Usability Analysis of Cost-Benefit Tracker: A Tool for Utility Analysis of Business Processes

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ABSTRACT

We introduce the Cost-Benefit Tracker (CB Tracker), which is a software for analyzing the economic potential of the business processes. We designed and developed the Cost-Benefit Tracker as a simple software-based BPMN 2.0[1] tool by integrating the concepts of the Service-Dominant Business Model design. As a result, the software is simple and straightforward to use more than enterprise BPMN 2.0 software. The entrepreneurs can use the presented software-supported method to financially evaluate own business processes designed as BPMN 2.0 diagrams, before committing a large amount of financial resources into realisation of these. In order to evaluate the usefulness and usability of the proposed software we tested it with a specific scenario including tasks with representative test persons from possible target groups. We also used standardized surveys like Computer System Usability Questionnaire (CSUQ) and Nielsen's Heuristic model (NHE) to obtain the insights on usability of the system. The findings of usability evaluation of CB Tracker will be presented as main contribution of this paper.

CCS CONCEPTS

• **Human-centered computing** → **Usability testing**; • **Software and its engineering** → **Designing software**.

KEYWORDS

HCI, utility analysis, digital business models, tools evaluation

1 INTRODUCTION

Customers are moving from buying products towards integrated solutions [5, 9]. Furthermore, customers are moving from buying physical goods to digital services as solutions. Therefore, the business model design is shifting from a Goods-Dominant (G-D) perspective towards a Service- Dominant one by adopting a Service-Dominant Logic. Under this new logic, the business model concept has been re-framed as the Service-Dominant (S-D) Business Model [5]. The Service-Dominant Business Model takes the value network approach of the S-D Logic instead of the traditional value chain approach of the G-D Logic. This change is required for designing solutions as value co-creation between business actors such as users and companies. The value co-creation takes places within a business ecosystem: the value network. Furthermore, the rise of digital services requires tools for modeling digital ecosystems as business models [6]. In this work, we explore the relationship between business models and business processes from the financial perspective: financial costs and financial benefits. By tracking of costs and benefits in a business process, we can help business model designers to understand how the value is shared among the actors of the value network. The value shared among the parties has been explored by using business model tools such as e3-value [3]. However, a tool-set that shows how the financial costs and benefits that integrate the business model level operation level has not been developed yet. This approach is incorporated through the Cost-Benefit Tracking software.

2 COST-BENEFIT TRACKER

The Cost-Benefit Tracker (CB Tracker) is a prototype software that uses business processes for analyzing the flow of costs and benefits. The software requires a BPMN 2.0 diagram as input for setup and conduction of utility analysis (figure 1). The tool allows management of a repository of different business processes in BPMN 2.0, as well financial tracking and insights from the perspectives of different actors. It supports visual task-wise assignment and tracking of costs (figure 2), balance score card comparison of all costs, benefits and co-creation activities (figure 3). The CB Tracker also offers the overview for overall cost and benefit share (figure 3). The users can see also automatically calculated Benefit-Cost Ratio (BCR) that tells them whether the process is profitable or not. The goal of usability evaluation in this paper is to find out, whether CB Tracker interface satisfies and supports the target users by the workflow of cost-benefit based utility analysis.

3 RELATED WORK

Usability and user experience are often interchangeable terms. On the one hand, usability outlines the importance of user performance and awareness in Human-Computer Interactions (HCI). On the other hand, user experience includes usability plus the user's perception, emotions, preferences derived from the interaction with the system: before, during and after using the system [1]. In order to identify usability problems, metrics are used. Previous literature shows that there exist various approaches for addressing the quality of a system, such as: UX testing, questionnaires, cognitive walkthrough, observational/controlled experiment and heuristic evaluation. There are various methods, which can be used to identify

