

New Product Development Integrated with Usability

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SUMMARY

This paper proposes a novel approach titled ‘New product development integrated with usability’ which integrates usability within the product development cycle of a new product. This approach primarily caters to new products in the rail industry, however can be applied to other sectors also. The approach was developed on the basis of the lessons learnt from a usability study conducted as part of the development of a new Rail Traffic Management software in the U.K. The approach details a series of steps to design and conduct usability studies such that the impact on user satisfaction, system effectiveness, and overall business outcomes is highlighted earlier in the design cycle. This approach is likely to result in ample opportunities to recommend and implement changes with relatively minimal impact on the product development cycle.

KEYWORDS

Usability Testing, New Product Development Integrated with Usability Approach, Business Case

Introduction

New products especially in the railway tend to be driven by functionality rather than by users (Hu, Cao, Tang, & Sun, 2022). This means that a new product could enter the market with a range of functionalities and interactions which may not have been tailored to the specific operational needs of the user. This could result in the users having to adjust to the product sometimes in a manner which is uncomfortable and dangerous to them rather than the product adjusting to the user needs. This leads to the importance of integrating human factors optimally with the product development cycle. This paper introduces a new approach titled ‘New product development integrated with usability’. The approach focuses on the usability aspect of human factors and the benefits of a product development cycle which has optimally integrated the aspect of usability within the development cycle. The approach primarily caters to new products in the rail industry, however can be applied to other sectors also.

Background

The ‘New product development integrated with usability’ approach was developed based on the lessons learnt from a usability study conducted as part of the development of a new Rail Traffic Management software in the U.K. The Traffic Management software product was developed over a series of sprint stages where additional features /functionalities were developed through each one. Additionally, there were no trained target audience for this product and no training manuals available as this was a product in development. Therefore, to integrate usability into the product development cycle a new approach was devised specifically for this project which involved a series of phases of usability testing in alignment with the software sprint stages. This approach was modified to be flexible to adapt to project changes based on the lessons learnt within this project.

This modified approach titled as ‘New product development integrated with usability’ applied from a railway perspective is detailed in this paper.

Early Human Factors Analysis

The first step of the approach is to conduct an Early Human Factors Analysis (EHFA). The purpose of the EHFA is to develop an understanding of the product, its target audience and the test facilities available in order to be able to develop a feasible plan for the testing phase. Moreover, the EHFA establishes an initial set of human factors considerations that are used to inform the development of the product. The EHFA can be carried out in a variety of ways suited to the project complexity. The EHFA Methodology Guide (Ministry of Defence, 2016) is a good reference for conducting an EHFA.

It is recommended to include the following two elements in the EHFA.

User Group

The formulation of a user group as part of the EHFA is critical to the application of the ‘New product development integrated with usability’ approach. The user group may be divided into two sub groups namely primary user group and secondary user group. The primary user group should include representatives of all the key stakeholders of the product. This may include end user representatives, subject matter experts and project representatives. The purpose of the primary user group is to represent the main target audience as well as technical and business side of the project with a high level of involvement in the stakes of the project. The members of the primary group will likely have to invest significant time and effort as part of the project development cycle.

The secondary user group should include in addition to the primary user group representatives of the wider stakeholders of the project. This may include technical specialists, software developers, business managers, supporting target audience representatives. The purpose of the secondary user group is to represent a wider group of stakeholders of the project and those who may have important contributions but may not have a significant amount of time and effort to invest in the project. Examples of primary and secondary user groups are illustrated in Figure 1.

