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Integrating Lean Canvas and SOS Validation for Early Validation of FTTH Design Automation

Budi Leksono[1], Budi Warsito[2], Sutikno[3]

[1]Master of Information Systems Program, School of Postgraduate, Diponegoro University, Indonesia

[2] Department of Statistics, Faculty of Science and Mathematics, Diponegoro University, Indonesia

[3]Department of Informatics, Faculty of Science and Mathematics, Diponegoro University, Indonesia

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ABSTRACT

This research evaluates the effectiveness of an early product validation framework that integrates Lean Canvas with State-of-the-Solution (SOS) Validation. The focus is on the development of Integrated High Level Design (iHLD), a Fiber to the Home (FTTH) network design automation product. The main objective of this study was to test critical assumptions related to the problem, solution, and value proposition among internal technical users. The research methodology adopted a descriptive-qualitative approach. Initial assumptions were mapped using Lean Canvas, then validated through customer discovery interviews adapted from SOS Validation principles. These interviews involved 23 internal users of the Survey Design Inventory (SDI). The collected data was analyzed descriptively and thematically.

The analysis showed that the assumptions regarding the main problem, i.e. the inefficiency and length of the manual network design process, were strongly validated by internal user responses. Similarly, assumptions regarding iHLD's solution (design automation) and value proposition (operational efficiency and ease of use) were also strongly validated. Quantitatively, the implementation of iHLD proved to drastically reduce design time. The average manual design time, which was previously 30 minutes per design, was successfully cut down to about 1.35 minutes per design, indicating a substantial increase in productivity. This positive impact also contributed to increased user satisfaction and reduced workload.

However, the study also identified that assumptions related to potential revenue streams and cost structures were hypothetical and had not been empirically confirmed at this early validation stage. The main conclusion of this study is that the problem-solution fit has been internally confirmed. However, further validation covering the technical aspects of the algorithm comparatively, external market acceptance, and overall business model viability, is absolutely necessary before the iHLD product can enter the scale-up or market expansion phase.

Key Words: Automation, FTTH, Lean Canvas, SOS, Validation,

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1. INTRODUCTION

The public's need for high-speed, stable, and reliable internet services continues to increase along with the rapid digitization in various sectors. In this context, *Fiber to the Home (FTTH)* technology is the most relevant and sustainable solution, given its ability to provide symmetrically large bandwidth, low latency, and capacity that can meet the needs of future applications, such as smart home services, high-quality video streaming, and industrial applications based on the *Internet of Things (IoT)* [1,2]. Therefore, internet service providers (ISPs) are facing pressure to accelerate FTTH network expansion as part of a strategy to improve competitiveness and operational efficiency in an increasingly competitive market.

However, in the implementation of FTTH networks, the network design stage is a major bottleneck that has a direct impact on time efficiency and investment costs. The conventional FTTH network design process involves complex stages, ranging from field surveys, cable route planning, splitter and node placement, calculation of material requirements, to the preparation of technical documents (*Bill of Materials/BoM*). This process is highly dependent on the skills of individual planners, requires substantial time, is prone to human error, and is difficult to standardize [3]. The study by Correia et al. (2023) revealed that manual network planning, especially in large-scale areas, can take months, with a high risk of estimation error, and is difficult to optimize quickly [3].

In response to these challenges, various service providers have adopted geographic information system (GIS)-based FTTH network design automation approaches and artificial intelligence (AI)-based optimization algorithms. These approaches aim to speed up the planning process, improve accuracy, standardize design results, and reduce the workload of network planners [4,5]. Mata et al. (2018) stated that the use of AI in optical network planning, including FTTH, enables faster, more efficient, and adaptive design decisions to changing field conditions [4]. In addition, design automation is also expected to significantly drive the efficiency of investment costs (CAPEX) and operating costs (OPEX) [5].

However, the development and implementation of this FTTH design automation system is not free from high risks, especially in the initial phase of product development. Given its complex nature and targeting the *Business-to-Business (B2B*) market, the validation process of FTTH network design automation products requires special attention. Effective validation not only ensures that the product can meet the technical needs of network planning, but also addresses business needs, internal process efficiency, and user acceptance [6].