[1] https://www.omg.org/spec/BPMN/2.0/

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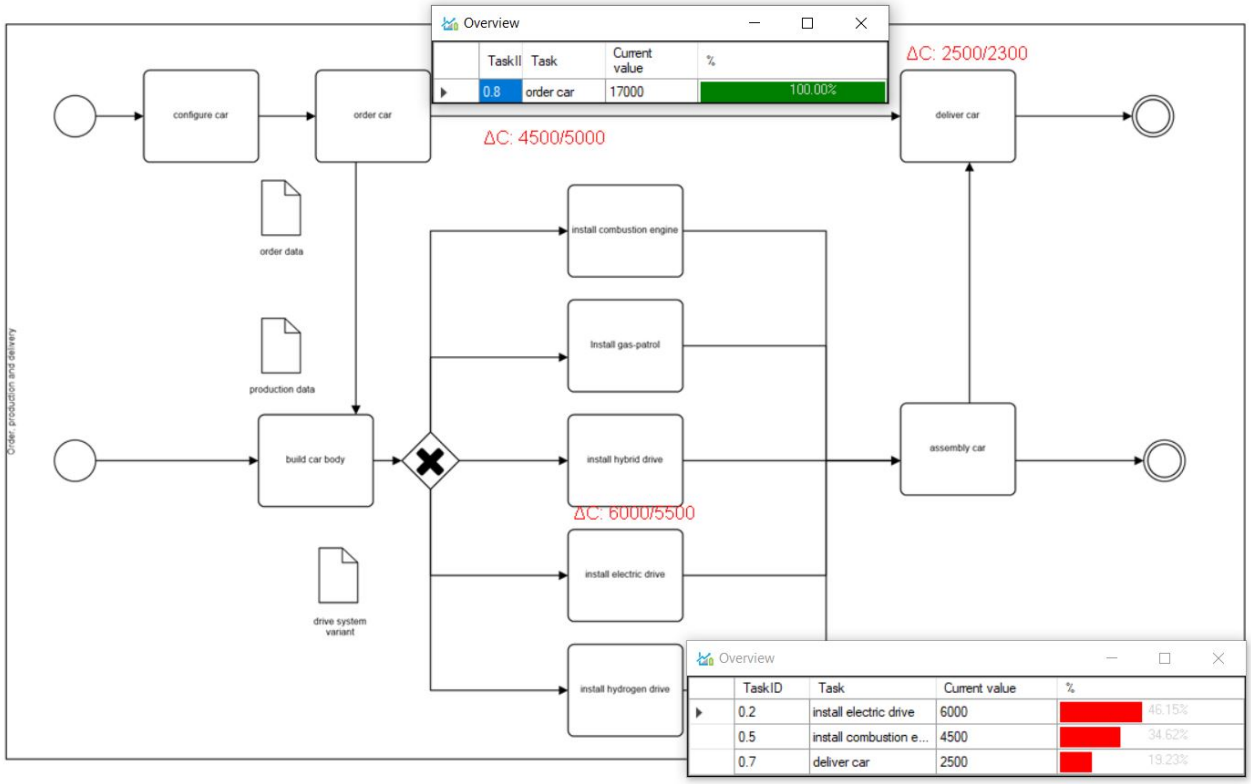

Figure 1: Cost-Benefit analysis in CB Tracker.

