

Usability Assessment Framework for Usability Testing of a Software Application

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Abstract—User experience is one of the key aspects nowadays in any successful web-based or Mobile based application. Usability is a measure of a software application or product that is calculated based on its users and it defines the easiness, efficiency of the application usage with user satisfaction. Look & feel and the navigation defines the usability of the application. The complex workflow or user actions can be made simple with the thoughtful User interface. A systematic study and strategy defined for the usability aspects will take the application usage to the next level. There are various proven frameworks available for improving usability. HCD framework, also known as Human Centered Design, is one of the impactful frameworks which focuses on understanding the end user for their needs, constraints, and behaviors. Design Thinking is another framework that helps in designing user-centric applications in a way that is intuitive and natural. This paper is focusing on defining the process for usability measurement. A complete framework for the usability parameter definition and its measurement at various levels of the application development phase is explained in detail in this paper. There is a wider literature review done for the proposed strategy, the details will be provided along with a comparative study.

Index Terms— Usability, HCD, Design Thinking, usability parameters.

I. INTRODUCTION

Incorporating usability considerations into software engineering processes can improve user satisfaction, increase productivity, reduce user errors, and improve overall software quality. Therefore, software engineers should understand usability principles and strive to develop software that meets the needs and expectations of its users.

The aesthetics and navigation of the application play a crucial role in ensuring the usability of the software. It needs to collaborate with user experience (UX) designers and usability experts to understand user requirements, gather feedback, and incorporate usability principles into the software development process. [1] The systematic approach to usability is responsible for implementing user interfaces, designing workflows, and optimizing software interactions to enhance usability.

The extent to which a software product or system may be effectively and efficiently used by its intended users to achieve their goals while experiencing satisfaction is referred to as usability. [3] User interface design, navigation, input techniques, error management, and overall user experience are all included. Usability is important because it can improve user pleasure, productivity, and system effectiveness. Poor usability, on the

other hand, can result in user dissatisfaction, errors, lower adoption rates, and inferior consequences.

One of the domains where usability is of utmost importance is the realm of Seed Distribution Systems. These systems are crucial for efficient seed management and distribution in the agricultural industry. The usability of such systems directly affects the effectiveness of tasks like ordering seeds, tracking inventory, managing deliveries, and ensuring the timely availability of quality seeds to farmers. Ensuring that these systems are user-friendly, intuitive, and capable of meeting the unique needs and expectations of end users is vital for maximizing productivity and facilitating seamless operations in the agricultural sector.

The objective of this research paper is to address this research gap by proposing a comprehensive framework for measuring the usability parameters of the Seed Distribution System from the perspective of end users. This framework aims to provide a structured approach for evaluating the user interface, navigation, input mechanisms, error handling, and overall user satisfaction in the context of seed distribution. By identifying usability strengths and weaknesses, this research will contribute to optimizing the design and functionality of Seed Distribution Systems, ultimately improving user experiences and operational efficiency.

The subsequent sections of this paper will delve into the literature review, Usability Assessment framework and conclusion, providing a comprehensive exploration of the usability parameters in Seed Distribution Systems.

A. Literature Review

Usability testing is essential for developing software systems that are user-friendly, efficient, and dependable. User satisfaction, productivity, error reduction, engagement, adoption rates, cost-effectiveness, and competitive advantage are all directly affected. Organizations can improve the overall quality and success of their software products or systems by adding usability testing into the software development lifecycle.

Following section provides study of usability assessments through various literatures reviews.

F. Paz et al [2] discussed the significance of usability testing. The research focuses on the experimental examination of usability assessment utilizing two approaches and comparing the findings. The first step, heuristic evaluation, was carried out by five Human-Computer Interaction specialists, and the second usability test was carried out with the assistance of eight postgraduate students. And the study shows that the outcomes of both strategies are the same. The article also highlights the usability issues discovered during the heuristic evaluation.

Deepak Gupta et al [3] The term 'software usability' has been defined in accordance with the hierarchical usability paradigm. The hierarchical usability model revealed seven aspects and 23 elements, according to the research. For selecting usability features, the current study presents a modified moth-flame optimization (MMFO) technique. The proposed method can be used in research to predict the usability of various software or Web applications.

