traceability framework for solo designers in multi-brand startup contexts.

Methods: A single-case study was conducted at an Indonesian insurtech startup. Data were collected through two focus group discussion (FGD) sessions involving nine participants, one individual interview, a six-point Likert-scale questionnaire ($n = 10$), and artifact analysis, with the researcher acting as a participant-observer.

Results: The framework achieved 100% completeness across 17 qualifying design tickets, defined by substantively completed *Description Panels* (FSE-structured fields: Summary, Question/Issue, Final Decision, Evidence, and References) and *Before-After Panels*. Questionnaire results showed a median and mode of 6 across all items and 100% agreement-side responses, although these results should be interpreted with caution because of potential ceiling effects and social desirability bias. Cronbach's alpha was 0.853. AI-assisted drafting also emerged during implementation as a means of reducing the perceived documentation articulation burden.

Conclusion: The DDC demonstrates operational feasibility and positive stakeholder reception within a single case, providing an adoptable documentation artifact for solo designers in Southeast Asian startup environments. The findings remain bounded by the single-case design and small sample and should not be interpreted as generalizable outcomes.

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INTRODUCTION

The rapid growth of digital product development has elevated design systems as critical infrastructure for ensuring visual and functional consistency across platforms. However, while design systems excel at standardizing what is built, such as components, tokens, and patterns, they systematically omit documentation of why those decisions were made (Frost, 2016; Lamine & Cheng, 2022). This “what vs. why” gap is a well-recognized challenge in the design rationale literature Hyun and Hurtado (2023) and Mirabito et al. (2024), yet practical frameworks that address it in operational settings remain scarce, particularly in resource-constrained contexts.

This problem becomes critical in under-resourced technology startups across Southeast Asia, where a single designer referred to as a solo designer is responsible for the full scope of design operations across multiple products, platforms, and brand identities simultaneously. In this context, the absence of structured rationale documentation creates conditions for knowledge evaporation: the progressive loss of decision context due to reliance on informal communication channels, personal memory, and ad hoc versioning. As teams evolve and projects accumulate, this loss translates into redundant stakeholder communication, ambiguous developer handoffs, and difficulty onboarding new team members (Guerino et al., 2024; Marcel & Marzuqi, 2025).

Design systems help product teams maintain visual and behavioral consistency by providing shared libraries of components, tokens, and usage guidelines (Frost, 2016; Kamath, 2022). In practice, however, they tend to document what was built rather than why it was built that way. An analysis of 4,714 issues across 41 open-source design system projects found that fewer than 10% addressed documentation of design decisions, reflecting a broader pattern in which design systems function as component registries rather than knowledge repositories (Lamine & Cheng, 2022). This gap becomes most visible during handoffs, design revisions, and team transitions, when the reasoning behind past decisions is no longer accessible.

In small and medium-sized enterprises (SMEs) and early-stage startups, design work is frequently managed by a single individual without dedicated team support (Chen & Schiele, 2017; Raju, 2026). This model offers efficiency advantages but introduces a structural vulnerability: all design knowledge is concentrated in one person. When that individual relies on memory rather than documentation, organizations struggle to measure and build on past design decisions, a pattern consistent with findings on under-documented design management in SMEs (Kramoliš & Šviráková, 2022). Guerino et al. (2024), in a survey of 90 startup professionals, identified team size limitations and resource constraints as primary barriers to structured UX practice, with documentation being consistently deprioritized in favor of speed.

The multi-brand context adds further complexity. Unlike a single-product designer, a solo designer managing multiple brand identities must simultaneously maintain brand-specific adaptations, track cross-brand consistency decisions, and make the rationale behind intentional variations explicit, distinguishing deliberate brand differentiation from accidental inconsistency. This operational reality has received limited systematic attention in the design documentation literature.