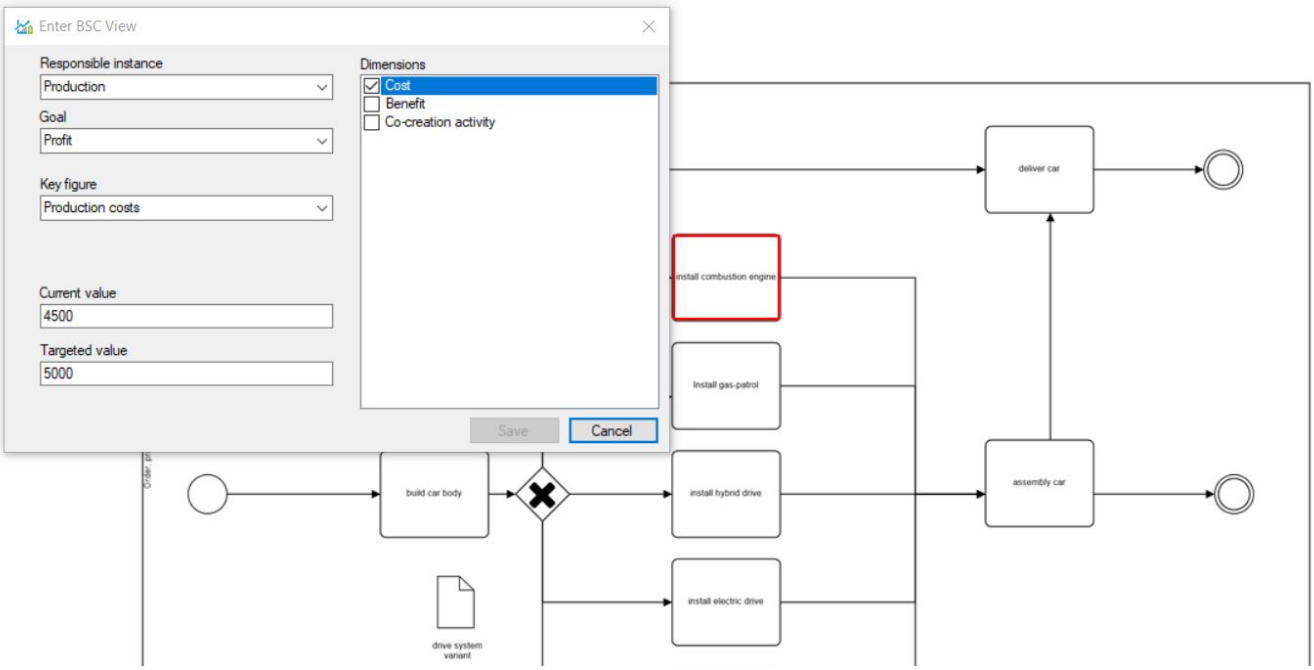

Figure 2: Assignment and tracking the costs and benefits.

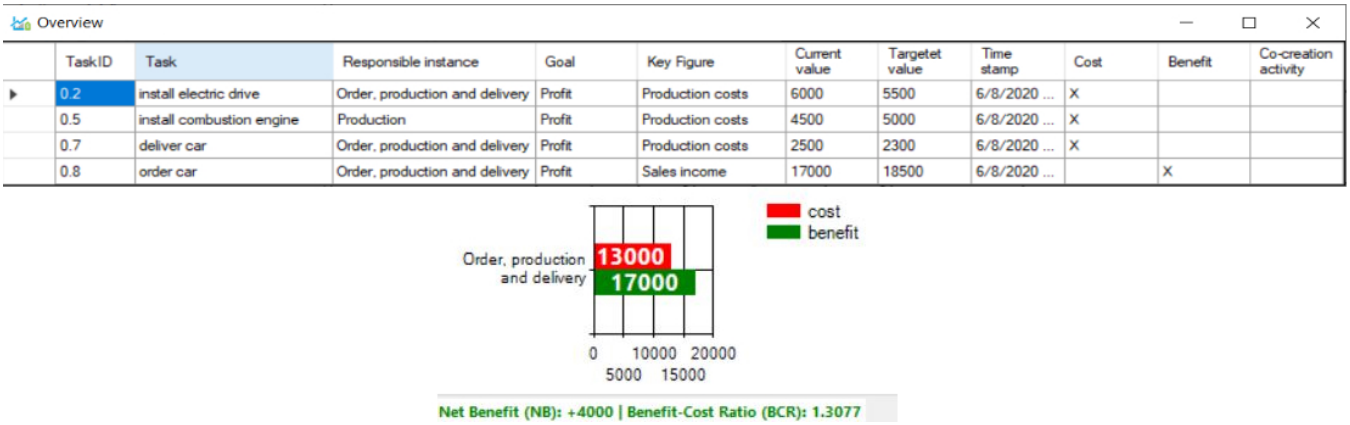

Figure 3: Comparison of KPIs and Cost-Benefit Overview.