M. A. Kabir et al. [4] studied and contrasted eleven well-known quality models. The study also provided an improved usability model with twelve usability category-based characteristics. This model demonstrates an improved usability model. According to our comparative analysis, it also addresses the key usability issues. Each usability criterion's importance was defined in the proposed model.

Anders Bruun & Jan Stage [8] details in their paper for the experimental study for the comparison of usability test performed by the usability test specialist and the newly trained Software Development Practitioners (SWPs). As per their study it indicates that with very small duration i.e., of 30 mins of training the SWPs conducts the usability test in depth and observations are standing same the observations made by usability test specialist.

Layla Hasan et al [9] detected the gaps in the results performed by test users and the heuristic evaluation. As per their research, some of the critical problem may skip or ignore if the focus is only on heuristic evaluation and not done with test users. Since the real time issues can be only captured by the test users. if the organization take the decision of user interface design or redesign based on either of the test results then there will huge lost in cost since the core issues might be uncover. Hence the research suggests employing both level of the testing by test users and by heuristic evaluation to get a comprehensive result.

Lodhi [10] research is for choosing the assessment parameters in the usability testing. The experimental study for the academic related web sites has been done in this paper. It suggests performing the heuristic evaluation if there is constraints on the budget and time for the usability testing.

A. P. Singun [1] is the comparative study of two alike system i.e., Human centred interaction and Education. The research is done using a online tool called 'Test Prep e-ToolKit' and also referred as web based blue print. It proposes the Interaction design model which based on the user centred development approach.

J. Chen et al. [11] present a usability engineering paradigm that covers usability requirements, analysis, design, testing, and user feedback. The study emphasizes that the technology team is not the only stakeholder in important business software design; domain specialists and end users are also involved.

H. B. Santoso et al [12] states the usability test results performed for the application which is developed to gather the personal identity of the farmers to develop the farmers group. WEBUSE usability testing method has been used to perform the test which includes the set of 24 questions which focuses on the 4 categories Content, Navigation, user interface, performance, and development. The test results have proven the acceptable usability level of the system and also identified weaknesses to optimize further.

Sivaji et al [13] is the research on the usability assessment performed on e-Government application. The paper states that the need of all stakeholders needs to consider while performing the usability test, hence the Heuristic Evaluation (HE) specialist should perform the usability assessment to maximize the defect detection.

K. T. Martono [14] research focuses on the usability test performed on the educational game of puppet. This usability test is performed based on a specific set of questionnaires and by performing the survey the scale has been derived to check if the system is acceptable. And the results of the useability assessment performed for this mobile application game for android users is successful, the methodology is known as SUS i.e. System Usability Scale.

II. USABILITY ASSESSMENT FRAMEWORK

Usability assessment definition involves several steps to ensure a systematic and effective evaluation of a product or system. The general outline of the usability procedure shown in Figure 1.