Design rationale refers to the documented reasoning behind a design decision, including the alternatives considered, trade-offs evaluated, and justifications for the final choice (Mirabito et al., 2024). Despite a substantial body of theoretical work, adoption in industry remains low. Alexeeva et al. (2016) and Mahinkanda et al. (2023) trace this to a formality problem: rigorous methods require dedicated tooling and impose high cognitive overhead, while informal methods often fail to capture enough depth to be useful. The QOC framework MacLean et al. (1991) and Gieß et al. (2023) which organizes decisions around Questions, Options, and Criteria, and its extension, TEAM Masip et al., (2012) and Zamakhshari and Fatwanto, (2023), which adds explicit trade-off tracking, both address the depth problem but were designed for collaborative teams with dedicated tool support, making them difficult to sustain in leaner environments.

Mirabito et al. (2024) proposed the Feature-Specification-Evidence (FSE) framework as a lighter alternative. Developed inductively from 846 pages of design reports across 28 student teams and cross-checked against five industry reports, FSE organizes rationale around three elements: Feature (what is being designed), Specification (the requirements it addresses), and Evidence (the information that supported the final decision). Its flexible format makes it potentially well-suited to fast-paced solo work, though it had not been empirically tested in an operational startup context prior to this study.

Cognitive Load Theory Sweller (1988) and Muzaini et al. (2026) offers a useful explanation for why documentation practices fail under pressure: when a system demands too much mental effort per use, people stop using it, especially in fast-paced environments (Lavrsen & Daalhuizen, 2024). This suggests that effective lightweight documentation must minimize incremental effort per documentation act. Recent developments in generative AI offer a potentially relevant mechanism: AI-assisted drafting can reduce the textual articulation burden while preserving the designer's decision ownership, provided that human validation remains central to the process.

Zhang et al. (2025) identified that designer-developer collaboration suffers from fragmented decision-making procedures and low mutual understanding. AI-assisted documentation, in which a designer uses generative tools to draft rationale and then validates the output, represents an emerging practice that may bridge articulation burden reduction with documentation quality. This intersection has not been empirically studied in the context of solo designers managing multi-brand product portfolios.

Traceability in design documentation means being able to trace a decision back to its context: why it was made, what alternatives were considered, and how it connects to the final output. Without this, decisions become invisible over time. Hyun and Hurtado (2023) found that design decisions are frequently scattered across tools, left implicit, or never updated after implementation, creating rework and maintenance overhead that compounds as products grow. For solo designers, traceability needs to work without adding a new platform to an already stretched workflow, since documentation systems that impose additional overhead or require dedicated tooling tend to be abandoned in practice (Alexeeva et al., 2016; Gutierrez Lopez et al., 2017; Mahinkanda et al., 2023). The practical implication is straightforward: effective lightweight documentation must live inside the tools a designer already uses, not alongside them.

Beyond the structural challenge of documentation, the emergence of generative AI assistants has introduced a new operational dimension. Solo designers increasingly use AI assistants during their design processes, yet the implications of AI-assisted documentation for perceived articulation burden, rationale quality, and documentation sustainability remain underexplored in this context.

This paper presents the Design Documentation Canvas (DDC), a lightweight, integrative framework that combines the Feature-Specification-Evidence (FSE) model with QOC/TEAM notation, operationalized as a Figma canvas embedded within a Jira workflow. The DDC was designed, implemented, and evaluated through a single-case study at a specific insurtech startup in Indonesia; thus, the findings are contextually bound to this organizational setting and may not generalize to other startup types or geographic regions.

Key contributions include: (1) empirical operationalization of the FSE model in operational solo designer contexts; (2) preliminary findings on how AI-assisted drafting reduces perceived articulation burden during rationale documentation; and (3) emergent evidence that the Before-After Panel functions as a developer scope calibration mechanism.

