Project Number: 248294

VICON

Virtual User Concept for Inclusive Design of Consumer Products and User Interfaces

Deliverable Report

D4.3: Evaluation report on how convenient it is to use virtual user model and adapted prototype

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Author	Pierre Kirisci, Svetlana Matiouk, Yehya Mohamad, Markus Modzelewski
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Deliverable abstract	This deliverable presents the results of the end-user evaluation of the VUM and of the VICON prototypic software system. The objective of the evaluation is to determine how convenient the Virtual User Model is to use by the product developers. The evaluation focuses upon the usability and the functionality of the VICON toolset and aims to propose suggestions for improvement.

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Executive summary

This deliverable represents the evaluation report on how convenient it is to use virtual user model and adapted prototype of the VICON software. Based upon the experience gained through the development of the VICON reference products by the industrial partners DORO and ARCELIK in the scope of task 4.2, the VICON sketch tool, annotation tool, and evaluation tool have been substantially improved. This refined version of the VICON software has been evaluated by operating the three design phases through the designers and product developers of the VICON industrial partners DORO and ARCELIK. Additionally, the feedback of external users (particularly industrial designers, product developers, and project managers) was captured as far as possible. The methodologies applied were online and offline questionnaires, combined with telephone interviews. In the first two phases a total number of 15 subjects participated, while for the third phase where the VIRTEX application has been assessed a total number of 9 subjects were involved.
The deliverable starts by providing an overview regarding the state-of-the-art in questionnaire standards with a focus upon the standard ISO 9241-11, which was particularly used in the evaluation. This is directly followed by a comprehensive description of the evaluation procedure pursued in all three phases addressed in the VICON solution. The main part of the deliverable deals with the analyses of feedback of the test subjects regarding the operation of the sketch tool, annotation tool, and VIRTEX application. All questionnaires, diagrams, and supplementary material can be found in the annex of this document. The deliverable is finalized by the conclusions and outlook.

1 Introduction

The objective of Task 4.2 (Validation of Virtual User Model by development of reference products) is to test the performance of the Virtual User Model from the point of view of the end users (designers). VICON end users were asked to use the VICON toolset to develop reference products. Feedback was then collected from them based on their experience. The objective was to determine the end users' opinions and feelings of the Virtual User Model's impact upon the specification of user interfaces (UIs) for consumer products.

Using the VICON toolset, the design teams of the industrial partners DORO and ARCELIK were asked to develop and evaluate a virtual prototype of a user interface (UI) of a mobile phone and washing machine. The design and evaluation process itself is comprehensively described in D4.2, while the focus of this deliverable D4.3 is on the evaluation the virtual user model by operating the three design phases of VICON through the designers and product developers of the VICON industrial partners DORO and ARCELIK.

Additionally, the feedback of external users (industrial designers, product developers, and project managers) was captured as far as possible.

The evaluation process is based upon a standardised questionnaire about usability, partly according to the ISO Norm 9241-110 with a respective rating scale. This technique of capturing data offers the opportunity to record opinions about the satisfaction of the users with specific facets of the software. It should be noted that the ISO Norm 9241-110 questions were adapted to the individual phases of the VICON toolset since the Standard proved to be too general and too software-focused in some parts. In consequence, an adapted version was prepared with relation to the first and second design phases, and another version of the questionnaire was adapted to the third evaluation phase. It was not possible to use the same questionnaire for all phases due to the fact that sketch and CAD design and evaluation are usually performed by different user groups. While the sketch is done by the industrial designer, the CAD design and evaluation might be done by an engineer or technician. Therefore different questions were required for the different phases.

2 Methodology

An empirical method (questionnaire) was used to evaluate the VICON software. Questionnaires are often used for evaluating products and services as they prove to be an effective approach for capturing quantitative and qualitative feedback from users.

In the following section a brief overview of the state-of-the-art regarding standards and principles for preparing questionnaires is presented. Following this, the end-user evaluation procedures and the questionnaires used for assessment of the VICON prototypic applications are described.

2.1 State-of-the-art standards

2.1.1 Standardised questionnaires

Generally, questionnaires can be created in accordance to a specific context or through using a standardised questionnaire. Particularly regarding the investigation of usability aspects, there exist several predefined questionnaires or sample templates for questionnaires.

The following list provides a brief overview of existing standardisation initiatives regarding usability questionnaires:

- Attrakdiff2: Measurement of sensed and hedonic, pragmatic quality

- User Experience Questionnaire: Quantifying user experience in software products
- ISONORM 9241/110 [Prümper, 1997] Basics of dialogue design.
- IsoMetrics [Gediga & Hamborg, 1997]: Rules in design according to the ISO Norm 9241/10
- SUMI (Software Usability Measurement Inventory): Method for subjective evaluation [Bevan & Curson, 1997], [Kirakowski & Corbett, 1993]
- QUIS (Questionnaire for User Interaction Satisfaction): developed by Norman and Schneiderman for the measurement of satisfaction for software products [Harper & Norman, 1993]
- ErgoNorm [Dzida, 2000]
- EU-CON II [Stary, 1997]

2.1.2 Questionnaire according to the ISO NORM 9241-110

Questionnaires based upon the ISO Norm 9241-110 are not only suitable for the evaluation of iteratively designed prototypes, but also for the evaluation of final implemented software systems. In spite of the versatile applicability for testing a broad range of software systems, this special ISO norm is often considered for the evaluation of graphical user interfaces using interaction devices such as a mouse. The ISO Norm 9241-10 is however not only applicable for evaluating software, but also for hardware. As such, *user interfaces* are internationally defined as: "All components of an interactive system which provide information and control elements for the user in order to perform a specific task within an interactive system".

2.1.3 Concept of Usability (ISO 9241-11)

According to ISO 9241-11 (DIN EN ISO 9241-11), usability is defined as the extent of usage of a product by users within a context of use in order to achieve specific goals with effectiveness, efficiency and satisfaction. The following principles should be fulfilled according to the ISO Norm when designing software user interfaces:

- **Effectiveness** – the goal of the user of the software should be fully attained
- **Efficiency** – the goal of the user of the software should be fully and adequately attained with the least effort
- **Satisfaction** – The goal of the user should be easily attainable

Furthermore, according to the DIN EN ISO 9241 part 10 (DIN9241-10), these seven principles are proposed, which are also supported by the ISO 9241-11:

Suitability for the task – The software should support the user at fulfilling his/her tasks.

Capability of self-descriptiveness – the software should provide the user with sufficient explanations, thus the explanations should be easily understandable.

Controllability – the user should be able to work and interact with the software according to own preferences.

Conformity with user expectations – The software should respect the habits of the user through a consistent and reproducible design

Error tolerance – Possible errors of the users should be prevented by the software

Capability to individualize / Personalisation – With only little effort it is possible to adapt the software to the preferences of the user

Assistance in learning – The software should be easy to learn and provide assistance in learning for the user.

2.2 VICON evaluation procedures & questionnaires

Together, the three VICON prototype applications (sketch, CAD design and Virtex evaluation) form a comprehensive toolset for inclusive design support. In order to get the most out of the qualitative analysis of such a toolset, the evaluation was divided into two major parts: (1) the evaluation of the Sketch and CAD design applications and (2) the evaluation of the Virtex application and the general virtual user concept of VICON.