usability problems. These inspection methods can be categorized as follow: survey, analytic inspection and empirical evaluation. Questionnaires are suitable for a simple and cost-effective collection of subjective user opinions in large numbers. Their evaluation is based on the principles of statistics. Averaging and standard deviation can be used to identify problem areas in an interactive system.

4 METHODOLOGY AND EXPERIMENT DESIGN

The usability evaluation in our case is conducted by using the questionnaire and heuristic evaluation. For our purpose we used Computer System Usability Questionnaire (CSUQ) and Nielsen's Heuristic Evaluation (NHE).

The Computer System Usability Questionnaire (CSUQ) offers prepared questions. This type of questionnaire works well in not controlled laboratory settings. The CSUQ offers reliable and accurate results [4].

The Nielsen's Attributes of Usability (NAU) and Nielsen's Heuristic Evaluation (NHE) are both questionnaires established by Nielsen [7]. The NAU is structured in 7-points scale and five items in total. The five items comprise learnability, efficiency, memorability, errors and subjective satisfaction. NHE includes ten heuristics. The NHE offers more advantages compared to NAU, because it is more concrete, effective and not generalized like NAU.

Previous research states that testing with five users is efficient enough to find severe usability problems. Researchers came up with this result by using the following formula: $1 - [(1 - p)]^n$, where (n) is the number of evaluators and (p) is the individual problem detection rate [8]. According to Virzi, the average detection rate lies between 0.32 - 0.42 [10]. Nielsen and Landauer confirm that the optimum cost-benefit ratio for finding usability problems involves no more than five evaluators. Five usability testers cover more than 80% of usability issues [8].

For this reason, the experiment is conducted with five participants of different backgrounds (Business / Software Engineering / Research). Users are given four tasks to accomplish. The tasks addressed the features of the software and the work with utility analysis setup. The users tasks were defined as follows:

- Task 1: Import test BPMN 2.0 Model to the application internal repository and open it in Cost-Benefit Tracker.
- Task 2: Define a key figure for tracking cost and an utility goal
- Task 3: Assign the key figure to a task in BPMN 2.0 model using the tree view and context menu.
- Task 4: Show the cost overview of the test BPMN 2.0 Model in lower left free space under tree-view by choosing the right option in the context menu.

As proof of completion for the tasks the users have to deliver short answers or screenshots into testing protocol template they get at the beginning of experiment. At the end of task completion, they also have to answer how much time overall they needed to complete all tasks.

Additionally as further part of the experiment they also have to complete two surveys: CSUQ and NHE.

The aim of the usability study is also to find out, where the users got stuck, how long it took them to finish certain tasks and what difficulties they came across, as well as to sense their overall satisfaction with the interface.

5 EVALUATION AND RESULTS

All users succeeded to complete the tasks. The average time they needed to complete all tasks lies by 12,4 minutes. Average age of the test persons lies by 44,4 years, which means, that we have experienced users with specific domain knowledge from business and engineering.

The Computer System Usability Questionnaire (CSUQ)[2] contains 19 questions classified in three main categories: System Usefulness (1-8), Information Quality (9-15) and Interface Quality (16-19). The CSUQ is measured in 7-points scale where 1 means "strongly disagree" and 7 "strongly agree". The results for the first set of questions 1-8 regarding System Usefulness are shown in table 2 and figure 4 The results for the questions 9-15 addressing the Information Quality are shown in table 3 and figure 5

The results for the questions 16-19 regarding Interface Quality are shown in table 4 and figure 6

[2]https://garyperlman.com/quest/quest.cgi?form=CSUQ

Table 1: Times per user to complete all tasks.