In the context of product validation, various approaches have been developed to minimize the risk of new product development failure, such as *Business Model Canvas (BMC), Stage-Gate Model, Design Thinking, and Agile Product Discovery*. However, these approaches have limitations, especially in dealing with complex technical products with high levels of uncertainty. For example, BMC is more suitable for mature business models; while the *Stage-Gate Model* tends to be rigid and slow in the face of changing product hypotheses. *The Design Thinking* approach emphasizes more on exploring user needs empathetically, but pays less attention to measurable business and technical validation aspects; while *Agile Discovery is* more suitable for use after the product enters the advanced development stage [7].

Alternatively, the *Lean Canvas* approach introduced by Ash Maurya (2012) is considered more relevant to address product validation challenges in the early phases of product development under conditions of high uncertainty. *Lean Canvas* facilitates developers to systematically map key assumptions related to problems, solutions, unique value propositions, customer segments, key metrics, and unfair advantages on one page, which can be evaluated quickly and iteratively [7]. Furthermore, Ries (2011) emphasizes the importance of integrating *Lean Canvas* with *Customer Discovery* methods and validating solutions directly to early users as part of the *Validated Learning* principle in the *Lean Startup* framework [6].

To support stronger validation of FTTH network design automation products, the Lean Canvas approach can be strengthened with the *State-of-the-Solution Validation (SOS)* principle, which emphasizes validation on three main pillars, namely *Problem Validation*, *Solution Validation*, and *Value Proposition Validation* [8]. Through the combination of *Lean Canvas* and SOS adaptation, it is expected that the product validation process can be carried out in a more structured manner, focusing on the biggest risks, and enabling faster and data-driven decision making.

Based on this description, this research aims to apply *Lean Canvas* as an initial validation tool in the development of FTTH network design automation applications. The validation was conducted with a *Customer Discovery Interview* approach using an internal questionnaire adapted from the SOS principle. This research is expected to contribute to strengthening the initial validation of FTTH network design automation products as well as providing input to the development of validation methods that are more adaptive and relevant for complex technical products.

2. LITERATURE SURVEY

Product validation has long been identified as a crucial phase in technology development, particularly in the *Business-to-Business (B2B)* domain. In this context, validation focuses not only on product conformance to technical

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requirements, but also on the fulfillment of business aspects, internal processes, and complex multi-stakeholder engagement [1]. Frederiksen and Brem (2017) emphasize that in the context of B2B technology, validation from the ideation phase is key to reducing resource waste and accelerating the achievement of *Product-Market Fit* [2]. The need for validation becomes even more crucial when the developed product is a software automation solution in the telecommunications infrastructure domain, such as *FTTH (Fiber to the Home*) network design. Correia et al. (2023) showed that the development of an algorithm-based FTTH design automation system requires validation not only in terms of algorithm functionality, but also in terms of user acceptance, business efficiency, and process integration [3]. This shows the need for a product validation approach that integrates technical and business aspects simultaneously from the initial phase.

Various product validation frameworks have been developed and widely used. The *Business Model Canvas (BMC)*, developed by Osterwalder, is one of the popular tools in mapping new business models [4]. However, a number of studies have shown that BMC is less able to accommodate the validation of critical assumptions at the new product ideation stage, especially in a technical B2B context [5]. Similarly, the *Stage-Gate Model* is considered less flexible and slow in responding to the dynamics of fast-changing market needs, making it unsuitable for product development that is still under high uncertainty [6]. Other approaches such as *Design Thinking* focus more on exploring user needs empathetically. Although strong in identifying user needs, this approach is weak in validating data-driven business and technical aspects [5]. *Agile Product Discovery* is also widely used in the feature development phase, but is not specifically designed for *Problem-Solution Fit* validation at the ideation stage, especially in technical B2B products [7].