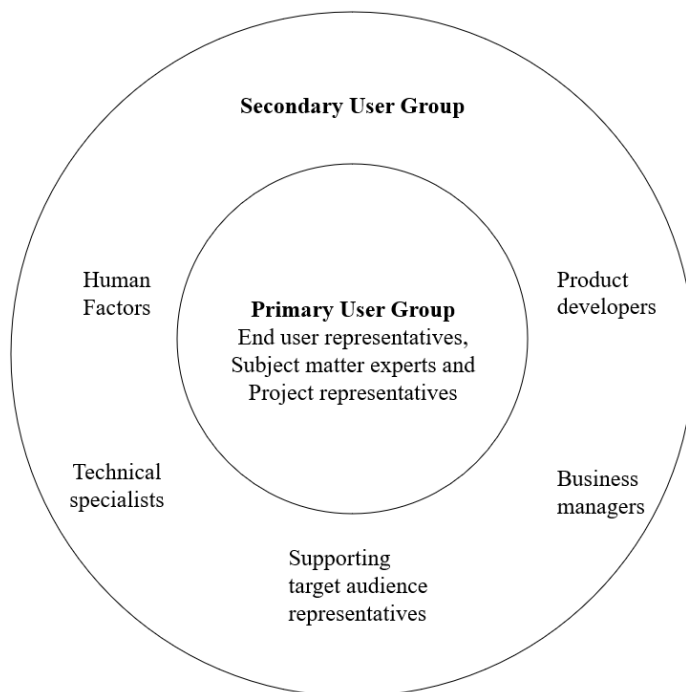


Figure 1: User Group Example

Expert Review

Expert Reviews is another crucial element of the EHFA which is carried out by Human Factors Specialists to develop a degree of familiarity with the product and to conduct a first pass review of the product. The first pass review may be conducted based on usability standards such as International Organization for Standardization (ISO) 9241 (2018). A standard’s-based checklist could be created specifically to those clauses which are applicable to the product to better structure the review.

Any human factors considerations or non-compliances identified during the Expert Review could be captured in a Human Factors Register. It is important that the Human Factors Register is linked to the master register for all issues identified as part of the product development cycle. This aids with the visibility of HF issues along side other issues and facilitates chunking of similar issues or fixes together. The output of the EHFA should raise awareness of the major human factors and usability considerations that may impact on the successful delivery of the product capability. Moreover, it should also be the basis of the human factors register that will be used to track human factors considerations through the product development cycle.

Test Phase

The output of the EHFA can be used to design a test plan for the product. The ‘New product development integrated with usability’ approach adopts a progressive layered experimental design. This means that the product is progressively tested with each new layer of functionality that is added to it. To apply this approach, the product development cycle is divided into different phases of usability testing. Ideally, each of these phases should align with the product development milestones or sprint stages so that there is a phase of usability testing planned for each new layer of functionalities added or modified. For example, if there are four sprint stages of product development, there should ideally be four phases of usability testing with each phase aligning with the sprint stage. This means that the usability test schedule aligns with the product development cycle, allowing for accurate testing and evaluation of each new layer of functionality, including regression elements. Moreover, this provides the opportunity for the product development team to implement usability recommendations along with their planned product development activities thus minimising the potential for disruption. The experimental design is illustrated in Figure 2

