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Heuristic Inspection of an Analytics Dashboard for an Oyster Mushroom Micro-Enterprise: Usability Problems and Design Revisions

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ABSTRACT

Analytics dashboards are increasingly offered to agricultural micro-enterprises, but their users often have limited digital literacy, and design flaws can make such dashboards unsuitable for daily record keeping. This study inspected the initial prototype design of a web-based analytics dashboard developed for an oyster mushroom micro-enterprise in Deli Serdang, Indonesia, and traced how its usability problems were handled in the revised version used in the first field trial. The research team walked through six representative tasks, examined every page against Nielsen's ten heuristics, rated each problem on a 0–4 severity scale, and compared the findings with the revised design. Seventeen problems were identified in the prototype; nine were rated major or catastrophic, and one prevented a core task, recording expenses, from being completed. The most frequently violated heuristic was the match between system and the real world (six problems), reflecting units, calculations, and terms that did not follow farm practice. The revised design resolved fifteen problems and partly resolved one, while one problem remained and two new data-safety problems were introduced. The findings indicate that heuristic inspection helps align dashboard logic with farm practice before user testing.

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1. INTRODUCTION

Micro, small, and medium enterprises (MSMEs) are a central part of Indonesia's economy, and digital tools are increasingly promoted as a way to improve their record keeping, decision making, and competitiveness. Readiness for this transition, however, is uneven. Indonesian MSMEs face financial, human-resource, and operational constraints when adopting digital technology [1], and digital literacy has been shown to determine whether small businesses succeed in transforming their operations [2]. Beyond access to technology, adoption in small firms depends on whether the workforce has the skills to use it [3]. For a micro-

enterprise, a digital system that is difficult to operate may therefore be abandoned even when its functions match business needs.

These constraints are pronounced in agriculture. Reviews of digital agriculture for smallholders identify digital skills and literacy as recurring barriers, alongside infrastructure and affordability [4], while studies of farm management information systems report that limited usability and a poor fit with farmers' routines hinder their uptake [5]. Co-designing interfaces with smallholders has been found to improve their ability to understand and use digital platforms [6]. In mushroom cultivation, most digital solutions focus on monitoring and controlling environmental conditions through Internet of Things (IoT) devices [7], [8]. Comparatively little attention has been given to tools that help growers manage production and financial records, or to how usable such tools are for the people who operate them every day.

Analytics dashboards are commonly used to present such records. A dashboard arranges the most important information on a single screen so that it can be monitored at a glance [9], and dashboards now serve a wide range of purposes and audiences beyond executive reporting [10]. Whether a dashboard fulfils this purpose depends on its usability, which ISO 9241-11 defines as the extent to which a system can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use [11]. In 2026, a community service program by Politeknik Negeri Medan developed a web-based analytics dashboard for Sukamaju Farm, an oyster mushroom micro-enterprise in Deli Serdang Regency, North Sumatra, Indonesia. The dashboard replaced handwritten notes and simple spreadsheets with three modules: production records for nine cultivation racks holding about 9,000 substrate bags (baglogs), a baglog cycle module that schedules replacement, and a financial module that calculates net profit. The program's evaluation indicated that some users still could not independently read the net profit for a given period and did not uniformly understand the value of rack-level recording. Because that evaluation focused on user competence, it could not determine whether these difficulties stemmed from the users or from the way the interface presented information.

Heuristic evaluation is an inspection method in which evaluators examine an interface and judge its compliance with recognized usability principles [12]. It is inexpensive, can be applied early in development or to systems already in use, and produces problem descriptions that translate directly into design changes. Nielsen's ten heuristics, refined through a factor analysis of a large set of usability problems [13], remain the most widely applied set. Because a single evaluator finds only a fraction of the problems, three to five independent evaluators are recommended for summative assessments [14], and the variability between evaluators, known as the evaluator effect, means that the results of any single inspection should be interpreted with care [15]. In iterative development, heuristic inspection is also used by design teams to review their own interfaces between versions, with task-based walkthroughs helping to focus the inspection on real use [16]. Domain-specific heuristics have been proposed for information visualization [17], and methods for developing such heuristics have been reviewed [18]; where no validated set exists for a domain, general heuristics remain a practical starting point.

