

Evaluating a Regional Yield Potential System using the CATWOE Analysis and UCD Approach

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Abstract

This study evaluates the effectiveness of the User-Centered Design (UCD) and CATWOE approaches in developing the SINPOHAD village information system for mapping and managing regional economic potential. The results show that UCD achieves a higher accuracy score (88%) than CATWOE (83.33%), indicating its superior ability to meet user needs in terms of usability, learnability, efficiency, satisfaction, and accessibility. While CATWOE provides a strong systemic foundation for requirement formulation and transformation processes, its limited consideration of user experience and environmental constraints results in lower performance. The integration of both approaches yields a design that is strategically structured and highly responsive to real user conditions. The findings confirm that SINPOHAD improves governance efficiency, accelerates decision-making, and enhances community participation through intuitive interfaces and spatial data mapping. The system offers a replicable model for other villages, supporting digital transformation initiatives and sustainable regional development.

Keywords:

Evaluation, Information System, CATWOE, UCD Analysis

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1. Introduction

Regency possesses substantial economic potential, particularly in the sectors of fisheries sector. The rapid growth of digital transformation in Indonesian industries drives organizations to redesign their data management processes to improve operational robustness. Prior studies show that effective business-process analysis is fundamental for developing scalable information systems, especially in public institutions and enterprise environments. Rany et al. highlight how enterprise architecture analysis helps organizations map data flows, identify inefficiencies, and establish structured information governance. The issues that similarly affect Electric Automotive Indonesia as it manages complex production data streams [1]. These findings emphasize the need for a development framework that accelerates system delivery while maintaining structural clarity, which aligns strongly with the principles of the Rapid Application Development (RAD) method.

Researchers also stress the importance of user-centered system design to ensure that digital solutions align with stakeholder needs. Mishra and Dhar demonstrate how user-centered models improve system usability and operational accuracy in small-scale industries, reinforcing that stakeholder feedback must be integrated throughout

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development cycles [2]. In the context of an automotive company, frequent interaction among production managers, logistics teams, and engineers necessitates a development method that continuously incorporates user input. Consequently, RAD becomes suitable because it prioritizes iterative prototyping and rapid refinement, enabling the system to adapt to evolving operational scenarios.

Soft System Methodology (SSM) studies offer additional insight into understanding complex organizational problems. Sumadyo shows that SSM assists teams in defining ambiguous system requirements and aligning them with organizational goals [3]. Mehregan et al. further demonstrate that SSM techniques facilitate structured problem analysis in environments where multiple stakeholders hold different perspectives of the system [4]. These findings reveal that Electric Automotive Indonesia faces similar challenges when harmonizing production, supply-chain, and administrative data, making a flexible and iterative method such as RAD essential for effective system development.

Several works focus on structured problem framing techniques such as CATWOE, which help identify system actors, constraints, and expected outputs. Sun's analysis of CATWOE illustrates how organizations articulate critical system components and clarify transformation processes within complex ecosystems [5]. More recent applications of CATWOE in agriculture and rural development contexts show that this technique improves understanding of system interactions and supports decision making in multi-stakeholder environments [16], [17], [19]. For Electric Automotive Indonesia, these insights highlight the need for well-defined system boundaries and clear role identification before implementing a high-performance data processing system.

The role of prototyping as a development strategy also appears prominently in several earlier studies. Ridwan et al. demonstrate that rapid prototyping accelerates the creation of monitoring systems for logistics operations, improving tracking accuracy and stakeholder engagement throughout development [6]. Munazilin and Udmah similarly validate that web-based information systems benefit from iterative prototype evaluations, which help identify usability inconsistencies and enhance real-time operational decision-making [14]. These findings support the adoption of RAD, where prototyping remains central to ensuring system robustness and operational readiness in automotive data environments.

User interface and user experience (UI/UX) considerations are also essential for ensuring efficient system interaction. Paramarini and Karmilasari show that task-centered design improves usability in e-commerce platforms, while Indriana and Adzani demonstrate that UI/UX optimization strengthens mobile application interaction effectiveness [7], [13]. Hussain et al. expand these principles by showing that adaptive user interfaces enhance system responsiveness to user context and performance needs [23]. In manufacturing settings such as Electric Automotive Indonesia, clear and responsive interfaces reduce data-entry errors and support faster decision-making, reinforcing the importance of user-focused system development supported by RAD's iterative cycles.