User	# Tasks	Time (Minutes)	Job	Age
User 1	4	5	Researcher	33
User 2	4	15	Developer	47
User 3	4	15	Business Expert	42
User 4	4	12	Research Assistant	47
User 5	4	15	Project Manager	53
Avg.	4	12,4		44,4

Table 2: Results of CSUQ - System Usefulness.

Question Nr.	User 1	User 2	User 3	User 4	User 5
System Usefulness					
1	5	6	6	6	6
2	5	4	6	6	5
3	6	6	7	n/a	7
4	6	6	7	n/a	6
5	6	5	7	6	6
6	3	5	7	5	6
7	7	6	7	6	7
8	4	7	7	6	7
Avg.	5,25	5,625	6,75	4,375	6,25
Std.Dev.	1,28	0,91	0,46	2,72	0,707

Table 3: Results of CSUQ - Infomation Quality.

Question Nr.	User 1	User 2	User 3	User 4	User 5
Information Quality					
9	4	4	6	6	6
10	4	7	7	6	6
11	5	3	6	6	6
12	5	6	6	6	7
13	6	6	6	6	5
14	6	6	7	6	7
15	3	4	7	6	7
Avg.	4,71	5,14	6,42	6	6,28
Std.Dev.	1,11	1,46	0,53	0	0,75

Table 4: Results of CSUQ - Interface Quality.

Question Nr.	User 1	User 2	User 3	User 4	User 5
Interface Quality					
16	1	5	7	6	6
17	1	4	7	6	6
18	4	6	7	6	7
19	4	6	7	6	7
Avg.	2,5	5,25	7	6	6,5
Std.Dev.	1,73	0,95	0	0	0,57

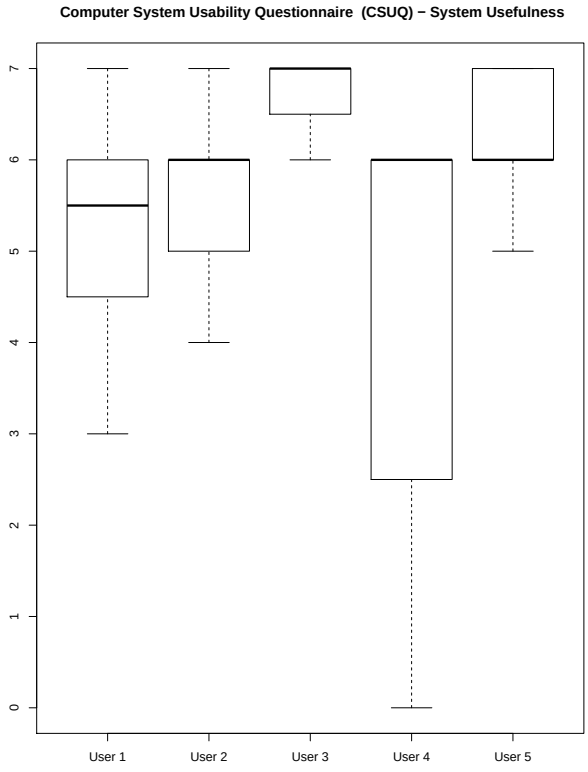

Figure 4: CSUQ - System Usefulness - Boxplot.

Table 5: Results of NHE.

Heuristic	User 1	User 2	User 3	User 4	User 5	Avg.	Std. Dev.
1	3	4	7	6	5	5	1,58
2	4	6	7	6	5	5,6	1,14
3	6	5	7	n/a	5	4,6	2,70
4	4	4	7	n/a 6	4,2	6	2,68
5	4	4	7	6	6	5,4	1,34
6	6	5	7	6	6	6	0,71
7	6	6	7	7	5	6,2	0,84
8	4	2	7	6	5	4,8	1,92
9	4	2	7	6	5	4,8	1,92
10	5	3	7	6	5	5,2	1,48

A side by side user-wise comparison of the scores of all three categories is shown in figure 7.