As a response to such limitations, *Lean Canvas* developed by Maurya (2012) emerged as a more relevant tool to facilitate early validation in high uncertainty product development phases [8]. Lean Canvas focuses validation on the most critical assumptions such as *Problem*, *Solution*, *Unique Value Proposition*, and *Key Metrics*, allowing teams to identify the biggest risks early on [2]. Ries (2011) also asserts that the *Lean Startup* approach underlying *Lean Canvas* provides room for rapid and iterative experimentation-based *Validated Learning*, which becomes essential in the development of high-risk products such as FTTH network design automation software [9]. Nevertheless, in the context of technical B2B products such as FTTH design automation, *Lean Canvas* remains an important drawback. Khanna et al. (2021) note that *Lean Canvas* does not explicitly accommodate validation of the product's technical performance nor business value testing based on actual data from internal users [5]. Hahn et al. (2024) even emphasized that in complex B2B products, *Lean Canvas* should be strengthened with methods that focus more on *Problem-Solution Fit* and *Value Proposition* based on empirical data [6].

In response to this void, several recent studies have recommended the integration of *Lean Canvas* with the *State-of-the-Solution (SOS) Validation approach*. Brecht et al. (2021) showed that *SOS Validation* is a lightweight method that is effective in testing the problem, solution, and value proposition in a structured and rapid manner through simple field experiments [1]. *SOS Validation* emphasizes the importance of validating the problem, solution effectiveness, and user-perceived value, which is seen as more contextual and relevant in complex and high-risk technical B2B domains [7]. Nonetheless, based on the literature review conducted, no study has been found that explicitly combines *Lean Canvas and SOS Validation* in the context of developing FTTH design automation products or similar technical automation products. This gap is an important research opportunity to fill, given the need for more responsive, lightweight, and data-driven validation to mitigate the risks of complex technical B2B product development [1, 5].

3. OBJECTIVE OF RESEARCH

The purpose of this research is to apply and evaluate a combination of *Lean Canvas and State-of-the-Solution (SOS) Validation* as an early validation framework in the development of an FTTH network design automation product. The research aims to test the effectiveness of the approach in mapping and validating critical assumptions related to *Problem, Solution, and Value Proposition,* and assess the relevance of the method in the context of complex and high-risk B2B technical products.

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4. RESEARCH METHODOLOGY

This research uses an exploratory qualitative-descriptive study approach to validate the assumptions of an FTTH network design automation product named *iHLD (Integrated High Level Design).* This research method adopts a combination of *Lean Canvas* (Maurya, 2012) and *State-of-the-Solution (SOS) Validation* (Brecht et al., 2021) which are widely used in the initial validation of technology-based products, especially in complex *Business-to-Business (B2B)* domains [9].

4.1. Object of Research

The object of the research is the iHLD application, which is an application designed to automate the FTTH network design process, including cable route planning, network element placement, and *Bill of Quantity (BoQ)* estimation. The validation targets in this research are internal users, namely network planners and *Survey Design Inventory (SDI)* teams as potential target users of the product.

4.2. Validation Framework and Process

The validation was conducted in two stages that refer to *Lean Startup* principles, *Validated Learning, and* the *Customer Discovery Interview* approach [12,14]:

Stage 1: **Lean Canvas Formulation**

Product assumptions were mapped using the *Lean Canvas* consisting of *Problem, Customer Segment, Solution, Unique Value Proposition, Key Metrics, and Unfair Advantage* blocks [8]. Formulation was done based on literature, benchmarking, and exploratory interviews with internal stakeholders.

Stage 2: **Customer Discovery Interview based on SOS Validation**

Assumption validation was conducted using a structured customer discovery interview method, which was designed according to the SOS Validation principles [6]. This approach was used to test:

a) Severity and frequency of the problem (problem validation),

b) Perceived effectiveness of automation solutions versus manual methods (solution validation),

c) The perceived value of using the solution (value proposition validation).

This method was chosen for its effectiveness in minimizing internal bias and accelerating the testing of critical assumptions in a B2B technical environment [9]. The questionnaire was distributed internally to 23 network planners from the SDI team who had used or tried the application.

4.3. Data Collection and Analysis

Data was collected through questionnaires in 2 stages, namely stage 1 to obtain current problems and stage 2 to obtain experiences from internal users of *iHLD* applications consisting of perception scales, closed questions, and open questions. Quantitative data was analyzed descriptively to describe user perception patterns of problems, solutions, and value propositions. Qualitative data was analyzed using a thematic approach to explore suggestions, further needs, and risk perceptions from internal users [14].