METHOD

This study employed a single embedded case study design exploratory and descriptive in nature with a qualitatively dominant mixed-methods approach (Muzaini et al., 2026; Yin, 2018; Zakariya, 2022). The research context was an insurtech startup operating in Indonesia that managed a multi-brand digital insurance portal. The researcher occupied the role of participant-observer as the organization's sole designer, enabling direct access to design decision-making processes while also introducing potential researcher bias, a limitation that was explicitly acknowledged and mitigated through methodological triangulation.

The researcher's triple role as framework designer, solo designer, and FGD facilitator introduced layered bias risks, including social desirability and demand characteristics. Several structural conditions mitigated these risks: all participants completed the Likert questionnaire individually via Google Forms after the FGD session, without the researcher's real-time presence, thereby reducing direct social pressure during scoring. FGD sessions were conducted online via Zoom, with participants joining from their own locations. Triangulation across four data sources, particularly artifact analysis, which was independent of participant self-report, provided an additional check against purely perception-based claims.

The research proceeded in three phases, as illustrated in Figure 1: Phase 1 (Design and Preparation), encompassing the literature review, framework design, and instrument development; Phase 2 (Data Collection), comprising FGD sessions, an individual interview, a questionnaire, and artifact analysis; and Phase 3 (Analysis and Reporting), following Braun and Clarke (2006) thematic analysis procedure and Katsiroumpa and Galanis (2026).

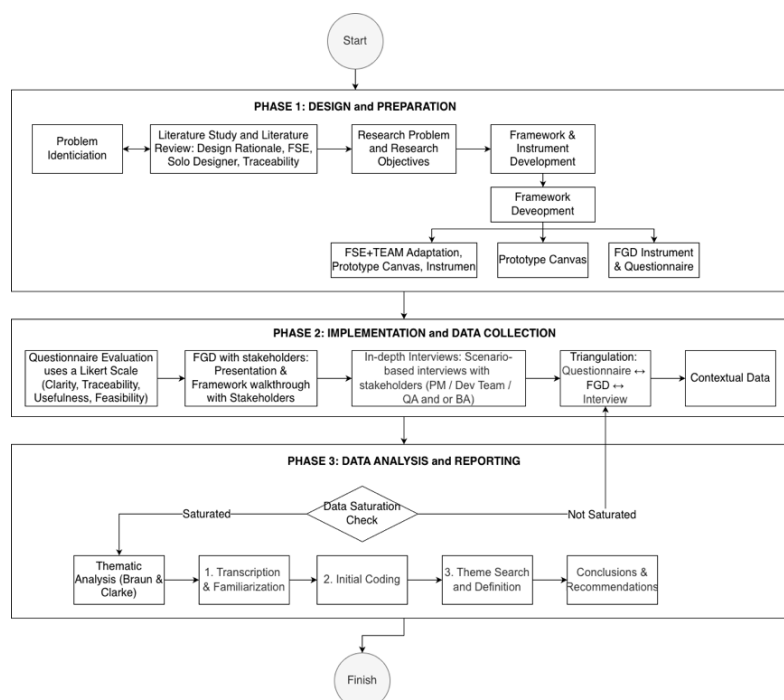


Figure 1. Three-Phase Research Design

The Design Documentation Canvas was designed following five principles: Lightweight (minimal documentation overhead per ticket), Integrated (embedded in the existing Figma-Jira workflow), Stakeholder-Oriented (accessible to non-designers), Traceable (linked to source tickets), and Multi-Brand Aware (accommodating intentional cross-brand variation). While implemented using Figma-Jira in this study, the framework's three-layer structure was conceptually transferable to other combinations of design and project management tools, a proposition that was not tested here and warrants future investigation.