This division of the evaluation also addressed the fact that the product evaluation application Virtex is intended to be used independently of the CAD environment. Thus the end-user, who doesn't have *Siemens NX* software installed, can easily test the application as well. Beyond that, the sketch, CAD design, and evaluation are usually performed by different user groups.

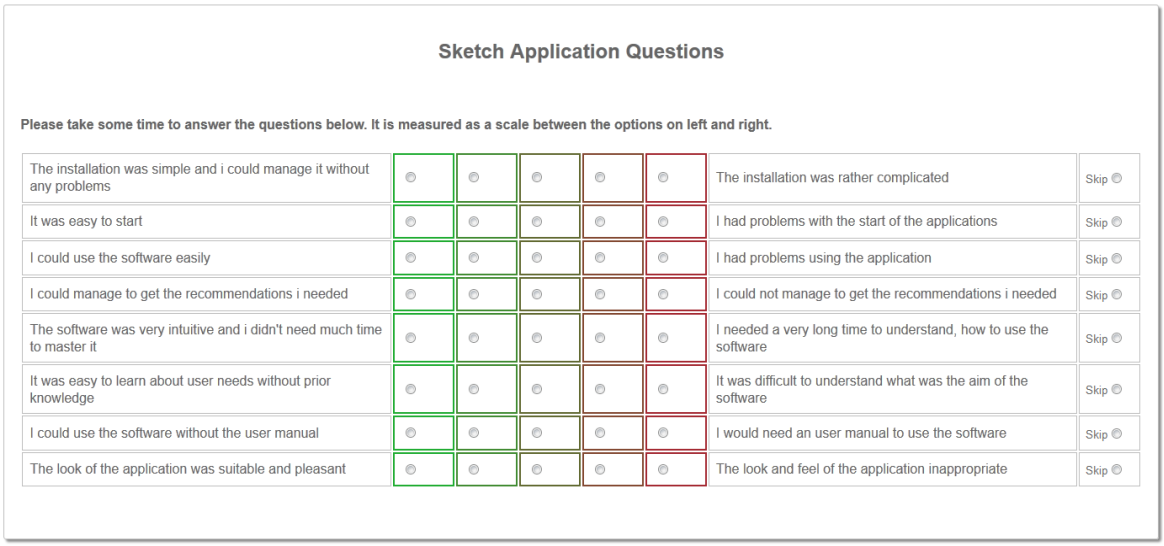
The end-user evaluation procedures used in the two evaluation parts were adapted to address the structure of the relevant sections of the software. That way the first part was designed as an online installation guide and questionnaire, and the second part used traditional testing instruction and questionnaire files, since Virtex was delivered as an executable file and didn't require installation.

All developed questionnaires were kept as short as possible regarding the number of questions. As such, the wording of the questions was kept as clear and concise as possible in order to avoid misunderstandings. Since it was expected that some questions might inspire the participants to provide additional comments, room for adding comments or ideas for improvement was also provided.

The evaluation results of both evaluation parts aimed to identify areas of the VICON software and model that require improvement.

2.2.1 Design of the Sketch & CAD Design applications evaluation

The first part of the online questionnaire started with a general introduction to the evaluation of the sketch and design phases. Before the installation of the software, a participation agreement (see Appendix E; informed consent), and questions related to the company and pre-expertise were answered by the participants. The user was then accompanied through the installation of the sketch application, highlighting the most important features step-by-step with the help of screen shots. The participant of the evaluation was then presented a specific use case, and motivated to use the VICON sketch application to configure the scenario and gain recommendation results. After this short experience with the VICON sketch application, eight questions were posed to the participant, with a scale of five choices (from very positive to very negative) as seen below in *Figure 1*.



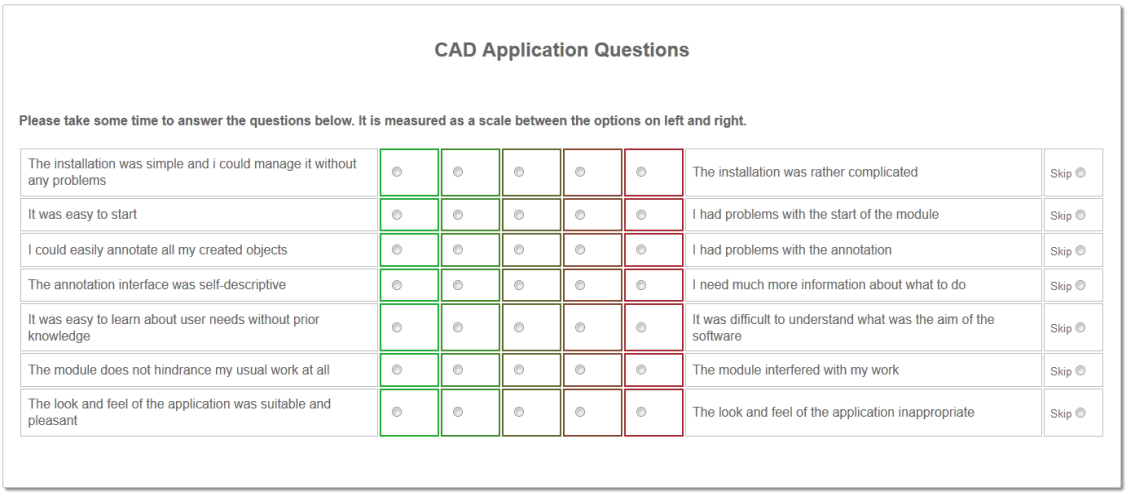
Sketch Application Questions

Please take some time to answer the questions below. It is measured as a scale between the options on left and right.

The installation was simple and i could manage it without any problems						The installation was rather complicated	Skip
It was easy to start						I had problems with the start of the applications	Skip
I could use the software easily						I had problems using the application	Skip
I could manage to get the recommendations i needed						I could not manage to get the recommendations i needed	Skip
The software was very intuitive and i didn't need much time to master it						I needed a very long time to understand, how to use the software	Skip
It was easy to learn about user needs without prior knowledge						It was difficult to understand what was the aim of the software	Skip
I could use the software without the user manual						I would need an user manual to use the software	Skip
The look of the application was suitable and pleasant						The look and feel of the application inappropriate	Skip

Figure 1 - Questions to the participants of the evaluation after using the VICON sketch application.

The second part of the online questionnaire focused upon the CAD application (VICON annotation tool). Here the user was guided through a comprehensive explanation of the VICON annotation tool. For a full exploitation of the annotation tool, the user was required to have Siemens NX already pre-installed on his/her system. This was already the case for the industrial partners DORO and ARCELIK. It was possible for external participants to perform the evaluation based upon the features of the annotation tool presented in screenshots. Similar to the sketch application, the evaluation participants were presented a series of seven questions, with a scale of five choices (from very positive to very negative), which are illustrated in *Figure 2* below.



CAD Application Questions

Please take some time to answer the questions below. It is measured as a scale between the options on left and right.