Studies on rural information systems and administrative platforms also reveal the importance of robust data integration. Muhtar et al. show that smart village systems rely on interconnected information modules to enhance service efficiency and data accuracy [12]. Rozi et al. and Afrianto and Mulyati highlight that rural administration systems benefit from modular architectures and well-structured database designs to support real-time reporting [15], [20]. These insights align with the automotive context, where integrated production, logistics, and financial data must synchronize seamlessly to ensure operational continuity.

Finally, system development studies consistently indicate that traditional linear development methods cannot accommodate environments with rapidly changing requirements. Gumilang et al. show that the Waterfall method struggles to adapt to evolving administrative needs, resulting in delayed implementation and rigid system structures [21]. Winiarti et al. further emphasize that modern systems require iterative refinement, rapid testing, and continuous validation to maintain performance reliability [22]. These limitations

reinforce the suitability of RAD for Electric Automotive Indonesia, where dynamic data-processing requirements and complex operational workflows demand a flexible and robust development methodology.

2. Related Works

CATWOE analysis is a thinking framework used to understand various perspectives in solving business problems, especially in systems that involve many interests [1]. This approach was developed in Soft System Methodology (SSM) and is widely used in the context of information system development to ensure that the implemented solutions are in accordance with the needs of users and other stakeholders [2]. As an analysis method, CATWOE includes six main elements, namely: Customer, Actor, Transformation (change process), World View, Owner, and Environment [3]. Each of these elements has an important role in identifying needs and expectations in a business or technological system.

In the context of web-based information systems, the CATWOE approach can help to ensure that the system being built is able to accommodate user needs as well as external factors that influence the sustainability of the system [4][5]. Research conducted by Ridwan [6] shows how the use of Geographic Information Systems (GIS) can increase efficiency in managing village potential by considering customer factors, actors involved, and the necessary digital transformation.

Various previous studies have developed web-based and GIS-based village information systems to support the promotion of regional potential and digital public services [7], [8]. Several studies have also applied a User-Centered Design (UCD) approach in building system interfaces to better suit user needs. However, these previous studies are generally partial and have not integrated the UCD approach with a systemic analysis framework capable of explaining social interactions and multi-stakeholder interests holistically.

Geographic information systems (GIS) and village digitalization are also important aspects in developing regional product potential information systems. GIS has proven effective in assisting spatial data-based planning and decision-making, as demonstrated in research demonstrating how Web GIS can help visualize village economic potential. Village digitalization through web-based information systems also accelerates information exchange and facilitates local resource management. [9]

In information system development, the UCD software development model is used to ensure that each stage is carried out sequentially and systematically, starting from needs analysis, system design, implementation, to maintenance. This model is suitable for projects that have clear and defined needs from the start, such as in the development of regional yield potential information systems. By integrating the CATWOE Analysis approach, web-based information systems, GIS, and the UCD development model. Effective management of regional potential depends heavily on the transparency and efficiency of the information system used [10]. With village digitalization, access to information regarding economic potential, demographics, and local resources becomes easier and can be optimized to improve community welfare [10][11], [12]. Research by Yasmin [13] shows that the use of websites as a regional promotion platform can increase investment attractiveness and support sustainable development.

Local actors have indeed been involved in the development of village information systems; however, the approach has largely remained top-down. Such an approach does not fully consider the dynamics of social change and the preservation of local values within the village context. An analysis using the CATWOE method highlights the importance of internal control mechanisms in public information systems, yet it has not been adequately linked to the continuously evolving social conditions of rural communities. As a result, the systems developed often fail to align with the real needs and characteristics of village

societies [14], [15]. Other studies emphasize the importance of communication infrastructure in rural areas as the main foundation in the implementation of web-based systems, showing that the availability of digital access remains a challenge in the development of digital villages.

3. Proposed Method

The selection of CATWOE Analysis and User-Centered Design (UCD) methods in the study of the Regional Potential Information System for Pabean Udik Village aims to integrate systemic and participatory approaches in the development of a complex village information system. The CATWOE Analysis method is employed to identify six key elements, including Customer, Actor, Transformation Process, Worldview, Owner, and Environmental Constraints, to provide a clear understanding of stakeholder roles, transformation processes, system values, and the constraints influencing the implementation of the information system.