4.4. Research Limitations

This research is limited to internal validation in the context of *Problem-Solution Fit and Value Proposition Fit*. Technical validation of the algorithm output as well as external user validation has not been done and will be an area for further research [6].

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5. RESULT AND DISCUSSION

5.1Result

The initial stage of product validation was conducted through assumption mapping using the *Lean Canvas* framework, as recommended by Maurya (2012) in the context of product development with high uncertainty. The initial assumptions included the main problems identified by the internal team, namely the length of the FTTH network design process, limited *SDI (Survey Design Inventory)* personnel, and delays in Go/No Go decision making. The proposed solution is the *iHLD* design automation application, which is expected to simplify the design process and automatic cost calculation. Other assumptions include *Value Proposition* in the form of speed, simplicity and ease of application implementation. To visualize this initial framework, Figure 1 presents the first version of *Lean Canvas* used as the basis for the initial validation process.

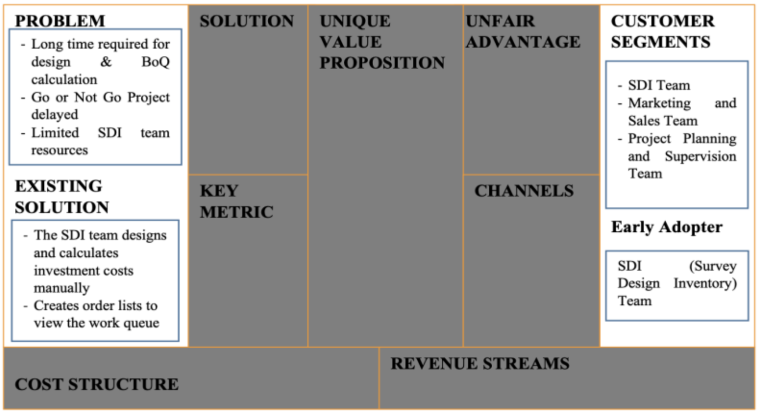

Figure 1 Lean Canvas Version-1

After the validation process, mainly through the stage-1 questionnaire and discussions with internal users, a number of blocks were updated to the Lean Canvas, where some blocks were fully validated (*Problem, Solution, Unique Value Proposition, Key Metrics*), while blocks such as *Revenue Streams* and *Cost Structure* were not yet the focus of validation (see Figure 2).

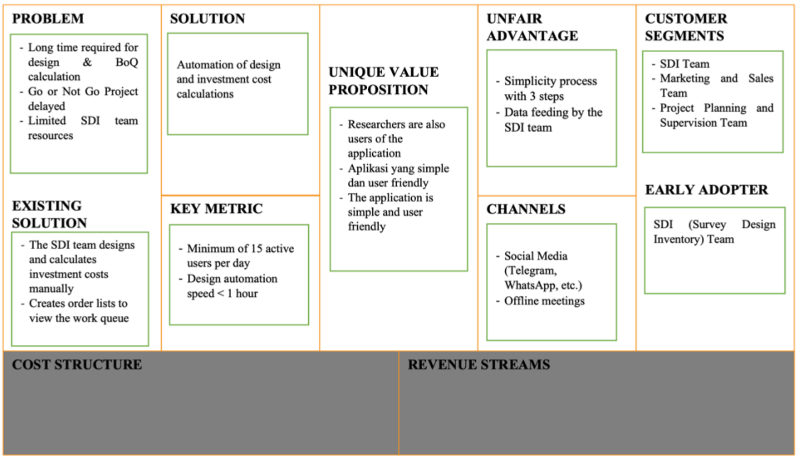

Figure 2 Lean Canvas Version-2

Comparison between the two versions showed strengthening of the *Problem* and *Key Metrics* blocks, as well as adjustments to the solution description and customer segments. These results provide a strong basis for the next validation phase and support the evaluation structure in the *State-of-the-Solution Validation* approach.