The installation was simple and i could manage it without any problems						The installation was rather complicated	Skip
It was easy to start						I had problems with the start of the module	Skip
I could easily annotate all my created objects						I had problems with the annotation	Skip
The annotation interface was self-descriptive						I need much more information about what to do	Skip
It was easy to learn about user needs without prior knowledge						It was difficult to understand what was the aim of the software	Skip
The module does not hindrance my usual work at all						The module interfered with my work	Skip
The look and feel of the application was suitable and pleasant						The look and feel of the application inappropriate	Skip

Figure 2 - Questions to the participants of the evaluation after using the VICON Annotation Tool.

The final part of the online questionnaire contained questions related to the ISO Norm 9241-110. These were categorized according to the following themes:

- Suitability for the task
- Self-descriptiveness
- Conformity with the expectations
- Suitability for learning
- Controllability
- Error tolerance
- Suitability for individualization

An overview of the entire online questionnaire can be found in the APPENDIX A of this deliverable.

2.2.2 Design of the Virtex application evaluation

The questionnaire

The main objective of this part of the end-user evaluation was to find out how convenient the product evaluation prototype, Virtex, is for designers to use. In addition, a section about convenience of the VICON's general virtual user concept was included in the questionnaire.

As a foundation for the questionnaire the design principles for interactive systems stated in the ISO 9241-110 were used. However it was decided that the questionnaire should focus on the following three principles:

- Suitability for the task
- Self-descriptiveness
- Conformity with user expectations

At the current stage Virtex is a prototype, which should show directions for future virtual usage simulation and task analysis. The prototype is limited, however the authors believe that it is sufficient to demonstrate the project idea of inclusive design support. Bearing this in mind it was decided to exclude the four ISO 9241-110 principles "Error tolerance", "Controllability", "Capability to individualize / Personalisation" and "Assistance in learning" from the survey. Without doubt, these principles cover very important aspects of an interactive system ready for the market. However, according to the authors' experience, these aspects are less important for a prototype application like the VICON toolset, which aims to demonstrate a general concept in order to identify how well it supports the tasks of the designers in their usual work environments and what further needs and ideas the designers have for the support of their work.

The questionnaire contained both statements to be rated and open questions. The rating scale of the statements had 7 values, which ranged between "strongly agree" and "strongly disagree":

- 1 = "strongly agree"
- 2 = "agree"
- 3 = "rather agree to some point"
- 4 = "neither agree, nor disagree"
- 5 = "rather disagree to some point"
- 6 = "disagree"
- 7 = "strongly disagree"

The statements related to whether or not the software prototype addressed the principles according to the ISO 9241-110. The open questions mainly addressed the objectives of the project

or conceptual questions, which might be of further interest. The last section of the questionnaire contained statements, which addressed the VICON virtual user concept and were related to the objectives of the VICON project.

The questionnaire consisted of two parts: (I) the screening part was about the participant's background, (II) and the second part aimed to collect feedback on the Virtex software prototype which the participant tested. The part I of the questionnaire was filled out before participants began testing the software. APPENDIX B presents the two parts of the questionnaire.

The questionnaire was designed in a traditional form by using fill-in forms[1] in a Microsoft Word document.

Assessment procedure

In order to ensure the high level of detail in the collected response, the second part of the questionnaire was conducted through telephone interviews which was transcribed by the interviewer. Only one participant (participant code: U2), for whom it was not possible to phone, provided his/her feedback "offline" in a written form. This participant also answered further questions, which emerged from his/her answers in the questionnaire.

The participants of the survey were asked to fill out a screening part of the questionnaire (Virtex questionnaire part I, see 0) before they started to read the testing instructions and test the software. They were provided with a download link to a testing package. The package contained:

- Testing instructions – The participants were asked to read them first.
- The main part of the questionnaire (Virtex questionnaire part II) - The participants were asked to read the questions before testing.
- The stand-alone Virtex application and its user manual.

All the documents delivered to the participants of the Virtex survey are presented in APPENDIX B.

After a participant completed the test following the instructions, s/he provided the feedback in a telephone interview in the form of answers to and comments on the questions in the Virtex questionnaire part II. All the interviews were conducted in English by one VICON researcher (from FIT).

2.3 Ethical issues

Based on the collaborative work of the VUMS cluster, an Ethics Protocol was developed for user testing with designers (see Appendix E). The protocol primarily addressed potential ethical issues relating to:

- Informed Consent
- Data protection
- Data management and reporting

[1] http://office.microsoft.com/en-001/word-help/create-forms-that-users-complete-or-print-in-word-HA010030746.aspx

3 Analysis of the responses to the Sketch and CAD Design applications

In the evaluation of the sketch and design application, a total of 15 subjects participated. From the VICON industrial partners, four designers from DORO and three designers from ARCELIK participated. Seven external subjects also participated. The seven external participants consisted of a mixture of academics and employees of companies who at least have something to do with product development. Of the 15 participants, 13 were male and 2 were female. All of the external participants have experience working with IT design and development.

Table 1 provides an overview of the participant profiles. Please note that the order of numbers in which they are presented in the table is different to the coding used in the results below (subject 1, subject 2, etc.) to keep the responses anonymous.

Table 1 – Overview of the participant profiles

Number	Category	Profile
1	VICON partner	DORO product designer
2	VICON partner	Veriday product designer
3	VICON partner	Veriday product designer
4	VICON partner	DORO product designer
5	VICON partner	Arcelik product designer
6	VICON partner	Arcelik product designer
7	VICON partner	Arcelik product designer
8	External participant	Design manager
9	External participant	Design researcher
10	External participant	Industrial engineer
11	External participant	Industrial engineer
12	External participant	ICT research manager
13	External participant	Project manager
14	External participant	Project manager
15	External participant	Industrial engineer

The questions are structured in sub-sections according to the themes addressed in the ISO 9241-110. These are: suitability for the task, self-descriptiveness, conformity of user expectations, suitability for learning, controllability, error tolerance, and suitability for individualization.

The results of the evaluation were produced in diagrammatic form. From of the seven categories 1-3 of the most significant diagrams are presented. A comprehensive overview of the remaining diagrams is included in Annex C of this deliverable. The participants had the option to provide additional comments in order to underline their opinions. Four subjects took benefit of this option. Their comments are integrated in this section.

Initially, the participants were asked to specify their degree of familiarity with inclusive design. While two participants were very familiar with inclusive design principles, three participants stated that they were not familiar at all, as can be seen in Figure 3. The rest of the participants were either familiar, moderately or slightly familiar with inclusive design approaches.