Heuristic evaluation has been used to refine web-based dashboards in health care [19], to evaluate mobile health applications before user testing [20], and to assess institutional information systems [21]. Earlier work by the authors applied usability testing to a digital literacy interface for children [22] and the System Usability Scale to a website prototype for an architecture practice [23]. These studies, however, concern professional or general-public users. Evidence on the usability problems of operational analytics dashboards in agricultural micro-enterprises, whose users combine farm work with record keeping and have varied educational backgrounds, remains scarce.

This study therefore inspected the initial design of the Sukamaju Farm dashboard and compared it with the revised version used in the first field trial. Its objectives were to (1) identify the usability problems of the initial design and rate their severity, (2) map the problems to the violated heuristics and to the pages in which they occurred, and (3) examine how the revised design addressed them and which problems remained or were newly introduced. The findings document one design iteration of a dashboard for agricultural micro-enterprise users and provide a basis for the user-based evaluation that follows.

2. RESEARCH METHOD

2.1. Research Design

This study was a descriptive case study of one design iteration. The initial design of the dashboard was inspected against Nielsen's heuristics, and the problems found were then compared with the revised design. The study proceeded in five stages, as shown in Figure 1.

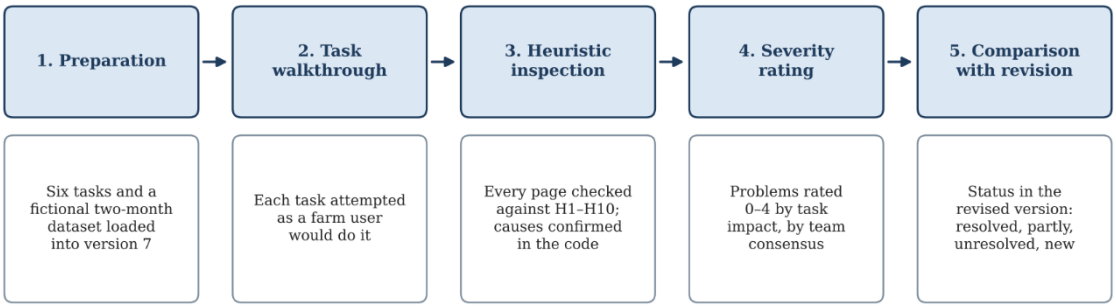


Figure 1. Stages of the heuristic inspection.

2.2. Evaluated Designs

Two versions of the dashboard were examined. The initial design was the last design produced before the field trial; it was a single-page web application that stored data in the browser's local storage and contained seven groups of menus (Table 1). The revised version, used in the first field trial with the enterprise, reorganized the content into five menus: Dashboard, Harvest Production, Baglog Management, Sales, and Reports. Because the initial design did not yet contain real records, a fictional two-month dataset was loaded before the inspection, consisting of daily harvest records for nine racks, sales transactions, and staggered baglog filling dates. The dataset was used only to make all tasks executable and did not change the interface or its functions.

Table 1. Menus of the initial design.

Menu in the initial design	Main functions
Dashboard	Today's harvest, sales by channel, total revenue, active baglogs, latest transactions
Harvest input	Entry of the number of baglogs harvested per rack and the price per baglog; harvest history
Sales input	Entry of sales by channel (online marketplace or offline), product, quantity, and price
Rack analysis	Harvest, revenue, and profit per rack for a selected month
Baglog stock	Baglogs entered, harvested, and remaining per rack; filling and removal dates
Monthly report	Sales per product and channel, net profit, baglog cycle report per rack
Backup, export, and settings	Backup and restore files, CSV export, product prices, costs, rack capacity

2.3. Inspection Procedure

The inspection was carried out by the research team in August 2026 on a laptop and a tablet. In the first pass, the six tasks in Table 2 were attempted as a farm user would perform them, so that the inspection reflected the actual context of use [16]. The tasks covered harvest recording, rack comparison, baglog replacement, and finance, and included the two activities that users had found difficult during the field trial: comparing productivity across racks (T2) and reading the net profit for a period (T6).

Table 2. Representative tasks used in the walkthrough.

Code	Task	Main menu used
T1	Record today's harvest of 12.5 kg for Rack 3	Harvest input
T2	Identify the rack with the lowest yield in the past week	Rack analysis
T3	Record the filling date of new baglogs on Rack 5	Baglog stock
T4	Identify the rack whose baglogs must be replaced first	Baglog stock
T5	Record the purchase of replacement baglogs as an expense	Sales input
T6	State the net profit for the previous month	Monthly report

In the second pass, every page was examined against the ten heuristics in Table 3 [12], [13]. For each problem, the page, a description, the violated heuristic, the affected task, and a screenshot were recorded on a standard form. When a displayed value appeared incorrect, the client-side code was examined to confirm the cause, so that calculation errors could be distinguished from presentation problems.