The framework integrated three layers within a single Figma canvas artifact, as shown in Figure 2. Layer 1 (Rationale Logic) captured the “why” and trade-offs using FSE, QOC, and TEAM notation. To resolve the tension between Layer 1's inclusion of QOC/TEAM and the completeness metric reported in Section 4.2, it is important to distinguish between mandatory and optional fields. Mandatory fields that counted toward the 100% completeness rate were the core FSE elements: Summary, Question/Issue, Final Decision, Evidence, and References within the Description Panel, plus both Before and After frames in the Before-After Panel. QOC/TEAM fields (Options, Trade-offs) were treated as optional enrichment fields, intended for tickets where genuine design alternatives were explicitly considered. Layer 2 (Multibrand Context) was operationalized at the workspace level through per-brand file separation and brand-adapted UI kits rather than as explicit canvas fields. Layer 3 (Traceability) linked each canvas to its source Jira ticket and Figma index via a Reference ID.

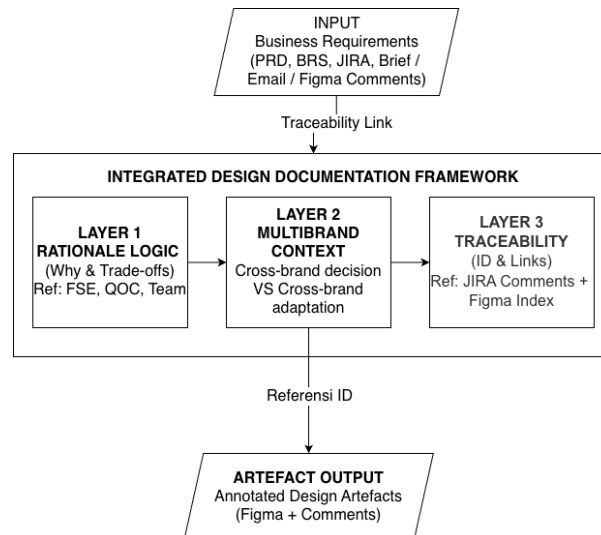


Figure 2. Integrated Design Documentation Framework Architecture

A notable operational pattern during implementation was the use of generative AI assistants (Gemini) as drafting assistants for the Description Panel. The workflow proceeded as follows: (1) the designer created a new canvas frame in Figma; (2) the designer copied the user story, acceptance criteria, and technical requirements from the Jira ticket and appended a single-line structural command specifying the target DDC outputs (Summary, Question/Issue, Options, Trade-offs, Final Decision, Evidence); (3) the designer validated the output, corrected terminology, simplified technical language, and rectified inaccurate context; and (4) the validated content was entered into the canvas with appropriate references. AI was positioned as a writing assistant that reduced perceived articulation burden, not as a decision-making agent. The documented rationale represented the designer's actual decisions, articulated with AI assistance, rather than AI-generated reasoning.

Canvases were created selectively for tickets involving either (1) a significant flow change affecting layout and user experience or (2) a new flow requiring visual representation for client or business stakeholder approval. Seventeen design tickets across two projects met these criteria during the study period. Figure 3 shows an example canvas from the implementation period, illustrating the Description Panel with FSE-structured rationale and the Before-After Panels with numbered annotations.

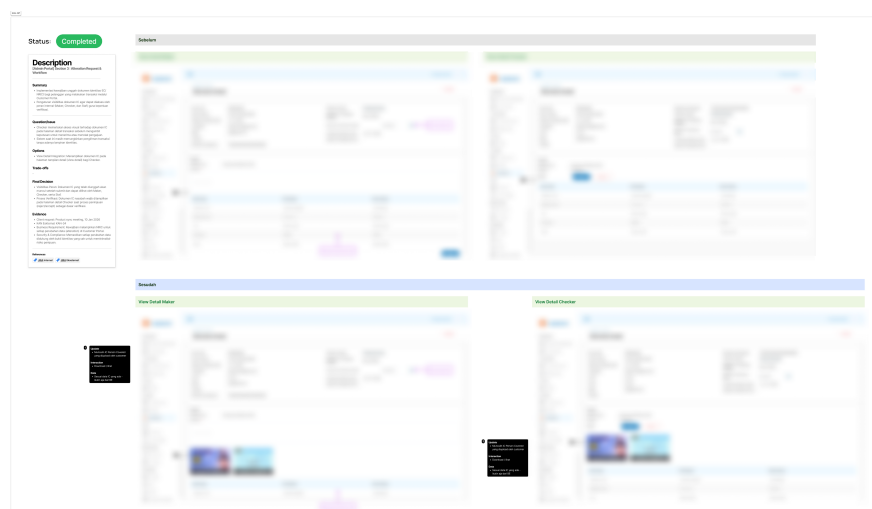


Figure 3. Example of Design Documentation Canvas (Figma). Sensitive product details have been blurred to protect organizational confidentiality