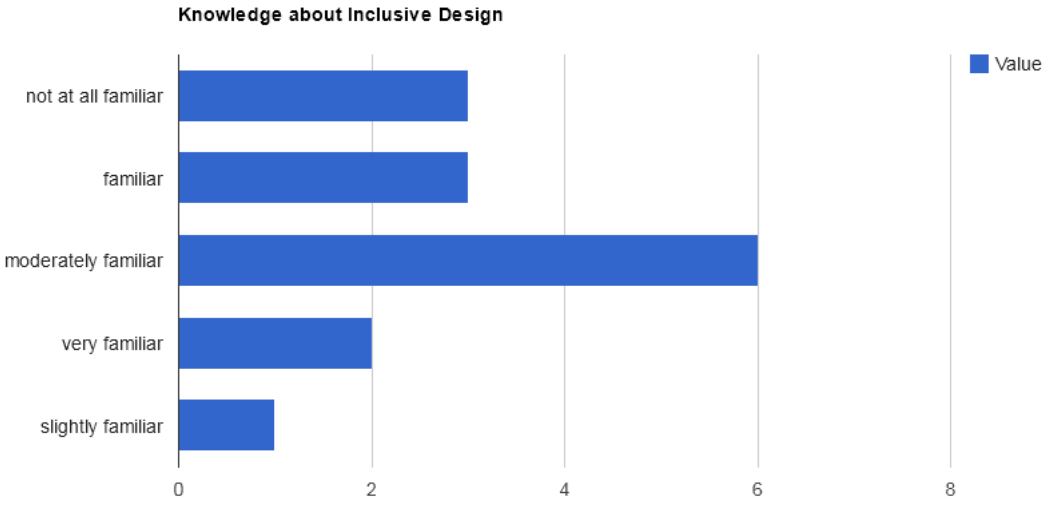


Figure 3 - Knowledge about Inclusive Design

Seven of the participants were not familiar at all with virtual user approaches, namely, design approaches where virtual user models are considered. As seen in Figure 4, this is nearly half of the participants, most of which were external participants. The rest of the participants were moderately familiar with VUM approaches in design. Thus, the two participants who were either familiar or very familiar were found to be among the VICON industrial partners.

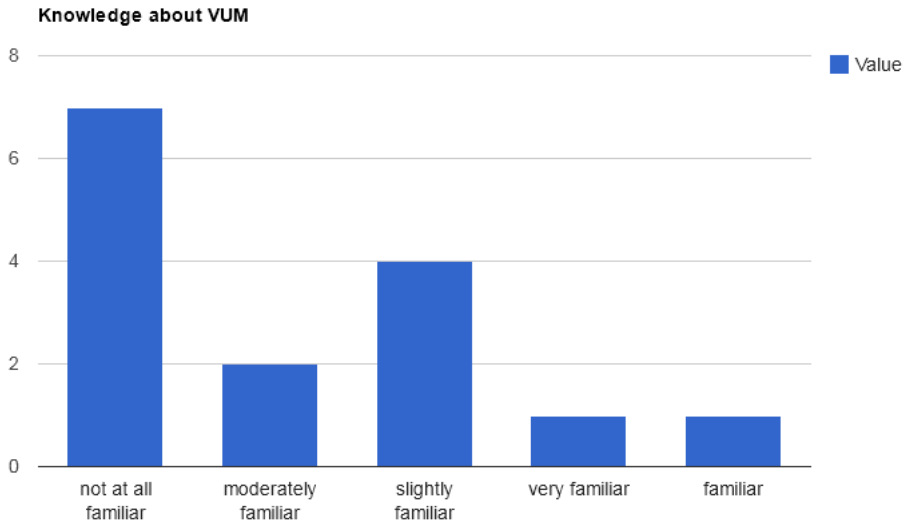


Figure 4 - Knowledge about VUM

3.1 Suitability for the task

Although there were some problems installing the software (e.g. compatibility with the participant's own system), the VICON toolset (sketch application and CAD annotation tool) was considered, by the majority of participants, to be easy to use. This fact is highlighted in Figure 5.

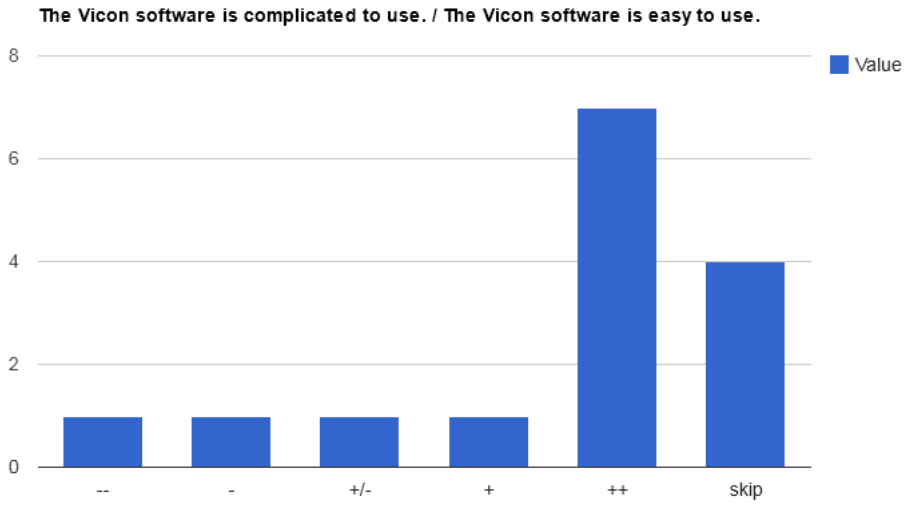


Figure 5 - Ease of use of VICON Sketch and CAD modules

Novice users can easily learn the features of the prototype VICON toolset without prior training and the interface was found to be intuitive and comprehensible. Some participants expressed desire for an initial wizard or tutorial to help get the process started. While the provided customization

options were positively noted, dockable window panels were suggested to allow to free arrangement.

As illustrated in Figure 6, the information and component and design recommendations were considered to be sufficiently helpful, comprehensive and supportive for the inclusive design process. One subject remarked that the amount of information is quite large and it takes a considerable amount of time to read and process all of it, but stressed at the same time that the importance of this information to be considered is worth the effort.

Comment of subject 4: It is not so clear to see the specifications of the user models and I cannot figure out how to edit them. Do we really need all these environments? Maybe grouping and reducing the number is better, because I have to repeat the actions for different environments again. This is the same for the tasks. There are so many tasks to check. The list of recommendations may have a colour code at the list view.'

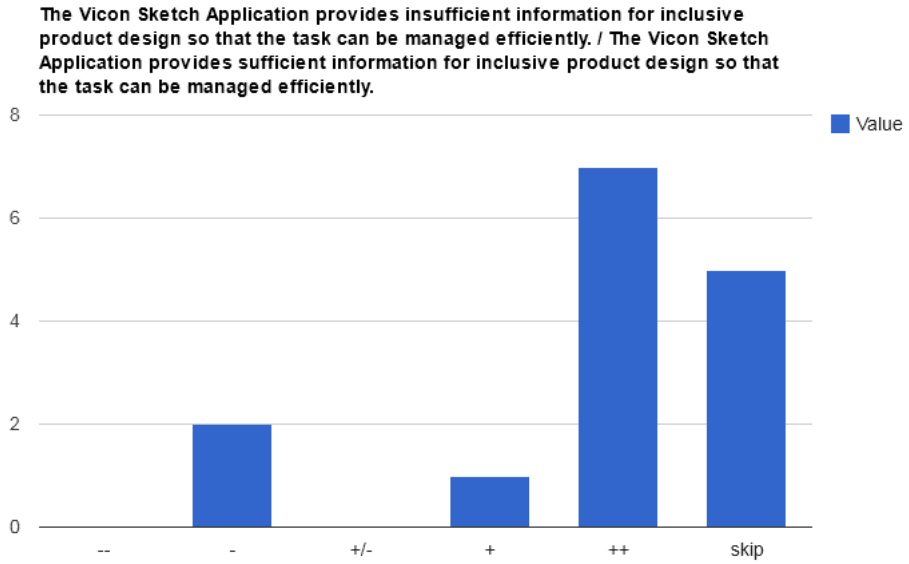


Figure 6 - Sufficiency of information

Moreover, for implementing inclusive designs, the participants felt that the VICON toolset provided a good spectrum of information (e.g. a wide choice of scenarios and the overview of software features) especially for the designer and product engineer (see Figure 7). One subject criticised the sheer amount of different profiles and suggested grouping them, while another remarked that some seemed redundant.