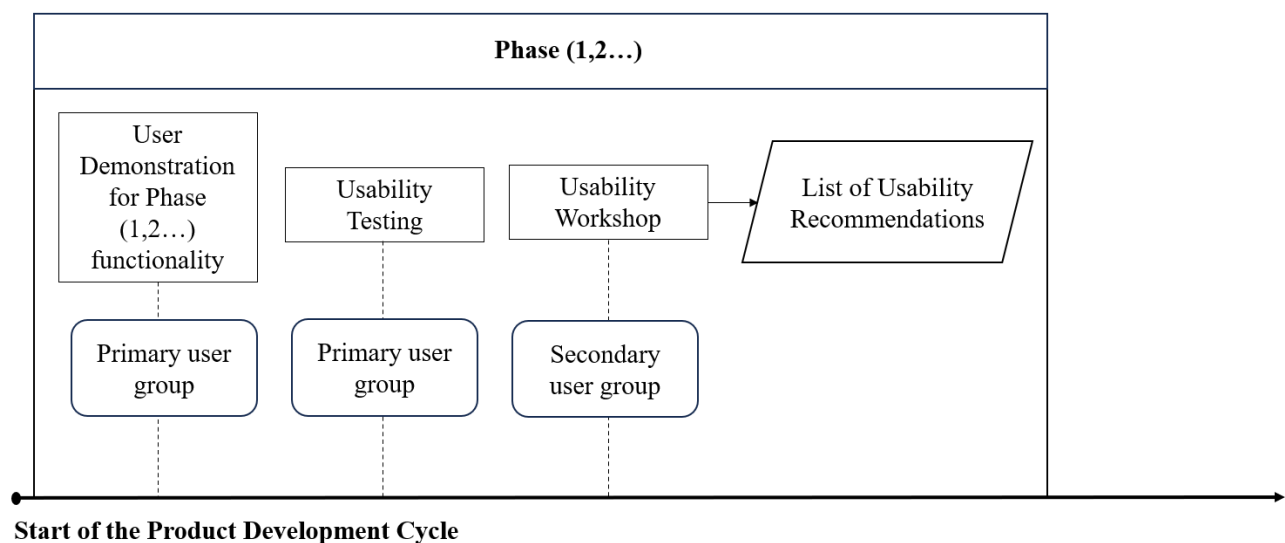


Figure 2: Experimental Design

User Demonstration for Phase functionality

For a new product under development, it is likely that there are no training manuals or how to guides for the user to exercise the product. Moreover, it is unlikely for the user to be trained in the product. This necessitates the need for a user demonstration session prior to conducting usability testing. The aim of the user demonstration session is to familiarise the user of the functionalities of that particular phase. Also, the primary user group has to be involved in these user demonstration sessions as they would be the subjects of the usability testing. For example, the user demonstration session for Phase 1 of a product would involve the product developers demonstrating the functionalities and operational characteristics of the product available at Phase 1. This could be done using a simulator or such similar facilities to the primary user group such that the primary user group can exercise all the Phase 1 functionalities of the system.

Usability Testing

The usability testing for a phase is carried out post the completion of the user demonstration for that particular phase. It is recommended to provide sufficient time post the user demonstration session for the primary user group to exercise the available product functionalities by themselves and gain confidence with the product. Moreover, this time can be used by the primary user group to create draft guidance on how to complete the operational tasks within the functionality available in that phase. This draft guidance could be collated and reviewed with the secondary user group and formalised as a 'Operational Goals' document. The Operational Goals document would detail the operational goals and the steps to achieve the operational goals with the functionalities available in that particular phase. This Operational Goals document could form the basis of the 'scenarios' to be tested by human factors for the usability testing. As the product develops further it is expected that the Operational Goals gets more and more complex to reflect the product functionalities and the intended operational interactions. The final round of usability testing for the product is expected to encompass the complete functionality of the product.

With regard to measurement of usability, it is important to be more formative in nature as rich feedback is crucial for the product developers to integrate usability into the product development process. A usability data collection sheet could be created which captures, for each Operational Goal, the task completion / success in relation to a set of user sub tasks, number of errors, no of assists required by the user from the tester, and most importantly the user's subjective comments and tester's observations. In addition, the industry standard System Usability Scale (Lewis & Sauro, 2009) maybe employed. It is recommended to use the same measures for each phase of usability testing to demonstrate the improvement in the usability of the product and identify weaknesses and recommend improvements.

In summary, the 'New product development integrated with usability' approach proposes that usability testing is conducted with the primary user group based on Operational Goals using the same measures for each phase of the product development process.

Usability Workshop

The usability workshop is conducted after the completion of the usability testing for each phase. The workshop involves the primary and secondary user groups. The objective of the usability workshop is to evaluate as a combined user group the usability issues identified as part of the usability testing. The workshop provides the combined user group the opportunity to recognise the usability issues identified with the product at that phase and as a group recommend solutions to the issue and prioritise it as part of the product development process. Also, the workshop provides a platform for wider awareness of usability considerations with all the stakeholders of the product.

List of Usability Recommendations

The list of usability recommendations forms the main output of the ‘New product development integrated with usability’ approach. The list of recommendations is a set of usability considerations agreed with all the stakeholder representatives and provides a traceable storyline of how usability is integrated throughout the product development process. The list of recommendations may also be integrated with the human factors register and the linked to the master register of the product for visibility. This could be complemented with a detailed test report for each phase collating all the data collected from the usability testing.

Discussion

The ‘New product development integrated with usability’ approach proposes an experimental design which involves the user throughout the product development process. The approach details a series of steps to design and conduct usability studies such that the impact on user satisfaction, system effectiveness, and overall business outcomes is highlighted earlier in the design cycle. The alignment of the usability test phases with the product development stages means that usability is evaluated organically in line with the product development cycle. This is likely to result in ample opportunities to recommend and implement changes with relatively minimal impact on the product development cycle. Moreover, this approach provides a traceable usability journey for the product through each of the development phases and the results may be used as evidence of benefits to the user in the product business case.

In addition to these, there is likely to be supplementary benefits to adopting this approach. The Operational Goals document created for the usability testing could form the basis of future training manuals and guidance. Also, the primary user group is likely to become a group of subject matter experts with regard to the operation of the product and therefore are likely candidates to become trainers for other personnel to use this product.

However, it must be noted that this approach primarily concerns itself with the usability aspect of human factors and wider human factors considerations may require a combination of approaches or methods. Also, this approach is tailored towards a formative nature of usability testing as part of the product development process and therefore may not be appropriate for a summative form of usability testing.

References

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