Figure 4 demonstrates the canvas as accessed via a Jira comment preview, illustrating the embedded workflow integration that leveraged existing Jira and Figma access without requiring

adoption of a separate documentation platform. Stakeholders could review design decisions directly within their existing ticketing environment without navigating to Figma unless detailed inspection was required.

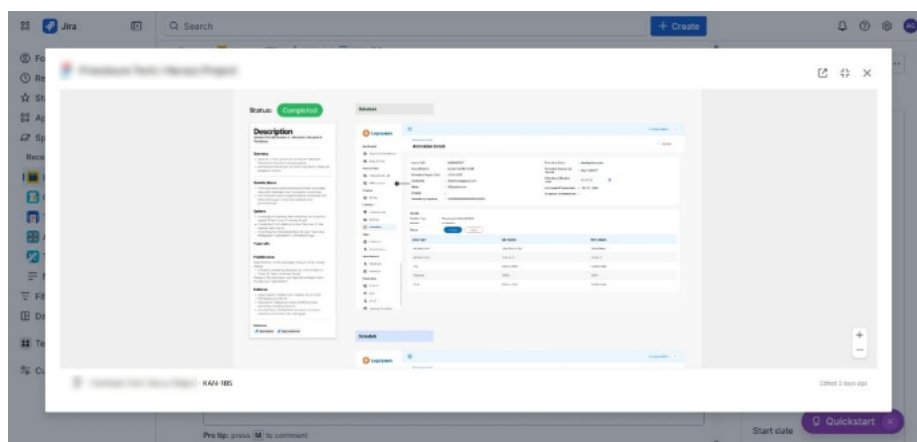


Figure 4. Canvas Preview Accessed via JIRA Comment. The canvas is embedded as a Figma link within the JIRA ticket comment field, accessible via the inline preview modal

Data were collected through four sources to enable triangulation: (1) two Focus Group Discussion (FGD) sessions conducted online via Zoom, involving nine participants across engineering, product management, quality assurance, and business analysis roles; (2) one semi-structured individual interview with a senior frontend developer who had participated in discussions during the framework's development and used it in day-to-day work; (3) a custom six-point Likert questionnaire ($n = 10$), comprising the nine FGD participants plus the individual interviewee, measuring four dimensions Clarity, Traceability, Usability, and Feasibility with 12 items in total (3 items per dimension); and (4) artifact analysis of canvas completeness records and baseline documentation conditions.

The six-point forced-choice scale was selected to eliminate the neutral midpoint, which respondents may use not because of genuine neutrality but because of reluctance to express a position. By removing this option, the scale directed respondents toward either the agreement or disagreement side, producing more differentiated data. Questionnaires were completed individually via Google Forms after the FGD session concluded, without the researcher's real-time presence, to reduce social desirability bias in scoring. All participants provided informed consent prior to participation, agreed to session recording, and were anonymized using codes P1–P10 in all reported data. The full 12-item instrument is provided in the Appendix.