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5.1. Problem Validation

Validation of problem assumptions was conducted through the distribution of phase 1 questionnaires to 41 internal users from the SDI team involved in planning and design. The questionnaire results showed that the main pain point experienced by users was the length of the manual design process. Before the use of the *iHLD* application, based on the stage 1 questionnaire, as shown in Table 1, 71% of respondents stated that in completing the design and calculating investment costs for FTTH design for 100 orders took > 3 days.

Table 1. Design duration and investment cost calculation

Question	Duration	Respondents	Percentage
How long do you estimate it will take to design and calculate the BoQ for 100 FTTH design orders?	< 1 day	2	5%
	1-2 days	7	17%
	2-3 days	3	7%
	>3 days	29	71%

The impact of these conditions is very real, including delays in making Go/No Go decisions that impact the realization of network construction and the potential loss of customers. This confirmed that the assumptions in the *Problem* block of the original *Lean Canvas* were not only relevant, but also a significant operational constraint for the network planning team. Problem validation also shows that the design process is not only time-consuming, but also related to the limited resources of the SDI team in terms of the number that is not balanced with incoming orders as shown in Figure 3 of the stage 1 questionnaire results that 90% of respondents stated that the number of orders is not proportional to the number of resources. These results reinforce the assumption that the automation products offered have a strong and empirically validated problem foundation.

Table 2. Order and Number of SDI Resources

Question	Answer	Respondents	Percentage
Is the number of resources in your unit proportional to the load order?	Yes	4	10%
	No.	37	90%

5.2. Solution Validation

After validating the problem, the next step is to test the effectiveness of the solution offered, namely the FTTH network design automation application (*iHLD*). The results of beta testing of FTTH design orders and direct observation to SDI team users show that the application has succeeded in speeding up the design process which previously took an average of 30 minutes to 1.35 minutes per Design Order as shown in table 3 that from a total of 89 design orders it took 7,230 seconds or an average per order of 81 seconds (1.35 minutes).

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Table 3. Duration of FTTH Design Automation

Duration (Seconds)	Number of Order	Total Duration (Seconds)
30	22	660
60	18	1.080
90	13	1.170
120	36	4.320
Total	89	7.230

The simplicity and ease with which the application can be used immediately without intensive training was appreciated by users. In addition to time efficiency, the application is also considered to reduce errors in *BoQ* input and calculation that previously often occurred in manual processes. However, users also provided input for further development, especially on the integration of mobile features so that it can be used directly by the technical and marketing teams. This user feedback is an important note for the next phase of development as well as showing user engagement and trust in the solution offered.

5.3. Value Proposition Validation

Validation of the value of using the *iHLD* application was carried out through a phase 2 questionnaire of 23 respondents, namely collecting data on user perceptions related to the perceived benefits of the application, the level of ease of application and the frequency of application use. All users as per table 4 100% stated the *iHLD* application as a fast and efficient design solution and 96% stated that the application can ease their workload. This not only impacts individual efficiency, but also allows Go/No Go decisions to be made faster and based on more accurate data.

Table 4. Benefits of iHLD App

Question	Answer "Yes."	Percentage	Answer "No"	Percentage
Can iHLD app be a fast and efficient design solution?	23	100%	0	0%
Can the iHLD app help ease your workload	22	96%	1	4%

Table 5. User Friendly Level of iHLD Application

Question	Not User Friendly	Somewhat User Friendly	Quite User Friendly	User Friendly	Very User Friendly
How user-friendly do you find the iHLD application?	0	0	1	10	12

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Table 6. Use of iHLD Application

Question	Everyday	Every Week	Every Month	If Necessary
How often do you use the iHLD app?	17	0	0	6

Apart from the benefits of the application in the Phase 2 questionnaire, it also measures the level of ease of the application in terms of access and how to use it so that most users state that the application is User Friendly according to Table 5 above. While as many as 17 users (74%) stated that they use the application every day, this shows that users expressed readiness to adopt the application as part of their daily workflow. Overall, the validation results show that *Problem-Solution Fit* and *Value Proposition Fit* were solidly achieved at the internal validation stage, in accordance with the validated learning principles proposed by Ries (2011) and the *Customer Discovery Interview* approach customized for B2B technical contexts [12,14].