Comment of subject 3: ''The same task appears multiple times in the tasks panel although there is not any difference in the description justifying that (e.g. I can see at least 3-4 options titled "check display" without any differences in their description)''

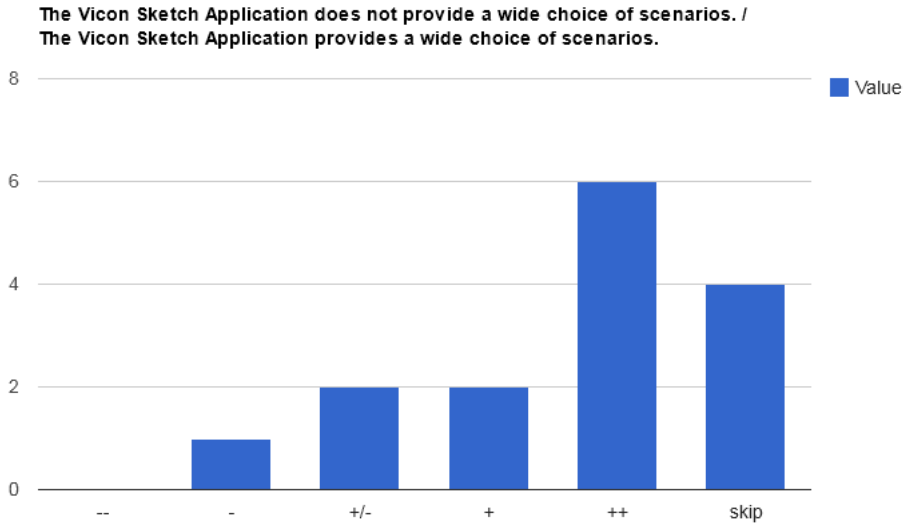


Figure 7 - Scenario choice

Overall, the information such as design recommendations and component recommendations were perceived as useful for inclusive design and presented in a comprehensible way by nearly half of the participants as emphasized in Figure 8 and Figure 9. One participant remarked that the results of the component recommendations were redundant since the same components were recommended several times.

Comment of subject 4: 'I only used the sketch application. The tasks are repeating. I have eight "press on/off button", and the rest is written twice. May be this is a fault related to my computer or installation. When I try to export recommendations as PDF, it was only one cover page, no more pages.'

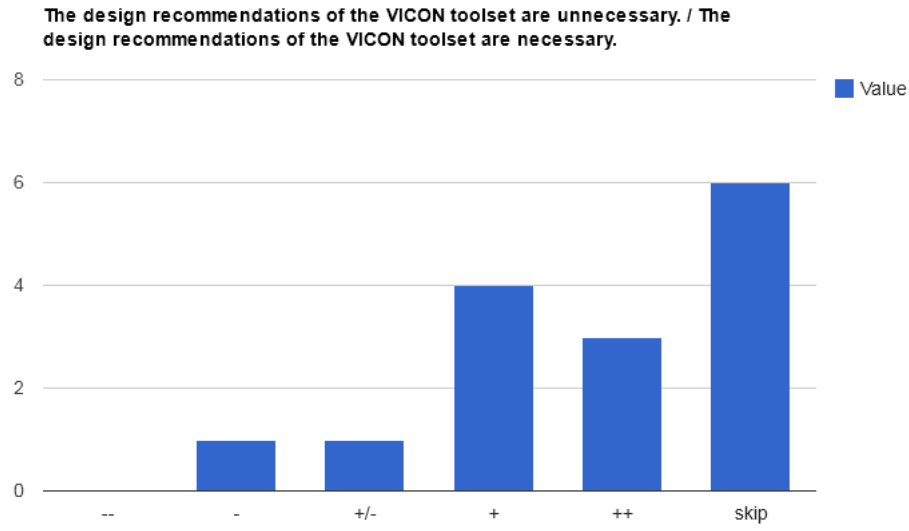


Figure 8 - Design recommendations

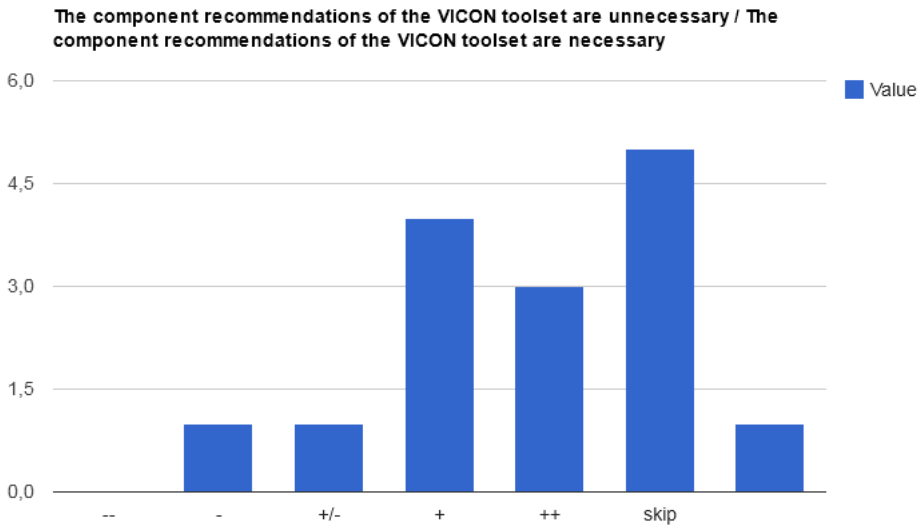


Figure 9 - Component recommendations

Although information retrieval was found to be relatively simple, one major drawback was that it took relatively long to go through the recommendations list. As seen in Figure 10, this was the impression of seven participants. The other half of the participants seemed to be more familiar with the application, and did not have the same impression.