Nielsen's Heuristic Evaluation (NHE)[3] contains 10 heuristics that can be rated with values 1 up to 7 where 1 means "bad" and 7 means "good". Also values as "n/a" by uncertainty are allowed.

Nielsen's Heuristics results are depicted in table 5 as numerical distribution of points. On the other hand, Figure 8 illustrates a graphical representation of the results for different heuristic aspects.

[3]https://garyperlman.com/quest/quest.cgi?form=NHE

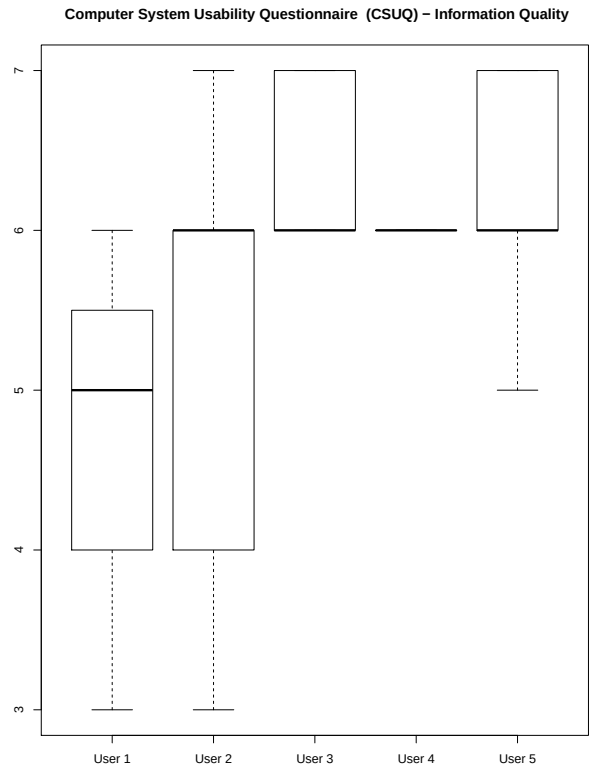

Figure 5: CSUQ - Information Quality - Boxplot.

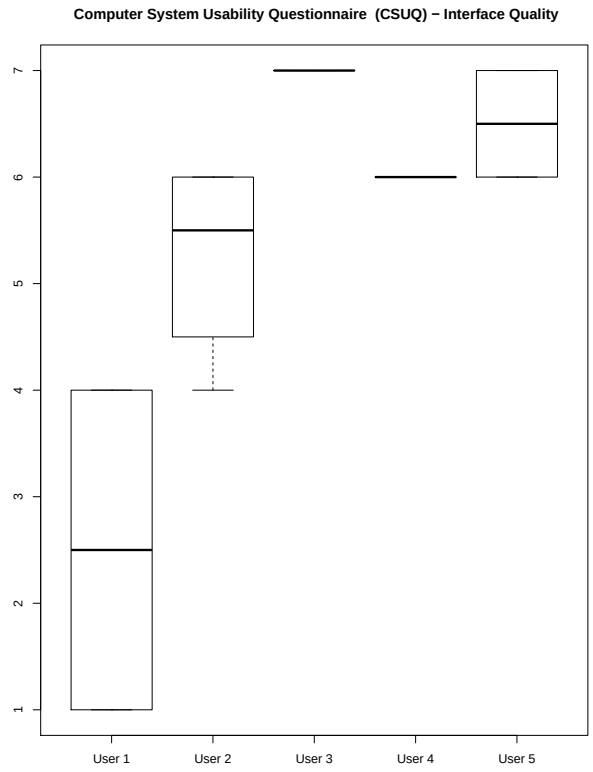

Figure 6: CSUQ - Interface Quality - Boxplot.