5.4. Early Adopter Behavior and Engagement

Observations during the *Product Validation (PV)* phase showed positive engagement from internal users of the SDI team as *Early* Adopters as shown in Figure 3.> 20 internal users actively use the *iHLD* application regularly in daily design activities, which indicates good adoption and exceeds the targeted 15 daily users. .

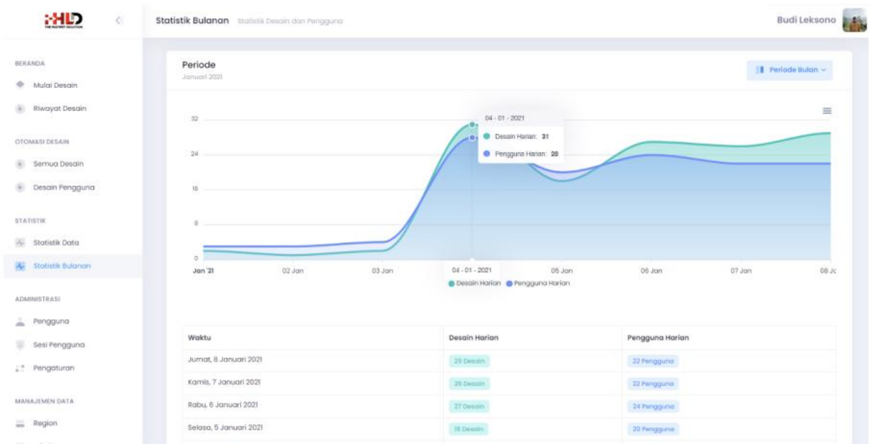

Figure 3 Active users and daily design during the product validation period

Aside from the app usage data, user engagement is also reflected in their activities in the communication channels facilitated through Telegram groups as well as online and offline user meetings. These channels are not only used to distribute updates and application usage guides, but also as a means for users to submit direct feedback, technical problems, and feature development proposals. Intensive interaction in communication channels with users is a positive indicator that users feel the benefits of the application directly in their daily activities. This good engagement from internal *Early Adopter* users is an additional validation of the *Key Metrics* assumptions mapped in the *Lean Canvas*, as well as strengthening the assumption that the developed solution has reached a solid *Problem Solution Fit* stage.

5.5. Gap Analysis between Lean Canvas and Validation Results

Based on the results of the entire validation process, a gap analysis was conducted between the initial assumptions mapped in the *Lean Canvas* and the findings from the field validation process. The analysis showed that the *Problem*,

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Solution, Unique Value Proposition, Key Metrics, and *Channel* blocks were fully validated based on usage data, user feedback, and the results of the *Product Validation* process. These blocks show consistency between initial assumptions and the field realities faced by internal users. In contrast, the *Revenue Streams* and *Cost Structure* blocks are still in the form of initial assumptions and have not been empirically validated. This is because the focus of the validation is still on the internal scope (internal discovery) and does not include validation of commercialization or adoption aspects outside internal users.

The gap analysis confirmed that the validation phase successfully validated the *Problem Solution Fit* and *Value Proposition Fit* in the context of internal users, but the market fit and scalability aspects require further exploration. Strategic insights from these results indicate that the next phase of development needs to focus on more rigorous technical validation of the algorithm output as well as adoption validation in external user environments to ensure product readiness for scale-up.

Discussion

The results of this study show that the combination of *Lean Canvas* and *State-of-the-Solution (SOS) Validation* provides an effective framework in facilitating problem-solution fit validation in the early stages of FTTH design automation product development. The validation conducted with internal users proved that the problem assumptions mapped in the Lean Canvas were strongly validated through evidence obtained from users. This supports the findings of Brecht et al. (2021) who emphasized the importance of validating *Problem Severity* and *Frequency* as an initial step in testing the relevance of the developed solution in a complex B2B technical context [6].