CATWOE functions as an analytical instrument within the Soft Systems Methodology (SSM) framework to examine complex, multidimensional problems in social and organizational settings such as village governance. In the context of regional potential information systems, the Customer component includes village communities, business actors, and government entities who rely on accessible regional potential information; the Actor component consists of village officials and system managers responsible for operating and maintaining the system; the Transformation element converts raw regional potential data into useful, analyzable information; the Worldview highlights the system's strategic role in supporting village digitalization and strengthening local economic empowerment; the Owner component involves village leaders and BUMDes as the main decision-makers; and the Environment represents regulations, infrastructure, and cultural considerations shaping system design. This perspective positions the system as both a technical and socio-organizational construct, allowing CATWOE to reveal diverse stakeholder viewpoints and generate holistic, contextually relevant solutions [16], [17]

The UCD approach plays a vital role in ensuring that the developed system truly aligns with the needs of its end users, including village officials, community members, MSME actors, fishermen, and tourists. UCD promotes active involvement of users throughout all stages. By emphasizing the core principles of usability, satisfaction, learnability, accessibility, and efficiency, UCD ensures that the system remains easy to operate, intuitive to learn, and accessible to a wide user base. This alignment helps the system meet real user expectations while improving acceptance and overall user experience. When integrated with CATWOE, UCD strengthens the development of an information system that is effective, adaptive to local needs, and sustainable for long-term community empowerment [1], [16], [18].

In this study, RAD models' development is a sequence of prototypes:

$$P_{i+1} = P_i + \phi(F_i) \quad (1)$$

where

- P_i = prototype at iteration i
- F_i = user and stakeholder feedback
- ϕ = transformation function mapping feedback into design improvements

The objective of each iteration is to optimize system performance:

$$P_i^* = \arg \max_{P_i} [\alpha \mathcal{R}(P_i) - \beta \mathcal{D}(P_i)] \quad (2)$$

where

- $\mathcal{R}(P_i)$ = robustness
- $\mathcal{D}(P_i)$ = processing delay
- α, β = weighting coefficients

The RAD cycle stops when:

$$\| P_{i+1} - P_i \| < \epsilon \quad (3)$$

indicating convergence toward an acceptable system design.

The following formulas are used to measure the accuracy level of applying the CATWOE and UCD methods in the development of the Regional Potential Information System. Since both approaches are qualitative and strategic in nature, the researcher converted the results into quantitative measurements based on user evaluation (UCD) and system element fulfillment (CATWOE) using a scoring approach and percentage of achievement measured with a Likert scale [19].

1. CATWOE Analysis Accuracy Measurement Formula. This formula is used to measure the level of achievement of the six CATWOE components in the developed system.

Components:

C = Customer

A = Actor

T = Transformation

W = Worldview

O = Owner

E = Environmental Constraint

Formula:

$$\text{Accuracy CATWOE} = \frac{\sum \text{Achievement Value of Each Component}}{\sum \text{Component} \times \text{Maximum Score}} \times 100\% \quad (4)$$

Rating Scale per Component (Likert scale 1–5 or %):

5 = Very appropriate

4 = Appropriate

3 = Quite appropriate

2 = Less suitable

1 = Not suitable

2. UCD (User-Centered Design) Accuracy Measurement Formula. This formula is used to measure the extent to which the developed system is accepted and used effectively by end users. Parameters Assessed:

a. Usability

b. Satisfaction

c. Learnability (ease of learning)

d. Accessibility

e. Efficiency (efficiency of use)

Formula:

$$\text{Accuracy UCD} = \frac{\sum \text{User Evaluation Score on Each Parameter}}{\sum \text{Parameter} \times \sum \text{Respondant} \times \text{Maximum Score}} \times 100\% \quad (5)$$

Each component in the CATWOE analysis framework is mapped and functionally connected to the User-Centered Design (UCD) stage, which will be used as a reference for

designing a regional potential product information system, as Fig. 1.