Table 3. Nielsen's ten usability heuristics [13].

Code	Heuristic	Focus
H1	Visibility of system status	The system keeps users informed with accurate, timely information
H2	Match between system and the real world	Words, units, and logic follow the users' own practice
H3	User control and freedom	Users can undo, edit, or leave an unwanted state
H4	Consistency and standards	Settings and actions behave the same way throughout
H5	Error prevention	The design prevents errors and data loss before they occur
H6	Recognition rather than recall	Information is visible where and when it is needed
H7	Flexibility and efficiency of use	Frequent tasks can be completed quickly
H8	Aesthetic and minimalist design	Screens contain only relevant information
H9	Help users recognize, diagnose, and recover from errors	Error messages are plain and suggest a solution
H10	Help and documentation	Help is easy to find and focused on the task

2.4. Severity Rating

Each problem was rated on Nielsen's five-point severity scale [24]. To reduce subjectivity, each rating was anchored to the effect of the problem on the tasks, as described in Table 4, and the final rating was agreed by consensus of the research team. Problems rated 3 or 4 were classified as high priority, those rated 2 as medium priority, and those rated 1 as low priority.

Table 4. Severity rating scale and criteria [24].

Rating	Category	Criterion used in this study
0	Not a problem	No effect on any task
1	Cosmetic	Noticeable, but does not affect task completion
2	Minor	Slows or confuses users, but the task can be completed correctly
3	Major	Task completed only with considerable difficulty, information shown is misleading, or a single record can be lost
4	Catastrophe	Task cannot be completed, or many records can be lost

2.5. Data Analysis

The problems were summarized by heuristic and by severity. Each problem in the initial design was then checked in the revised design and classified as resolved, partly resolved, or unresolved. Problems that appeared only in the revised version were recorded separately as new problems and were not counted in the total for the initial design. The revised design was interpreted with reference to dashboard design principles [9], [10].

3. RESULTS AND DISCUSSION

3.1. Overview of Usability Problems

The inspection identified 17 usability problems in the initial design (Table 5 and Figure 2). Of these, 9 were rated major or catastrophic, and one (P3) was rated catastrophic because it made T5 impossible to complete: the initial design offered no way to record an expense. The most frequently violated heuristic was the match between system and the real world (H2), with 6 problems, followed by H1, H6, H7, and H8 with two problems each. No problems in the initial design were assigned to error prevention (H5) or help and documentation (H10).

Table 5. Usability problems in the initial design by heuristic and severity.

Heuristic	Problems (n)	Severity 1	Severity 2	Severity 3	Severity 4
H1	2	0	0	2	0
H2	6	0	1	4	1
H3	1	0	1	0	0
H4	1	0	1	0	0
H5	0	0	0	0	0
H6	2	0	1	1	0
H7	2	0	1	1	0
H8	2	1	1	0	0

Heuristic	Problems (n)	Severity 1	Severity 2	Severity 3	Severity 4
H9	1	0	1	0	0
H10	0	0	0	0	0
Total	17	1	7	8	1

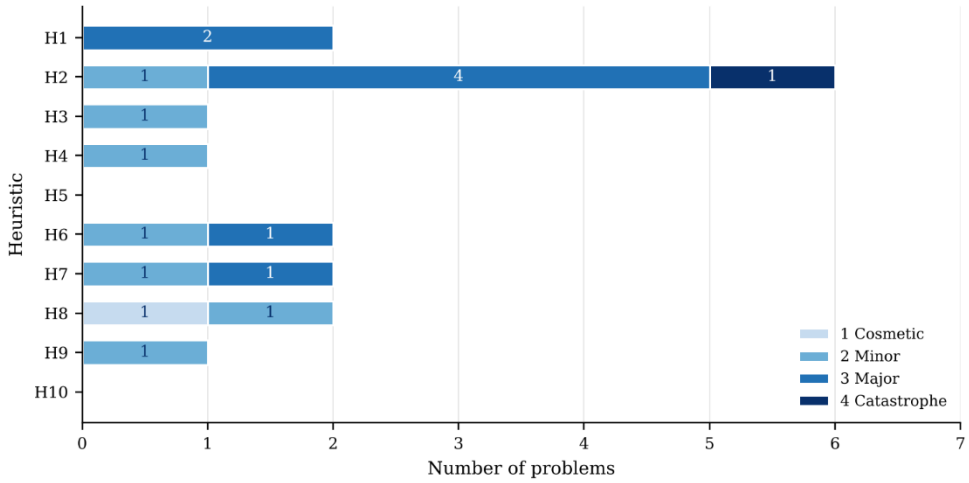


Figure 2. Distribution of usability problems in the initial design by heuristic and severity.