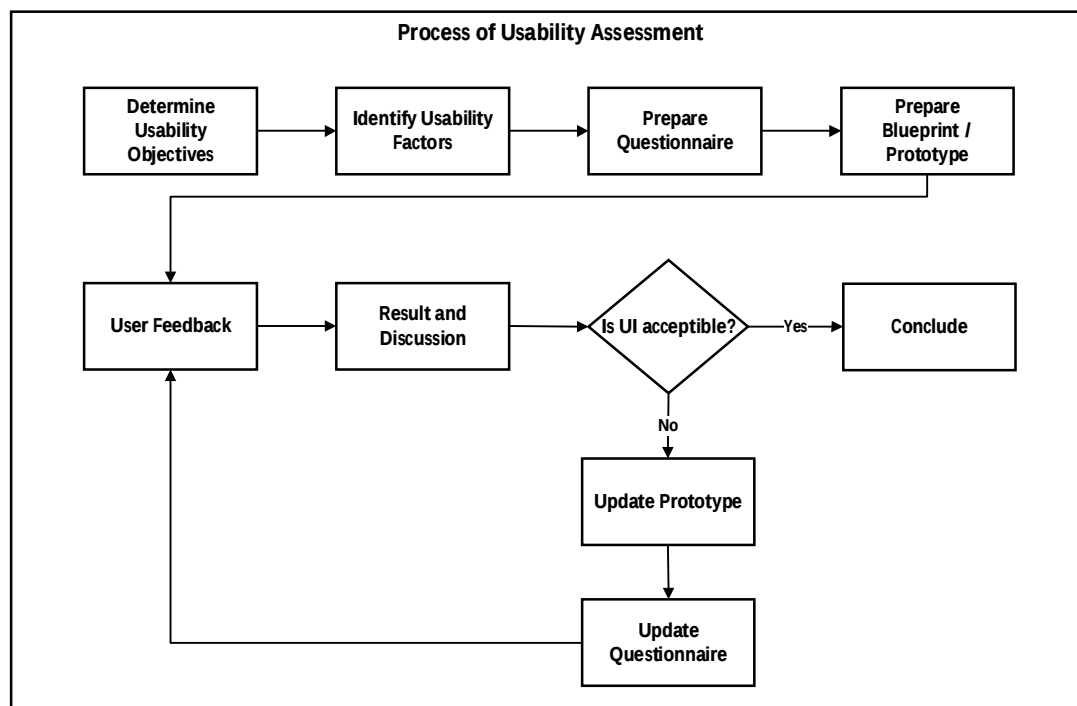


Figure 1: Process of Usability assessment

A. Determine Usability Objectives

This is one of the important steps in which the objectives need to define. Further usability testing will be conducted based on the objectives defined. Below figure shows the detailed steps to be performed in Objective determination step.

B. Study existing system

The first phase is to start with studying the existing Application, which includes a thorough understanding of the domain/function of the system and the understanding of the intended users. This is to understand the expectations of the users of the system. Once you understand the system then start understanding the pain areas of the existing system. This can be accomplished through a variety of approaches such as user interviews, observations, self-study of the system, and questionnaire-based surveys.

The usability assessment can further be divided in below four pillars of the usability design.

- Navigation – Can the user find it?
- Presentation – Is it easy to use?
- Content – Is it what users want?
- Interaction – Can the user act on it?

All the pain areas need to be categorized in these pillars based on its behaviour. This indicates the broader level of work area to revise or rethink on the usability aspects.

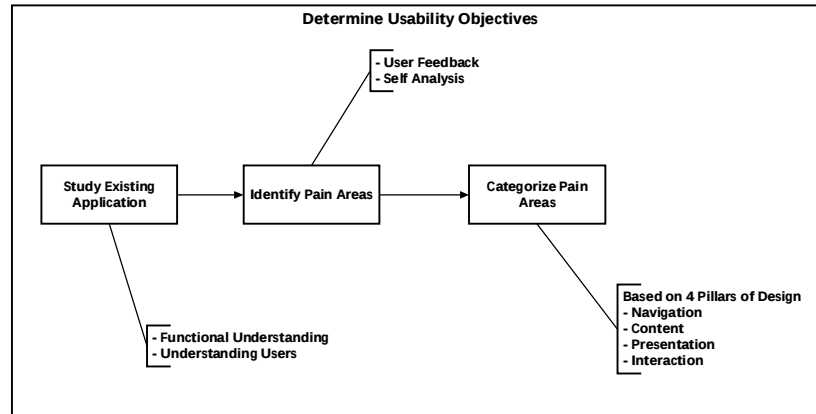


Figure 6: Determine usability objective

C. Identify usability factors

Another key step in defining the usability scope is to identify the usability factor. These factors are assigned to various user interface quality metrics. According to M. A. Kabir et al [6,] the ten usability factors are efficiency, operability, satisfaction, effectiveness, learnability, training, helpfulness, understandability, usability, and reliability.

D. Categories Pain Areas

Each of the usability elements linked with the category specifies the broader area of the system's usability assessment.

All the quality factors are detailed in the table below.

TABLE II. NOTE HOW TABLE IS LEFT ALIGNED

UF#	Quality Factors	Proposed Description	Category
UF1	Efficiency	Once users understand the system, efficiency reveals how rapidly they can complete activities.	Navigation
UF2	Operability	Operability refers to a software product's ability to allow the user to operate and control it.	Navigation
UF3	Satisfaction	Satisfaction relates to users' subjective answers regarding how they feel when using the product.	Interaction
UF4	Effectiveness	The precision and completeness with which users execute set goals is referred to as a task's effectiveness.	Content
UF5	Training	Training refers to how system resources instruct users on how to use a system.	Interaction
UF6	Learnability	The ability to absorb software stuff thoroughly while also gaining knowledge and skills comfortably.	Presentation
UF7	Understandability	Understandability indicates that users can easily comprehend a system task..	Presentation
UF8	Helpfulness	Helpfulness shows that it provides appropriate guidance to the user for a task in the system.	Presentation
UF9	Usability	The capacity of a software product to adhere to usability standards, compliance norms, style rules, or regulations is referred to as usability compliance..	Presentation
UF10	Reliability	The ability of software to perform required activities continuously without degradation or failure while also producing consistent and predictable outputs.	Content