Comment of subject 4: 'the information given as the recommendations is really long and takes time to read and understand each. But when I think of the work we are doing, this is the case and we need all of this information to be considered. Some may be repeating and duplication of what we already know.' --

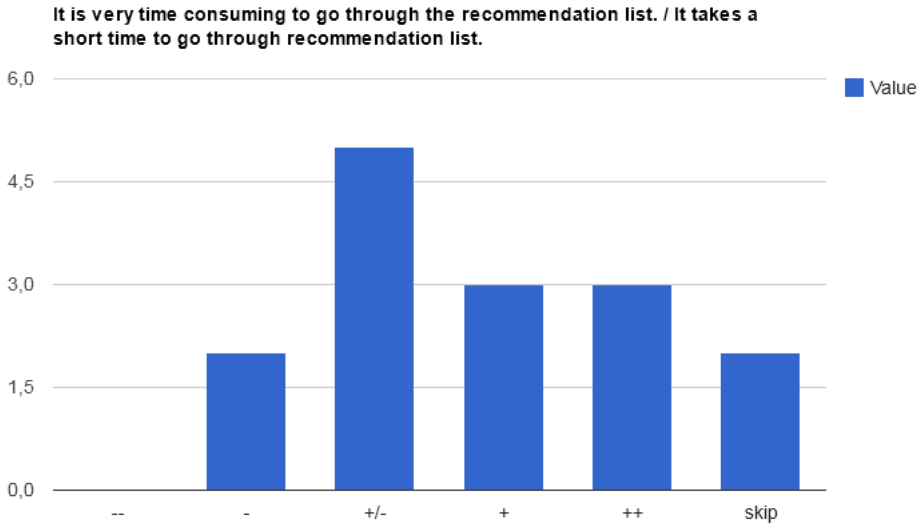


Figure 10 - List browse time

The look and feel of both applications was considered as suitable and pleasant by ten participants. Three participants were not satisfied with the user interface and suggested some improvements regarding the customization, as highlighted in Figure 11.

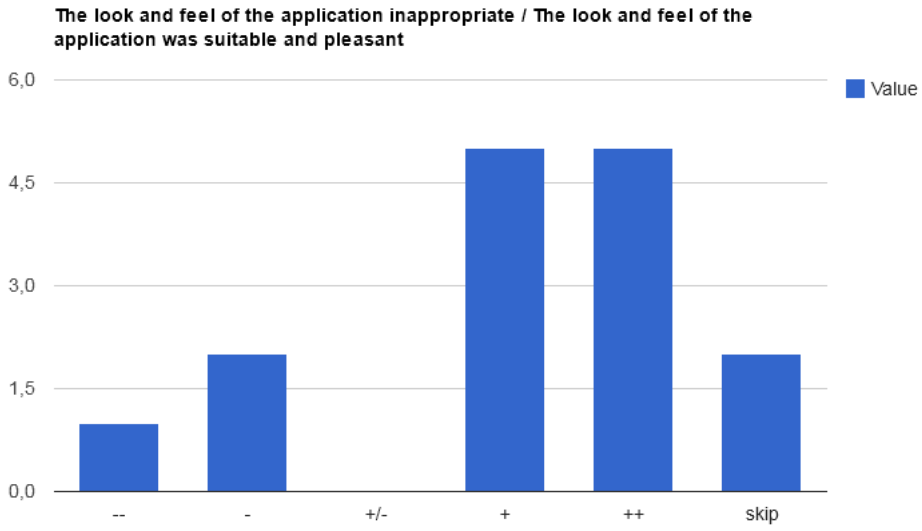


Figure 11 - Look and Feel

The specific comment of the participant is integrated in the sub-section "Customisation".

3.2 Self-Descriptiveness

The menu colours, abbreviations and the terms in the menu were comprehensible for the majority of participants. This can be confirmed through the figures Figure 12 - Figure 14.

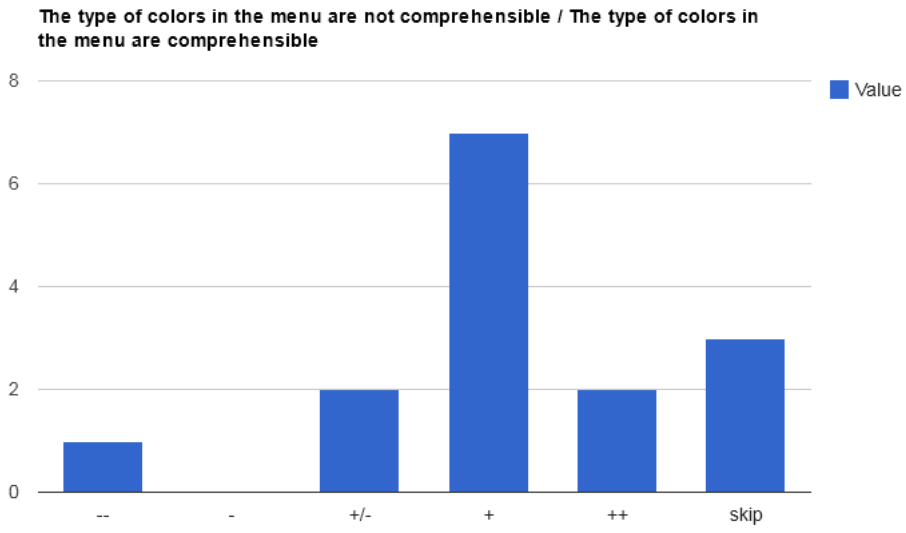


Figure 12 – Menu colours

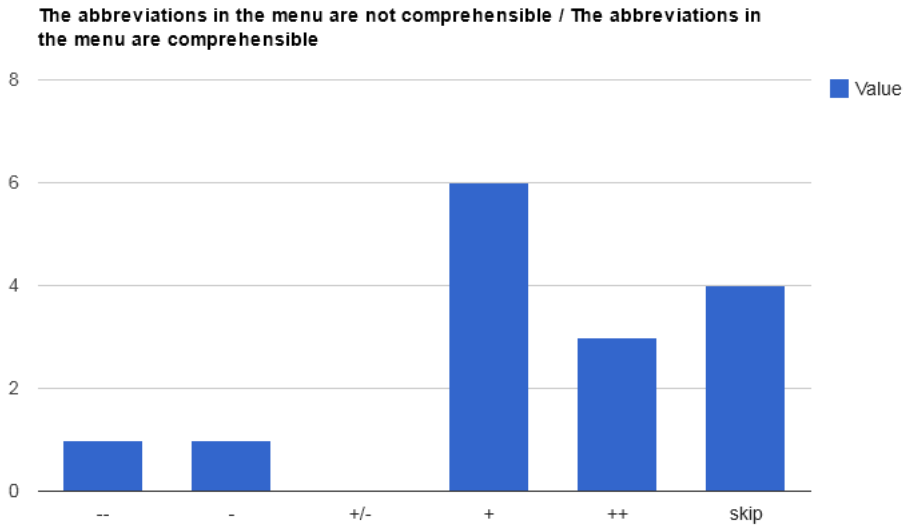


Figure 13 – Menu abbreviations

Figure 14 – Menu terms

Regarding the sketch application, the presented information for the user profiles, recommendations, environment and tasks appeared to be immediately comprehensible to at least nine subjects as seen in Figure 15.