3.2. Usability Problems in the Initial Design

Table 6 lists all problems found in the initial design. The most serious problems concerned the way the dashboard represented farm activities. Harvests were recorded as the number of baglogs harvested rather than as weight (P1), and their value was calculated with the selling price of a baglog as a product rather than the price of mushrooms (P2). The stock of each rack was reduced by every harvested baglog (P16), although a baglog is harvested repeatedly during its cycle; with the two-month dataset, most racks therefore showed zero remaining baglogs and harvests of more than 100% of their capacity, as illustrated in Figure 3(a). A further calculation error caused the active stock of every rack on the rack analysis page to be displayed as zero (P6), because the page read a data field that was never stored.

Financial information was incomplete and hard to find. Expenses could not be recorded (P3), so net profit depended on cost values set in the settings menu, and it was shown only in the last column of the monthly report rather than on the dashboard (P4). The profit per rack was computed by subtracting the purchase cost of a baglog from the value of each harvested baglog (P5), which produced figures with no clear meaning. For baglog management, the replacement date had to be estimated and entered manually (P8), and the dashboard did not indicate which racks were due for replacement (P9), which made T4 depend on the user's own calculation. The remaining problems concerned language and presentation: technical and English terms (P10), a generic error message (P11), a setting that had no effect (P12), repeated backup warnings (P13), month-only filters (P14), a long sales form (P15), and the absence of an edit function (P17).

Table 6. Usability problems identified in the initial design.

ID	Page	Problem	Heuristic	Task	Severity	Status in revision
P1	Harvest input	Harvest recorded as the number of baglogs harvested, not as weight (kg)	H2	T1	3	Resolved
P2	Harvest input	Harvest value calculated with the selling price of a baglog (Rp3,500) instead of the mushroom price	H2	T1	3	Resolved
P3	Sales input, settings	No way to record expenses; costs exist only as a per-product cost setting	H2	T5	4	Resolved
P4	Dashboard, monthly report	Net profit absent from the dashboard; shown only in the last column of the monthly report	H6	T6	3	Resolved
P5	Rack analysis	Profit per rack computed as harvested baglogs × (price − baglog purchase cost), giving misleading figures	H2	T2	3	Resolved

ID	Page	Problem	Heuristic	Task	Severity	Status in revision
P6	Rack analysis	'Active stock' of every rack always displayed as 0	H1	T2	3	Resolved
P7	Navigation	Rack information spread over four pages	H6	T2, T4	2	Resolved
P8	Baglog stock	Replacement date entered manually as an estimate instead of being calculated	H7	T3, T4	3	Resolved
P9	Dashboard	Racks due for baglog replacement not shown on the dashboard	H1	T4	3	Resolved
P10	All pages	Technical and English terms (Backup, Export CSV, Channel, Omzet, HPP, Auto-save, record)	H2	General	2	Partly resolved
P11	Input forms	Error message 'Lengkapi data!' (complete the data) does not name the missing field	H9	T1, T3, T5	2	Resolved
P12	Settings	'Number of active racks' setting is saved but has no effect	H4	General	2	Resolved
P13	Dashboard, sidebar, settings	Backup warning repeated in three places with duplicate buttons	H8	General	1	Resolved
P14	Monthly report, rack analysis	Filters limited to months; results for the past week cannot be viewed	H7	T2	2	Resolved
P15	Sales input	Long sales form (nine fields, including channel, order number, and shipping cost)	H8	T5	2	Resolved
P16	Baglog stock	Remaining baglogs computed by subtracting harvested baglogs although each baglog is harvested repeatedly; stock falls to 0 and harvest exceeds 100%	H2	T3, T4	3	Resolved
P17	Harvest and sales history	Records cannot be edited, only deleted and re-entered	H3	T1, T5	2	Unresolved

3.3. Design Revisions

Table 7 summarizes how the revised version responded to these problems. The revised design changed the underlying data model rather than only the appearance of the pages: harvests are recorded in kilograms with a price per kilogram, finances are recorded as income and expense transactions, and baglog replacement is calculated automatically 120 days after filling and displayed with a colour-coded status on both the dashboard and the baglog page (Figure 3(b)). The menu was reduced from nine entries to five, and terms such as Backup and Export were replaced with Indonesian phrases.