E. Prepare questionnaire

Now we have the basis ready with the category and usability factors. Next is to define the questionnaire. It will help to collect feedback of the current system or prototype from users. Each of the question should mapped to the Usability quality factors. The questions need to design considering below key aspects,

1. Question should have clarity; the user should not feel any ambiguity while reading it
2. Each question should have a single purpose, do not include multiple objectives in a single question.
3. Questions should have answer in yes or no or numerical inputs. Subjective answers are difficult to analyse.

Following are the sample questions, prepared to do the assessment of the Seeds Supply System.

TABLE II. NOTE HOW TABLE IS LEFT ALIGNED

#	Quality Factors	Question
1	Effectiveness	Using this technique, I believe I became productive quickly.
2	Effectiveness	This system has the bulk of the features and capabilities that I exp
	Effectiveness	Is content easy to search and understand? for e.g. used Title case and sentence case capitalization as required, acronyms or jargons are avoided?
3		
4	Efficiency	This system is simple to use.
5	Efficiency	Using this technique, I can accomplish my work swi
6	Efficiency	This system makes me feel at ease.
	Efficiency	Is System having appropriate interaction in case of subsequent process?
7	Helpfulness	The system generates error messages that clearly explain how to resolve the issues.
8	Helpfulness	Whenever I make a mistake while using the system, I am able to recover swiftly and effortlessly.
9	Helpfulness	The system's information is useful in assisting me to complete my work.
10		
11	Helpfulness	Is content accessible quickly?
12	Learnability	The organization of information on the system screens is clear
13	Operability	I cannot find what I am looking for.
14	Operability	How should I go back where I came from?
15	Operability	Where do I go next?
16	Operability	The link I clicked earlier is not available now?
17	Operability	Overall, I am satisfied with how easy it is to use this system
	Operability	Is content well formatted for e.g., use of bullets or tabular formats wherever required?
18		
19	Satisfaction	The interface of this system is pleasant
20	Satisfaction	I like using the interface of this system
21	Satisfaction	Overall, I am satisfied with this system
	Training	The information (such as online help, on screen messages and other documentation) provided with this system is clear
22		
23	Understandability	It was easy to learn to use this system
24	Understandability	Is overall layout of this system helpful to quickly navigate or process?
25	Understandability	Is content in this system is easy for high level scanning / quick reading?
26	Understandability	Is there consistency in User interface for color theme, layout?
27	Usability	It is easy to find the information I needed
	Usability	Is this system provide attention to appropriate section in a specific screen? for e.g. the important area is in focus, there is no unnecessary text in bold or CAPS format or focus on any image.
28		
29	Usability	IS this system UI compatible to all screen size and resolution?
30	Usability	Is content readable i.e. appropriate in format for font size, font color.

F. Prepare Blueprint / Prototype

A usability assessment needs to be performed on the system either a prototype or an existing system. Usability assessment is performed for the improvement or revised user interface if the system already exists. However, if the existing system is not available then a prototype needs to build which will give the look and feel, and navigation like the real systems. The prototype is the demo system that does not have the functionality and business validations. However, it provides the complete user interface for the control placements, menus, button position, the aesthetics like background colour, font colour, etc. There are various tools available to build the wireframes of the prototypes e.g. Balsamiq, Sketch, and Adobe Illustrator.

G. User Feedback

Usability is playing the utmost role in the success of any software application. Hence the usability review is considered one of the very important steps. The user feedback is taken based on the questionnaire on the prototype or wireframes design or existing system. All the answers are captured for each of the questions based on various ratings like Strongly Agree, Highly Agree, Agree, Disagree, Strongly Disagree, and NA (not applicable).