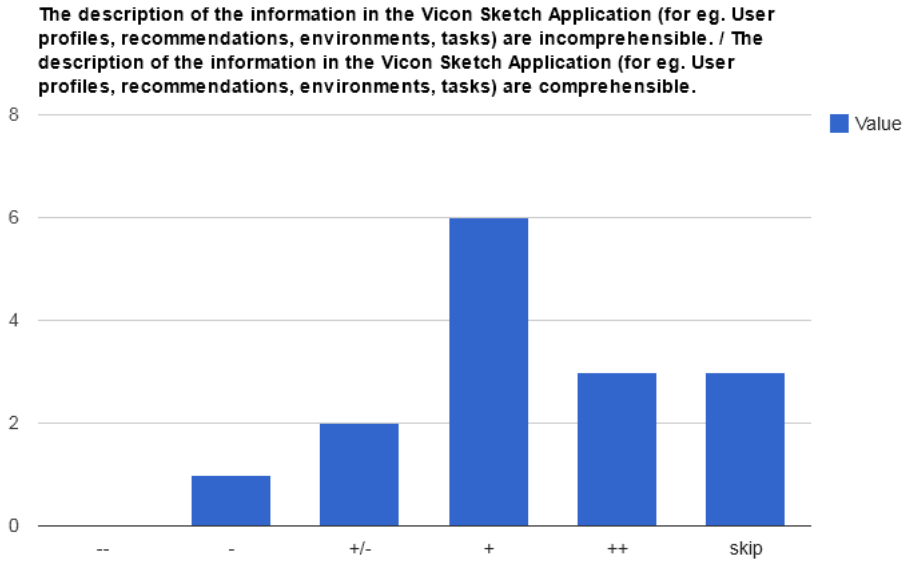


Figure 15 – Information comprehension overall

However, an issue was that the relative importance of each design recommendation (which was also highlighted through colours) was not immediately obvious to some designers (see Figure 16). In other words, the colour coding for design was not as self-descriptive as expected. Subjects suggested grouping or sorting the recommendations based on their importance to achieve a higher degree of comprehension and usability.

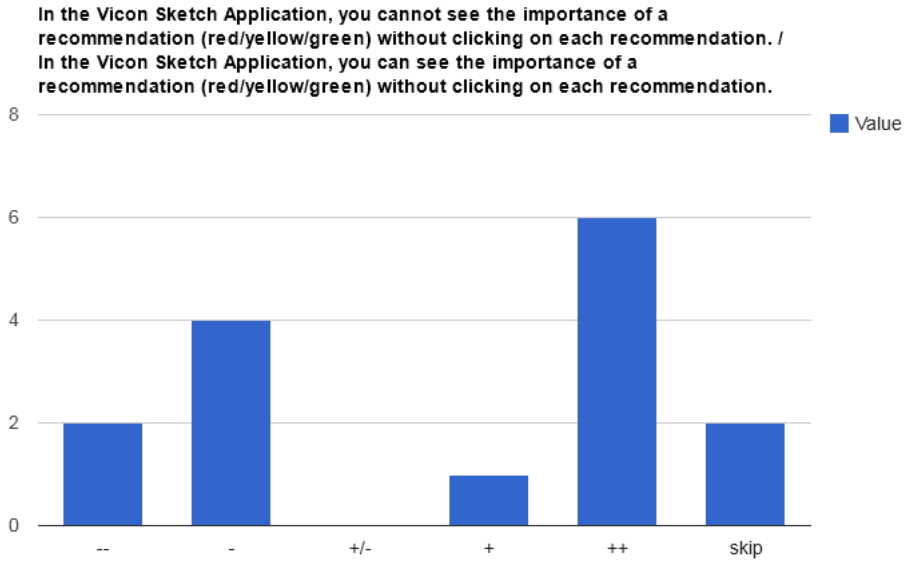


Figure 16 – Recommendation importance

3.3 Conformity with user expectations

For evaluating the conformity with user expectations, the questions addressed the consistency of the software structure, the ease of orientation, predictability of processing time, and the feature functionality expectations. For all aspects the majority of subjects had positive impressions as seen in Figure 17 and Figure 18.

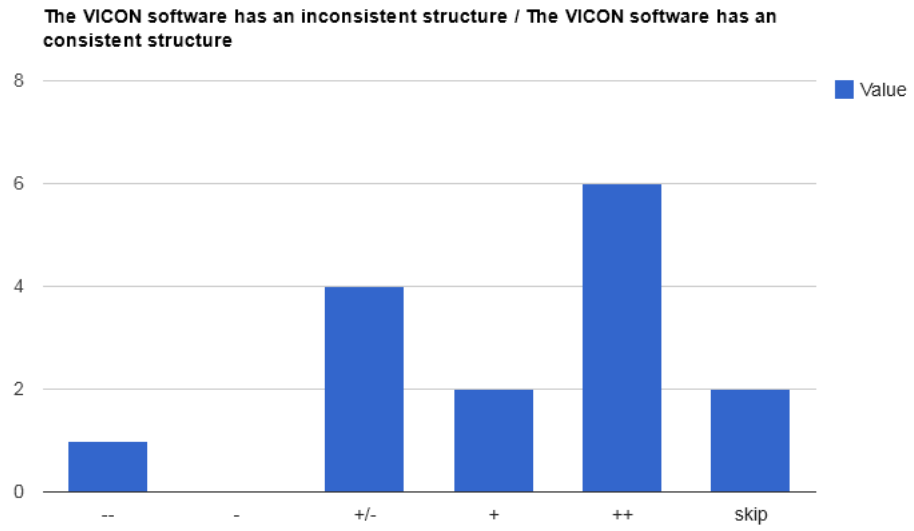


Figure 17 – Software Structure

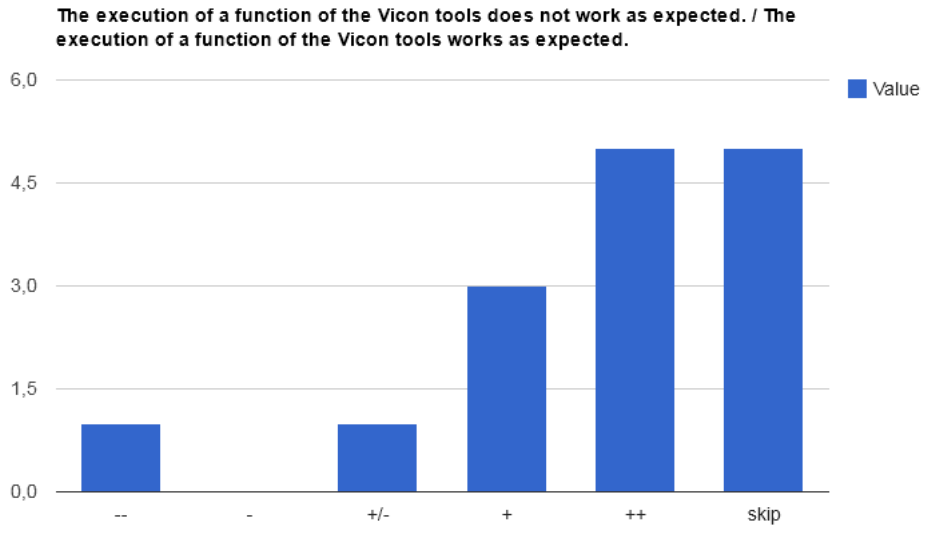


Figure 18 – Feature functionality expectations

3.4 Suitability for learning

As illustrated in Figure 19, it was stated by 8 participants that the time to learn to get acquainted with the sketch and annotation tool was minimal. This situation didn't particularly apply to the subjects which were already familiar with the VICON tools, but also to the ones that were using the sketch and annotation application for the first time.