Table 7. Changes in the revised version by theme.

Theme	Problem	Change in the revised version
Recording units and values	P1, P2, P16	Harvest recorded in kilograms with a price per kilogram; the number of baglogs harvested is optional; remaining stock is no longer derived from harvests
Finance	P3, P4, P5, P15	One transaction form with income and expense types; monthly trend of income, expenses, and net profit on the dashboard and sales page; profit per rack removed
Rack and baglog cycle	P6, P7, P8, P9, P14	Rack information grouped into Harvest Production and Baglog Management; replacement date calculated automatically; status shown as active, due soon, or overdue; reports by day, week, month, or year and by rack
Language and feedback	P10, P11, P13	Indonesian terms for backup and restore; error messages name the missing fields; a single backup notice in the sidebar
Settings	P12	Ineffective rack-number setting removed

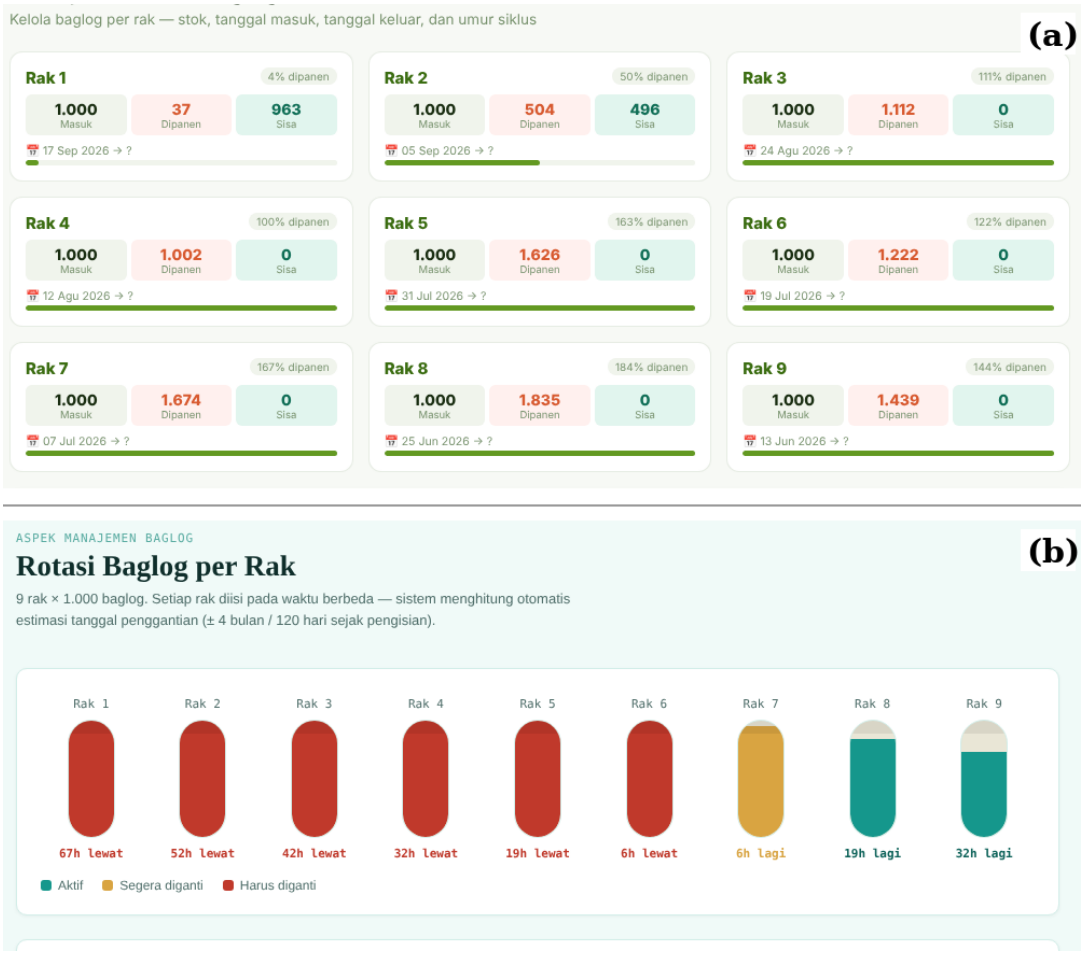


Figure 3. Baglog stock in the initial design with the test dataset (a) and baglog rotation status in the revised version with the enterprise's data (b).