Qualitative data were analyzed using reflexive thematic analysis following Braun and Clarke (2006) and Katsiroumpa and Galanis (2026) six-phase procedure. Quantitative data were analyzed descriptively, given the ordinal scale and small sample size. Validity was assessed using Corrected Item-Total Correlation ($r\text{-table} = 0.632$, $df = 8$, $\alpha = 0.05$), while reliability was assessed using Cronbach's alpha. Given the ceiling effect present in the data (median and mode of 6 across all items), the statistical validity and reliability results must be interpreted with caution: restriction of range reduces the discriminative power of item-total correlations and renders the alpha coefficient less stable (Taber, 2018; Tavakol & Dennick, 2011; Zakariya, 2022). Triangulation required confirmation across at least three of the four data sources for a finding to be considered robust (Charli et al., 2022; Creswell & Creswell, 2018; Weyant, 2022).

RESULTS AND DISCUSSION

Result

Baseline: Pre-Implementation Documentation Fragmentation

Prior to DDC implementation, retrospective archival analysis of two projects revealed significant documentation fragmentation. Project X (microsite, three weeks) recorded 80 clarification interactions distributed across five communication channels, with no centralized repository. Project H (multi-platform, six months) showed a rough estimate of 240–600 informal

discussions over two months. These figures are conservative reconstructions from communication logs and researcher memory, not precisely counted events, and are presented here as contextual illustrations rather than quantitative findings. Based on these estimates, approximately 70–90% of the design knowledge produced during the projects was at risk of non-recovery through traceable channels. Average clarification overhead was roughly estimated at 6–9 hours per project cycle, calculated from recurring clarification patterns concerning the same topics across multiple sessions.

Artifact analysis confirmed the problem at the structural level: active Figma files contained multiple brand pages without rationale documentation, while version history was maintained through manual frame migration to a separate archive file using ad hoc labels (Ver 1, Ver 2, Flow Ver. 4), with no documentation of the rationale for these changes.

Framework Implementation and Completeness

The Design Documentation Canvas was produced consistently across all 17 qualifying design tickets (completeness rate: 100%), exceeding the pre-defined acceptance threshold of 80%. Completeness here is defined operationally as both panels being substantively filled: the Description Panel requires Summary, Question/Issue, Final Decision, Evidence, and References to be present; the Before-After Panel requires both Before and After frames to be populated with numbered annotations. Optional QOC/TEAM fields (Options, Trade-offs) are excluded from this metric.

It is important to note that this completeness rate reflects the researcher's own discipline as the sole canvas creator, not independent verification. The researcher both designed and produced all canvases, introducing a degree of circularity into the completeness assessment. This rate demonstrates that producing the DDC was feasible for a solo designer under normal startup workload conditions; it does not constitute evidence of stakeholder adoption or long-term sustainability.

Table 1

Canvas Completeness per Project (mandatory fields only)

Indicator	Project H	Project X	Total
Total JIRA tickets	85	15	100
Tickets requiring design	14	3	17
Canvas implemented	14	3	17
Completeness rate (mandatory fields)	100%	100%	100%

Quantitative Evaluation: Stakeholder Perception

The questionnaire produced a median and mode of 6 (the maximum score) across all 12 items, with 100% of responses falling on the agreement side of the scale, exceeding the pre-defined acceptance criterion of $\geq 70\%$. The overall mean was 5.82/6.00.

These results must be interpreted with significant caution due to two interacting limitations. First, the ceiling effect: the concentration of responses at the maximum value produced very low variance, rendering both item-total correlations and Cronbach's alpha statistically unstable. This does not necessarily indicate poor instrument design, but rather that the scale was unable to discriminate between response levels in this sample (Taber, 2018; Tavakol & Dennick, 2011; Zakariya, 2022). Second, social desirability bias: all respondents were colleagues who knew the researcher personally, creating social conditions that may have inflated scores regardless of the individual questionnaire format. Results should therefore be read as an indication of initial positive reception, not as validated evidence of framework effectiveness.