Furthermore, the validation of the solution showed very significant achievements, where the *iHLD* application managed to drastically speed up the design process and reduce the workload of SDIs. The achieved process speed, which is an average of 1.35 minutes per design, confirms the effectiveness of the proposed solution and strengthens the argument that *Lean Canvas* can be a reliable tool in identifying *Problem* and *Solution* assumptions in the technology-based product ideation phase [3,12]. This success also strengthens the argument of Khanna et al. (2021) who pointed out that in the context of B2B technical products, internal user-based validation of *Problem Solution Fit* can provide a strong basis for continuing development to the next stage [9].

The *Value Proposition* validation results also indicate that users perceive real value from using the application, both in terms of work efficiency and reduction of human errors. The high level of internal user engagement, including active use of the application and participation in communication channels, indicates that the perceived value has reached a high level, in accordance with the SOS Validation principle which emphasizes the importance of value validation as an indicator of success in the early stages of product development [6]. This is in line with the findings of Croll and Yoskovitz (2013) who emphasize that active usage metrics *and Perceived Value* are important early indicators in the validation of data-driven products in the context of *Lean Analytics* [16].

However, the gap analysis results show that the validation is still limited to the *Problem Solution Fit* and *Value Proposition Fit* aspects in the internal environment. The *Revenue Streams and Cost Structure* blocks in Lean Canvas remain without empirical initial assumptions. This finding confirms the limitations of the *Lean Canvas* and *SOS Validation* approaches that focus on validating internal discovery, as also highlighted by Hahn et al. (2024) that internal validation does not automatically lead to external market fit, especially in B2B technical products that have high adoption complexity [10].

This discussion is also supported by the findings of Ghezzi and Cavallo (2020) who assert that the development of innovative business models in the B2B digital sector requires a more iterative *Agile* approach and combines *Lean Startup* with structured experimentation at the business model level, not just problem and solution validation [17]. In addition, Furr and Dyer (2014) mentioned that in large organizations or corporations, *Lean Startup* requires a more disciplined methodological adaptation to test new business models, especially in early stage validation before scale-up [15].

This research also identified limitations in the technical validation aspect of the algorithm output, which has not been tested comparatively with manual design methods. The validation carried out is still user perception without measurable technical testing of output accuracy, cost estimation, or impact on business indicators such as *Return Of*

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Investment for FTTH projects. This leaves room for further studies that can complement *Problem Solution Fit* validation with more rigorous technical performance validation as well as business model and *Willingness to Pay* testing in external markets [11].

Based on the results of this study, it is recommended that further development focuses on external validation with target users outside the internal SDI, including *Marketing* team users and non-technical decision makers. In addition, technical validation of algorithm output and validation of business feasibility aspects are important steps to ensure product readiness to enter the scale-up and *Market Adoption* stages [14].

6. CONCLUSION

The results of this study corroborate the initial assumptions regarding the identified problem, namely the length of the manual design process. It also validated the proposed solution, i.e. the implementation of automation through the *iHLD* application, as well as the value proposition that emphasizes increased efficiency and convenience for internal users. Quantitatively, the utilization of the *iHLD* app proved to significantly reduce the time taken for the design process. The original average duration of more than 30 minutes is now reduced to about 1.35 minutes for each individual design task. This success has also contributed to increased user satisfaction and a reduction in their workload.

The adoption rate of the app among internal users is very encouraging, with >28 daily active users consistently engaged. This figure far exceeds the initial target of 15 users. The app was appreciated for its simplicity and easy-to-use interface, making it easy to use without extensive training. The app was also effective in minimizing input errors and *Bill of Quantity (BoQ)* calculations. In addition, users showed high engagement, as evidenced by their regular use of the app and their active participation in dedicated communication channels for feedback and feature development proposals.

This study demonstrates the successful alignment between problem and solution in an internal context. Nevertheless, further validation is essential, covering comparative technical analysis of the algorithms, as well as assessment of external market acceptance and the viability of the underlying business model. These are absolute prerequisites before the product can move to the scale-up phase. Therefore, this study recommends a strategic focus on continued development to achieve external validation, conduct advanced technical validation, and explore various business models. These steps are important to ensure the product is ready for the scale-up and market adoption stages.

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