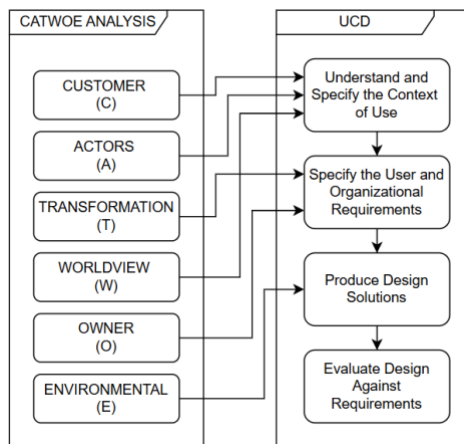


Fig. 1 between CATWOE Analysis and UCD

CATWOE and UCD integrate into one framework that supports data collection, requirement analysis, and system design. Customers (C) match the UCD step of defining the context of use by identifying community beneficiaries and their needs. Actors (A) match the step of specifying requirements, since village staff and managers set workflows and data roles. Transformation (T) supports the design phase by defining how manual data becomes structured digital information. Worldview (W) guides all UCD steps by ensuring the system reflects community values and benefits. Owner (O) links to design evaluation, as village authorities confirm alignment with strategic goals. Environmental constraints (E) shape the UCD process by ensuring the interface stays usable and accessible under local limitations.

4. Experimental Setup

One of the main duties and functions of the village head (kuwu) of Pabean Udik Village is to manage village resources, particularly the regional yield potential resources. These resources serve as the backbone of the village’s economy, as they directly influence the region’s per capita income. Moreover, effective management of these potential resources has a significant impact on the Village Development Index (IDM), positioning Pabean Udik as an independent village capable of competing with other regions within and beyond Indramayu Regency. A detailed description of each actor’s role is presented in Table 1 below:

Table 1 Actor Description

Actor	Actor Description
Head of Pabean Udik Village (Kuwu)	<ol style="list-style-type: none"> Actors who have a role in making decisions and policies regarding the need for data and information regarding potential regional products which will be used as material for making strategic plans which are outlined in the annual work program. Receive reports on potential regional output from MSMEs, and Income from the tourism and culture department.

Village service staff (web administrator)	<ol style="list-style-type: none"> 1. Actors who have a role in managing data and information about the regional potential in the Pabean Udik village area. 2. Actors who have a role in managing the Pabean Udik website.
The people of Pabean Udik village	<ol style="list-style-type: none"> 1. Actors who have a role in utilizing information and communication technology to see the potential of regional products in Pabean Udik village. 2. Actors who have a role in informing income from livelihoods as farmers, livestock breeders, and fishermen.
MSMEs	<ol style="list-style-type: none"> 1. Actors who have a role in reporting income from sales results 2. Actors who report the amount of production generated each time they produce 3. The actor who will record the business capital data used for production.

Fig. 2 depicts the business process of designing a regional potential product information system model which can be seen in the use case image.



Fig. 2for Mapping Regional Yield Potential

Pabean Udik Village is a coastal area with significant potential for natural resources and local wisdom, ranging from fisheries products, processing industries, to traditional batik culture. However, these various potentials have not been optimally developed due to several fundamental problems covering social, economic, educational, and infrastructure aspects. Based on the results of field identification, several key issues were identified, such as the failure of mangrove tourism development due to location limitations and damaged infrastructure, the low welfare of fishermen due to dependence on middlemen, and the suboptimal management of BUMDes business units due to limited human resource capacity. In addition, other challenges include the low level of community education which has an impact on the high rate of early marriage, the lack of regeneration of batik artisans, and limited promotion and digitalization in the salted fish and shrimp paste industry center. To address these challenges, a structured analysis was conducted based on mapping the relationship between problems, root causes, and solutions that can be applied contextually.

The CATWOE method was developed using several questions as the basis for root definition in Pabean Udik village as Table 2.