Table 2
Questionnaire Results by Dimension (n=10)

Dimension	Key Item	Mean	Median	Mode	% ≥4
Clarity	Numbered annotations aid comprehension (CL3: 6.00)	5.90	6	6	100%
Traceability	Canvas link in JIRA connects decision to business need	5.87	6	6	100%
Usability	Canvas reduces clarification frequency (US1)	5.70	6	6	100%
Feasibility	Integrates with existing JIRA workflow (FE2: 6.00)	5.80	6	6	100%
Overall	Cronbach's Alpha = 0.853 (interpreted with caution due to ceiling effect)	5.82	6	6	100%

Qualitative Findings: Six Themes

Thematic analysis of FGD transcripts and interview data produced six themes, each confirmed across at least three data sources.

Theme 1 – Communication Fragmentation as Baseline Pain Point: All nine FGD participants described pre-implementation documentation as dependent on informal channels such as chat logs, meeting minutes, and verbal communication, with the design state frequently misaligned between the active Figma file and the deployed product. This theme confirms the baseline condition identified in Section 4.1.

Theme 2 – Canvas Was Perceived as Enhancing Cross-Role Handoff Clarity: Participants across all four role categories reported an improved ability to understand design decisions without requiring direct designer consultation. A product manager described a shift from asking basic clarification questions to engaging with substantive design reasoning. This pattern was corroborated by the individual interview and questionnaire Usability scores, although the shift was not quantitatively measured.

Theme 3 – Before-After Panel as Scope Calibration Tool (Emergent Finding): Technical participants consistently identified the After panel as their primary entry point when opening a canvas. Individual interview data revealed a two-phase process: developers first assessed scope and implementation complexity from the Before-After visual comparison and then read the Description Panel for business context. This scope calibration function was not an intended design feature and emerged organically from usage patterns. CL3 (numbered annotations on the Before-After Panel) achieved the only perfect mean score in the questionnaire (6.00). Given that this finding is based primarily on one individual interview and FGD observations from a single case, it is presented as an emergent finding warranting further confirmation rather than as an established empirical contribution.

Theme 4 – Contextual Access Preferences: Participants reported complementary use of JIRA Preview and direct Figma access, determined by change complexity and work phase. Simple changes were reviewed via JIRA Preview, whereas complex changes requiring element-level inspection prompted direct Figma access.

Theme 5 – Specific and Actionable Improvement Areas: Participants identified four concrete improvement areas: annotation numbering consistency, reference links for interaction outcomes, click-based navigation for complex canvases, and a PM approval status indicator. The specificity of these suggestions indicates sufficient familiarity with the canvas to identify targeted enhancements rather than fundamental usability problems.

Theme 6 – Organic Adoption with Minor Discoverability Friction: Several participants accessed the canvas independently without prompting, suggesting initial organic adoption. However, one participant searched for the canvas link in the ticket description field rather than the comments field, indicating that link-location conventions had not been fully internalized. This finding suggests a need for a standardized discoverability marker in ticket descriptions.

QOC/TEAM Completion and AI-Assisted Drafting

In practice, the optional QOC/TEAM fields (Options, Trade-offs) were infrequently completed. These fields were left empty or minimally filled in most canvases, as design alternatives in this operational context were typically determined by client requirements or established best practices rather than through explicit multi-option deliberation. This low completion rate is consistent with findings by Alexeeva et al. (2016), Mahinkanda et al. (2023) and Gutierrez Lopez et al. (2017), who identified that documenting alternatives tends to be deprioritized in fast-paced work. The contribution of QOC/TEAM elements in this study is therefore conceptual and structural, providing a scaffold for situations in which alternatives arise rather than constituting an empirically validated component based on observed usage.

A recurring pattern observed in the researcher's reflective journal was the use of Gemini as a drafting assistant for the Description Panel. Writing structured rationale from scratch for every ticket was the most time-consuming part of the documentation process. Using AI to generate an initial draft shifted the task from composition to review, which appeared to make consistent documentation more sustainable. The input was drawn directly from JIRA ticket content (user story, acceptance criteria, and technical requirements), with the researcher appending a structural command specifying the DDC fields to populate.