6 DISCUSSION, CONCLUSION AND OUTLOOK

In this work we presented the results of a conducted usability study consisting of tasks combined with standardized CSUQ and NHE survey for five users from business, research, and software engineering domain. The usability experiment was designed to test the overall usability of the Cost-Benefit Tracker software designed to be used for tracking and financial utility analysis of business processes. The obtained results from CSUQ show that regarding the System Usefulness average ratings of all users lies by the value 5,65 by the scale with maximum of 7. Hereby, 3 out of 5 users rated this aspect higher then average. The average value for Information Quality lies by 5,71. Also here 3 out of 5 Users rated this aspect higher then average value. Same applies also for Interface Quality by an average value of 5,45. In the case of NHE the average values of 6 (Simple and Natural Dialogue, Speak the Users' Language, Feedback, Clearly Marked Exits,Shortcuts, Help and Documentation) out of 10 heuristics lie by or above the value of 5 on the scale where 7 represents the maximum rating. The value of other 4 heuristics (Minimize User Memory Load, Consistency, Good Error Messages, Errors Prevention) are above 4. This is still a value that is quite high however it points to some potential improvement fields such as: better error handling and making the task performing in the Cost-Benefit Tracker more consistent and intuitive without need of putting extra effort of memorizing workflow steps. As next step in

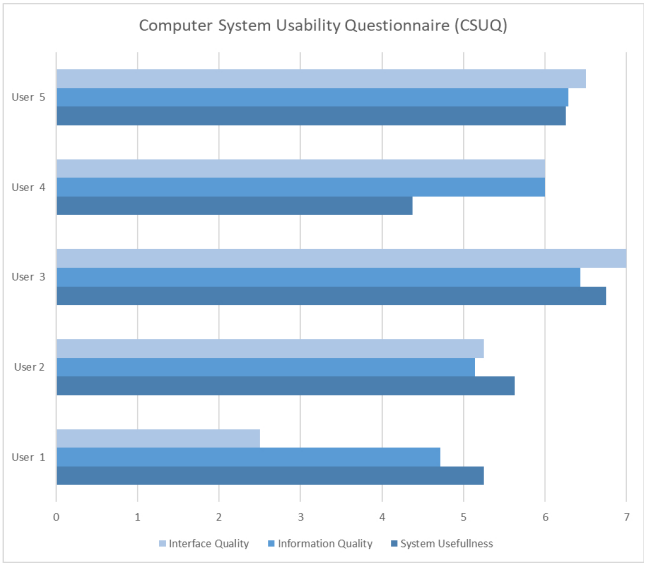

Figure 7: CSUQ - User-wise comparison of average scores for all three categories.

order to capture additionally overall satisfaction we are also planning to conduct the Questionnaire for User Interface Satisfaction

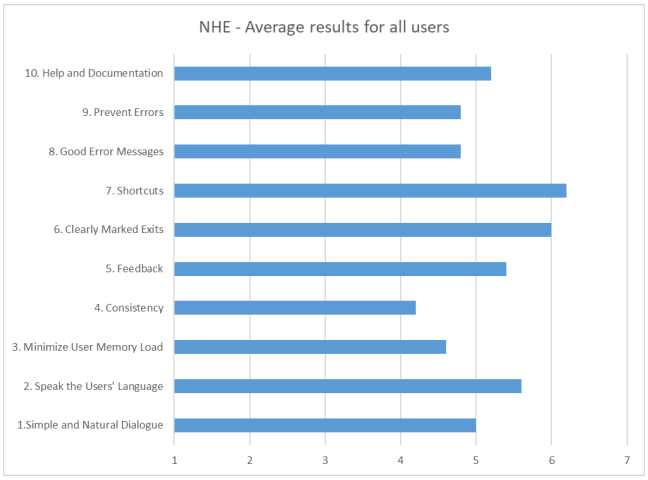

Figure 8: NHE - Heuristic-wise average scores for all users.

(QUIS)[4] introduced by [2]. Together with already obtained insights we will use the insights to improve our prototype at least to the beta level.

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