Table 2 Catwoe Analysis

CATWOE	Description
Customer	Parties who need information about the potential of regional products such as: Udik Customs Community, Immigrants, the Business World and the Industrial World, Regional Government.
Actor	Parties are directly involved with the system that will transform customer needs and system business processes, such as: Village Heads, Village Officials (web administrators), village communities, and MSMEs.
Transformation Process	Establishing input document requirements in the system to produce output documents tailored to user needs, such as mapping regional potential and mapping the IDM (Independent Village Development) from an independent village to a digital village.
World View	Provides a general overview of the mapping of regional product potential which will be included in the regional product potential map.
Owner	Users who have the authority to control and monitor the mapping of the regional potential in Pabean Udik village
Environmental Constraints	The designed system has established rules for each user involved in the system to prevent errors and to facilitate control of data access and system output.

Based on the results of the interview with the Kuwu of Pabean Udik village, we can enter it into the CATWOE analysis to obtain appropriate analytical study results, so that the mapping of regional yield potential can be done correctly. See Table 3.

Table 3. CATWOE Analysis and Achievement Indicators

CATWOE Components	Actor / Element Description	Target Achievement
Customer	Newcomers, business owners, industry, local government, investors	<ul style="list-style-type: none"> - Availability of information on potential local village resource yields is digitally based on data. - Providing access to data on strategic cooperation opportunities for investment and regional development. - Increasing the Village Development Index (IDM) value as an indicator of the transition towards a digital village. - Increasing the economic capacity of the community through optimizing digital-based marketing.
Actor	Village government (Kuwu and staff), local community	<ul style="list-style-type: none"> - Expanding the promotional reach of local tourist attractions using online platforms. - Facilitating literacy in primary and secondary education through collaborative outreach programs with relevant agencies. - Encourage the adoption of information technology by MSMEs to expand their markets and business networks.

Transformation Process	A systematic process for mapping the regional information input and output needs	<ul style="list-style-type: none"> - Digitizing local potential mapping, including the MSME, fisheries, agriculture, livestock, and tourism sectors, into one integrated information system. - Develop a digital-based IDM achievement map.
Worldview	Development perspective based on potential mapping	<ul style="list-style-type: none"> - Provides visual representations (graphs and maps) based on spatial data related to the distribution of local economic potential. - Displays the classification of potential based on the economic structure of the community: agriculture, fisheries, MSMEs, and tourism sectors.
Owner	Village government as owner and manager of the system	<ul style="list-style-type: none"> - Develop standard procedures for monitoring and evaluation of regional potential management systems. - Designing and developing business units that are managed professionally under the supervision of Village-Owned Enterprises (BUMDes). - Drafting internal regulations regarding user access management based on the division of work tasks and responsibilities (tupoksi).
Environmental Constraints	System operational regulations and limitations	<ul style="list-style-type: none"> - Implement a structured access rights scheme to ensure the security, transparency, and operational efficiency of the system.

Based on the analysis using the CATWOE approach, the authors conducted a mapping of the regional potential of Pabean Udik Village from the perspective of the residents' livelihoods. These sectors have contributed significantly to establishing Pabean Udik as an independent and self-sustaining village that is ready to transition toward a digital village. To achieve this transformation, comprehensive and optimized mapping is essential to enable the village head to fully understand the strength of existing resources and evaluate the readiness of human resources in supporting sustainable digital development.

5. Results and Analysis

This part focuses on the design of the user interface, which is tailored to user needs and aims to create a system that is easy to use, effective, and efficient. The development process involved coding activities that resulted in the creation of a web-based regional potential information system. [20], [21] An effective user interface design requires adherence to key design principles to ensure that the interface helps users achieve their goals. The user interface (UI) design of the Regional Potential Information System application for Pabean Udik Village was developed as a concrete integration of information technology and the needs of the village community in managing and promoting local potential digitally. The design process not only considers the functional aspects of the system but also emphasizes usability, simplicity, and accessibility for various types of users, including village officials, MSME actors, fishermen, artisans, and the general public. [22], [23].

In the testing phase, the author implemented a black-box method with three respondents: an administrator, a villager, and the village head. The black box testing method was chosen because it focuses on the overall functionality of the system. The

results of the web-based SINPOHAD black-box testing are presented in Table 4 below.