The validated output, not the raw AI draft, was what entered the canvas. The AI did not document design decisions; the designer did, using AI to reduce the perceived articulation effort. It is important to note that cognitive load was not formally measured using any validated instrument; the reduction in articulation burden is interpreted through the conceptual lens of Cognitive Load Theory Sweller (1988) and Muzaini et al. (2026), based on the researcher's reflective observations rather than empirical measurement. Similarly, the integrity of the AI-assisted rationale content was assessed by the researcher through the validation step and was not independently verified.

Two implications follow. First, the 100% completeness rate achieved in this study was supported by the availability of AI drafting assistance; whether the same rate would be achievable under high-workload conditions without such tools remains an open question. Second, AI-assisted drafting may represent a practically relevant mechanism for reducing the articulation overhead that typically causes documentation to be deprioritized, a proposition consistent with Cognitive Load Theory but requiring formal empirical testing.

Discussion

A significant limitation stems from the researcher's multiple roles as framework designer, solo designer participant, and data analyst. This embedded researcher position introduces substantial risk of confirmation bias and self-serving interpretation of results, potentially inflating perceived framework effectiveness.

This study makes three contributions, calibrated to the evidence available. First, it demonstrates that the FSE framework Mirabito et al. (2024) can be operationalized in a solo designer, multi-brand startup context, extending its documented applicability beyond the academic design team setting in which it was originally developed. Second, the emergent scope calibration function of the Before-After Panel offers a preliminary observation for the designer-developer collaboration literature Zhang et al. (2025), suggesting that clarity regarding visual change magnitude may serve an unintended but useful function in handoff artifacts, a hypothesis warranting structured investigation. Third, AI-assisted drafting is identified as a practically relevant operational mechanism that warrants dedicated empirical study at the intersection of generative AI, documentation sustainability, and knowledge management.

Against these contributions, several limitations must be weighed. The single-case design limits generalizability, although analytical generalization remains possible (Muzaini et al., 2026; Yin, 2018; Zakariya, 2022). The small sample size ($n=10$), combined with the ceiling effect, limits the statistical interpretability of the quantitative results. The researcher's participant-observer position, compounded by the absence of an external facilitator, constitutes the most significant methodological risk. Long-term adoption sustainability was not tested. QOC/TEAM elements were not empirically validated through participant use.

CONCLUSION

This study presented the Design Documentation Canvas (DDC), a lightweight design rationale and traceability framework evaluated within the context of solo designer practice at a resource-constrained, multi-brand startup in Indonesia. Guided by three research questions, the findings demonstrate that the DDC can be systematically designed and implemented by integrating the FSE framework with QOC/TEAM scaffolding in a multi-brand context. The framework was successfully embedded into the existing Figma-JIRA workflow, while AI-assisted drafting supported the documentation process by reducing the perceived articulation burden, although cognitive load was not formally measured. Stakeholders across different roles also demonstrated positive initial reception, with the Before-After Panel emerging as an unintended but practically relevant scope calibration tool for developers.

The DDC provides a directly adoptable documentation artifact without requiring an additional platform beyond the existing Figma-JIRA environment. Nevertheless, its findings should be interpreted as evidence of operational feasibility and initial stakeholder reception rather than generalized effectiveness because of the single-case design, small sample size, ceiling effect, and participant-observer position of the researcher. Future research should replicate the framework across different startup contexts, regions, and tool ecosystems; conduct longitudinal assessments of documentation sustainability; quantitatively measure handoff communication overhead; refine and evaluate the QOC/TEAM elements; and formally examine AI-assisted documentation using validated cognitive load instruments and independent assessments of AI-assisted rationale quality.

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AUTHOR CONTRIBUTION STATEMENT

Adina Fayza Gayo contributed to the conceptualization, methodology, framework design, data collection, investigation, data analysis, visualization, and preparation of the original manuscript. Hadziq Fabroyir contributed to the supervision, methodology, validation, and research guidance. Both authors contributed to the finalization of the manuscript and approved the final version for publication.

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