#	Usability Factor	Question	Strongly Agree	Highly Agree	Agree	Disagree	Strongly Disagree	NA
1	Effectiveness	I believe I became productive quickly using this system						
2	Effectiveness	This system has majority of the functions and capabilities I expect it to have						
3	Effectiveness	IS content easy to search and understand? for e.g. used Title case and sentence case capitalization as required, acronyms or jargons are avoided?						
4	Efficiency	It is simple to use this system						
5	Efficiency	I am able to complete my work quickly using this system						

Some organization prefers to perform the usability assessment from a HCI professional team to receive unbiased feedback. [8] This type of assessment is as per the Anders Bruun & Jan research. This is another way of getting the user feedback. The traditional way of HCD review is performed based on the business use case/scenarios. Each use case has a specific workflow. The user executes that workflow on the prototype or an existing application. The reviewer receives the user feedback by observing the user's actions and by asking several questions to users. All these feedbacks are captured and then the details analysis has been done to define the pain areas.

All the observations were collected and properly documented by various users. One of the best ways to decide the number of users to be involved in the assessment is sampling size using [1] Slovin's Formula.

$$n = \frac{N}{1 + Ne^2}$$

- n = Required number of respondents
- N = Total population/Users
- E = error / sampling error (Considered as 0.50)
- 1 = constant

H. Result and Discussion

A systematic analysis is required after the collection of the user's feedback based on the usability review. The below table indicates the ratings for each of the verbal interpretations. The ratings can be put for each of the questions based on the verbal interpretation chosen by the users for that question. For e.g., if the User has given feedback for Question 1 as "Agree" then the rating for that question would be 3.

[1] Each of the questions in the questionnaire is mapped to a Usability quality factor. All these ratings can be summed up for the specific usability quality factor. And the lowest number will indicate the area where usability improvement is needed in that system. [1] All the quality parameters in turn mapped to the four pillars of the usability design.

TABLE II. NOTE HOW TABLE IS LEFT ALIGNED

Verbal Interpretation	Ratings	Complete Description
Very Strongly Agree	5	Completely satisfied; fully meets the needs of the users
Strongly Agree	4	Extremely pleased; Highly matches the needs of the user;
Agree	3	Simply satisfied; Only fits the needs of the users
Disagree	2	Slightly pleased; Slightly meets the needs of the users
Strongly Disagree	1	Not pleased; Does not satisfy the needs of the users

Also, the same methodology can be useful if needed to do the comparison between the existing system in place and a prototype or new proposed system. The average number of the verbal interpretation for each of the quality factors can be put up for both systems. And the average can be taken. The highest average number will indicate the good usability factor of the system.

TABLE II. NOTE HOW TABLE IS LEFT ALIGNED

UF#	Quality Factors	User Ratings for existing system	User Ratings For New System
UF1	Efficiency		
UF2	Operability		
UF3	Satisfaction		
UF4	Effectiveness		
UF5	Training		
UF6	Learnability		
UF7	Understandability		
UF8	Helpfulness		
UF9	Usability		
UF10	Reliability		

Based on the above ratings it will help to conclude if the proposed system is acceptable in terms of the usability aspects. If it is acceptable then we can consider that all the usability quality factors have been addressed appropriately in the system considering the user's need.

And if these are not in the acceptable range then do the required changes in the prototype, update the questionnaire if required, and then perform the usability review for the User Feedback. This is the iterative approach for continuous improvement. This can repeat until the usability assessment average score reached the acceptable or highest number.

III. CONCLUSION

In conclusion, this research paper presented a systematic and effective procedure for conducting usability assessments. Organizations can gain valuable insights into the usability of their products or systems by following the defined steps, including determining objectives, Identifying Usability factors, preparing questionnaires, Preparing Prototypes, User review and feedback, Analysing the feedback, checking for acceptance, and based on that repeat or conclude. The procedure outlined in this paper emphasizes the importance of user-centered design and iterative improvement based on user feedback.

Usability assessments help identify usability issues and uncover user pain areas, which results in enhanced user experiences. Future research may explore the use of the latest technologies to enrich the usability assessment to the next level such as Virtual reality, Facial Expression analysis, and Augmented Reality. However, applying the procedure detailed in this paper will increase the usability of products or applications with respect to user needs, user satisfaction, and efficient use.

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