Table 4. SINPOHAD Testing

No	Testing	Test Result
1	Users access the SINPOHAD website	Successful
2	Admin and members log in	Successful
3	Admin and members create a new account	Successful
4	Admin confirms account data	Successful
5	Admin approves the updated data on village income based on livelihood criteria	Successful
6	Villagers can update income data	Successful
7	Villagers can see the growth of harvest yields or livestock sales.	Successful
8	The village head can see and monitor the village's potential income	Successful
9	The village head can see where the main potential of his area comes from.	Successful

In this study, we calculated accuracy after completing the model design for the regional product potential information system application. The application was then submitted to users for evaluation and assessment. The evaluation involved three types of users: web development experts, village heads, and administrators. The web development expert was tasked with evaluating and assessing the system using the CATWOE analysis approach, while the village heads and administrators conducted their evaluations using the UCD approach. The results of the accuracy measurement using the CATWOE approach, carried out by one web development expert, are presented in Table 5.

Table 5. Web Developer Expert Assessment

Component	Score (1–5)	Information
Customer (C)	5	Community involvement
Actor (A)	4	Active village apparatus
Transformation (T)	5	Digitalization is realized
Worldview (W)	4	In accordance with local values
Owner (O)	4	The village government actively manages
Environment (E)	3	Infrastructure constraints still exist

Using the CATWOE accuracy calculation formula, the following results are obtained:

$$\begin{aligned}
 \text{Accuracy CATWOE} &= \frac{\sum 5+4+5+4+4+3}{6 \times 5} \times 100\% \\
 &= \frac{25}{30} \times 100\% = 83,33\%
 \end{aligned}$$

The accuracy measurement using the UCD approach was conducted by users from the Pabean Udik village administration, namely the village head, the village administrator, and the tourism manager, as shown in Table 6.

Parameter	Village head	Village Admin	MSME Manager	Tourism Manager	Total
Usability	5	5	4	4	18
Learnability	4	4	4	5	17
Efficiency	4	5	4	4	17
Satisfaction	5	4	4	5	18
Accessibility	4	4	5	5	18
Total Score					88

Using the UCD accuracy calculation formula, the following results are obtained:

$$\begin{aligned} \text{Accuracy UCD} &= \frac{\sum(18+17+17+18+18)}{(5 \times 4 \times 5)} \times 100\% \\ &= \frac{88}{100} \times 100\% = 88\% \end{aligned}$$

Table 7 illustrate the interpretation of the results of accuracy calculations using the CATWOE and UCD methods.

Method	Accuracy Value (%)	Interpretation
CATWOE	83.33%	The system includes stakeholder roles, visions, and contexts.
UCD	88%	The system is easy to use, acceptable and relevant to users.

With an accuracy above 80% for both method approaches, it can be concluded that the integration of the CATWOE and UCD methods is very effective in ensuring the successful implementation of the village's potential information system from both technical, social, and user perspectives.

6. Conclusion

Based on the accuracy calculation results, the UCD method achieved a higher score (88%) compared to the CATWOE method (83.33%). This indicates that the UCD approach is more effective in ensuring that the designed information system meets the needs and expectations of end users, particularly in terms of usability, learnability, efficiency, satisfaction, and accessibility. UCD has been proven to make a significant contribution to user acceptance and comfort across different roles, including village heads, administrators, MSME managers, and tourism managers. On the other hand, the CATWOE method still provides a strong systemic foundation, particularly in formulating requirements and transformation processes from a stakeholder perspective. However, CATWOE's limitations in addressing user experience aspects and external environmental factors, such as infrastructure, contribute to its lower accuracy score. Therefore, integrating the systemic CATWOE approach with the user-oriented UCD approach is strongly recommended to develop village information systems that are not only conceptually strategic but also adaptive and inclusive of real user conditions in the field.

The research findings demonstrate that SINPOHAD effectively enhances the efficiency of village governance, accelerates decision-making processes, and promotes community participation in data-driven development. With its user-friendly interface and spatial data-based mapping functionality, the system is expected to serve as a replication model for

other villages with similar characteristics, supporting digital village programs and the achievement of independent village status. This study shows that the development of the Regional Product Potential Information System in Pabean Udik Village provides a strategic solution for mapping, documenting, and promoting the village's economic potential digitally and sustainably. Through the integration of the User-Centered Design (UCD) approach with CATWOE analysis, the system not only aligns with user needs but also considers the social, structural, and environmental factors that influence regional potential management.

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