3.4. Remaining and New Problems

Two problems from the initial design were not fully resolved. Some technical terms remained (P10), and records still could not be edited (P17). The revision also introduced two new problems, both related to error prevention (Table 8). Harvest and finance records were deleted immediately without confirmation, whereas the initial design asked for confirmation (N1), and data were kept only for the browser session, so closing the tab without downloading a backup would discard all records (N2). N2 was rated catastrophic because it can cause the loss of many records.

Table 8. Problems remaining or introduced in the revised version.

ID	Problem	Heuristic	Severity	Recommendation
P17	Records cannot be edited, only deleted and re-entered	H3	2	Add an edit action to each row of the harvest and finance history
N1	Harvest and finance records are deleted immediately without confirmation (the initial design asked for confirmation)	H5	3	Show a confirmation that names the record before deletion, or offer an undo option
N2	Data are kept only for the browser session and are lost when the tab is closed unless a backup is downloaded (the initial design saved automatically)	H5	4	Restore automatic saving in the browser, as in the initial design, and keep the backup reminder

3.5. Discussion

The distribution of problems shows that the main weaknesses of the initial design lay in its correspondence with farm practice rather than in its visual design. Six of the seventeen problems violated H2, and several of them were calculation or data-model problems that a visual inspection alone would not have revealed. This pattern differs from heuristic evaluations of mature dashboards and information systems, in which most problems were cosmetic or minor [19] or concentrated in aesthetic and minimalist design [21]. It

is consistent with reviews of farm management information systems, which identify a poor fit between systems and farmers' routines as a barrier to uptake [5], and with evidence that interfaces developed together with smallholders are easier for them to understand [6]. In this case, the revised design drew on the enterprise's own cash book, which brought the units and categories closer to the way the business was actually run.

Several problems in the initial design concern the same activities that users found difficult during the field trial. In the initial design, the net profit for a period could be found only in the monthly report and depended on cost settings that users did not enter themselves (P3, P4), and comparing racks relied on a page whose stock and profit figures were incorrect (P5, P6). For users with limited digital literacy [2], [4], such problems are likely to be attributed to their own lack of skill rather than to the design. The revision addressed these points by placing the answers to the users' main questions, namely how much was harvested, which racks need attention, and how much profit was made, directly on the dashboard, in line with the purpose of a dashboard as a single-screen overview [9], [10]. Whether these changes are sufficient for the enterprise's users has to be confirmed through user testing.

The revised design, however, removed safeguards that had existed in the initial design. Deleting records without confirmation and keeping data only for the session (N1, N2) expose the enterprise to data loss, which is serious for a business whose records are the main purpose of the system. A similar need for safeguards and help features was reported when a mobile health application was refined after heuristic evaluation [20]. Simplification should therefore be checked against all heuristics, not only against the problems being fixed.

This study has several limitations. The inspection was carried out by the research team, which was also involved in designing the dashboard, rather than by independent evaluators, so some problems may have been missed and the severity ratings may be biased [15]. The dataset used to execute the tasks was fictional (test data), and heuristic inspection predicts rather than observes user difficulties. A user-based evaluation with the enterprise's own users, measuring task performance and perceived usability, is planned to verify these findings and to evaluate the revised design, including the problems that remain.

4. CONCLUSION

The inspection of the initial design of the Sukamaju Farm dashboard identified 17 usability problems, 9 of which were major or catastrophic. The most frequent violation was the mismatch between the system and farm practice, including harvests recorded in baglogs instead of kilograms, baglog stock reduced by repeated harvests, and the absence of expense records, which made net profit unreliable and hard to find. The revised design resolved 15 problems and partly resolved one by changing the data model, grouping rack information, and calculating baglog replacement automatically, but records still could not be edited and two data-safety problems were introduced. Adding an edit function, confirming deletions, and restoring automatic saving are therefore the next priorities, followed by user testing with the enterprise's staff and other growers.

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