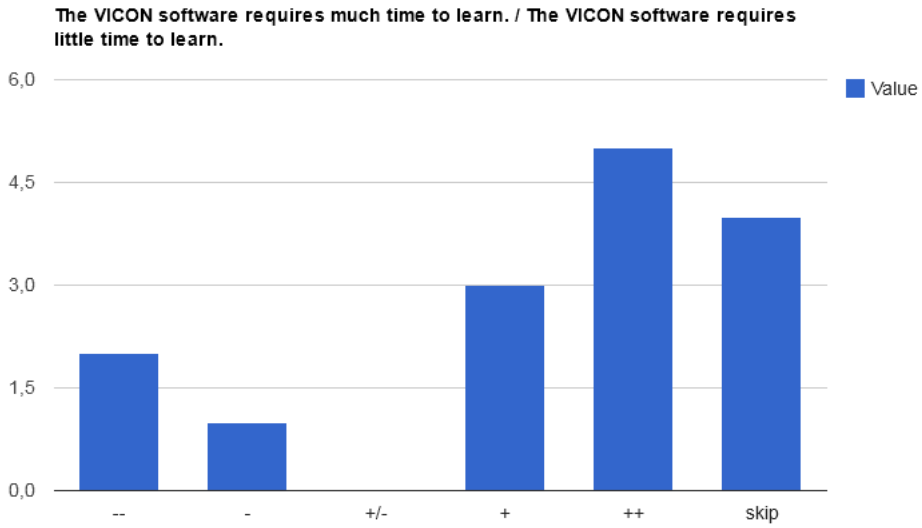


Figure 19 – Time to learn

It should however not be underestimated that 2-3 participants stated a need for help or an operation manual as seen in Figure 20. Although an easy operation manual for the sketch and annotation software has been created in the scope of D3.4, it was not integrated as a support as part of the evaluation.

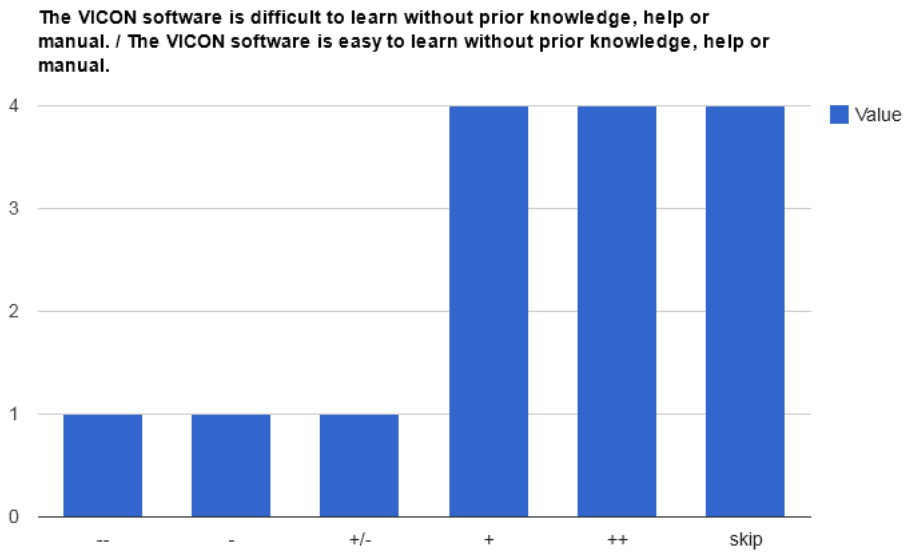


Figure 20 – Learning without prior knowledge

3.5 Controllability

For evaluating the controllability of the applications, focus was set upon storing and retrieving intermediate results, switching between the menus, and process termination. As an example in Figure 21, at least eight subjects were convinced that the VICON sketch and application software easily allowed to store and retrieve intermediate results and to continue at the same point later without any loss of information.

Figure 21 – Storing and retrieving intermediate results

The participants had a similar impression regarding easy switching between the menus and the termination of an ongoing process.

3.6 Error tolerance

The evaluation of error tolerance refers to the comprehension of error messages, the availability of trouble shooting information, the integration into existing CAD software, the existence of software-bugs, and stability. For these questions a rather high number of participants chose to skip these questions, which is due to the fact that the annotation tool was particularly prepared for integration with Siemens NX. Thus, Siemens NX was not the primary applied CAD system of all of the participants. Therefore, only those users who worked with Siemens NX were able to test the full potential of the annotation tool, and were in a more appropriate position to answer the questions. It is highlighted in Figure 22 that most of the subjects had only little to no problems in integrating the annotation tool flawlessly into their CAD environment. Moreover, the integration of the annotation tool did not hinder the designer in his/her work. It was easily implemented into the existing CAD infrastructure and did not disturb the usual workflow of the designer.

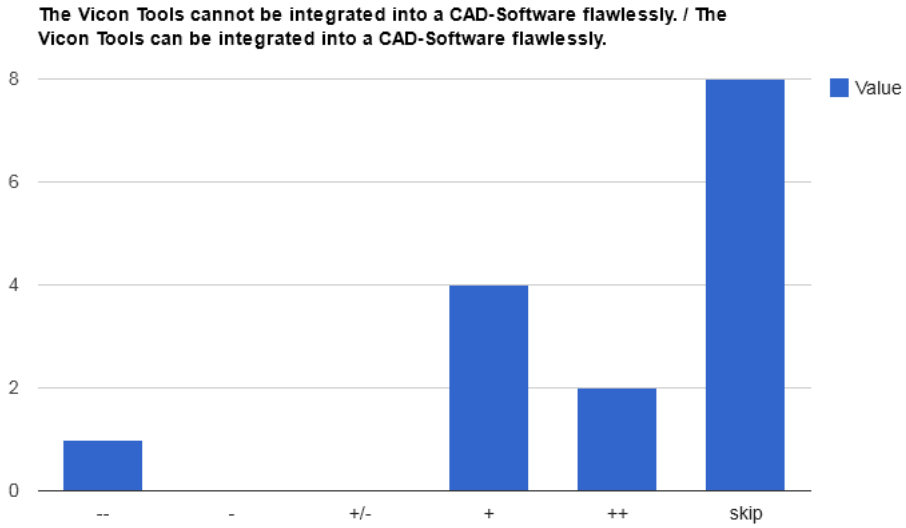


Figure 22 – CAD integration

Also noted was the lack of error messages and troubleshooting information within the software.

Comment of subject 2: *'I cannot see any error messages and troubleshooting information.'*

3.7 Suitability for individualization

The suitability for customization refers to customization according to the individual user's way of working and to the customization of the screen display (especially sketch application). As seen in Figure 23, nearly half of the subjects agreed that the VICON software can be customized according to their personal needs.

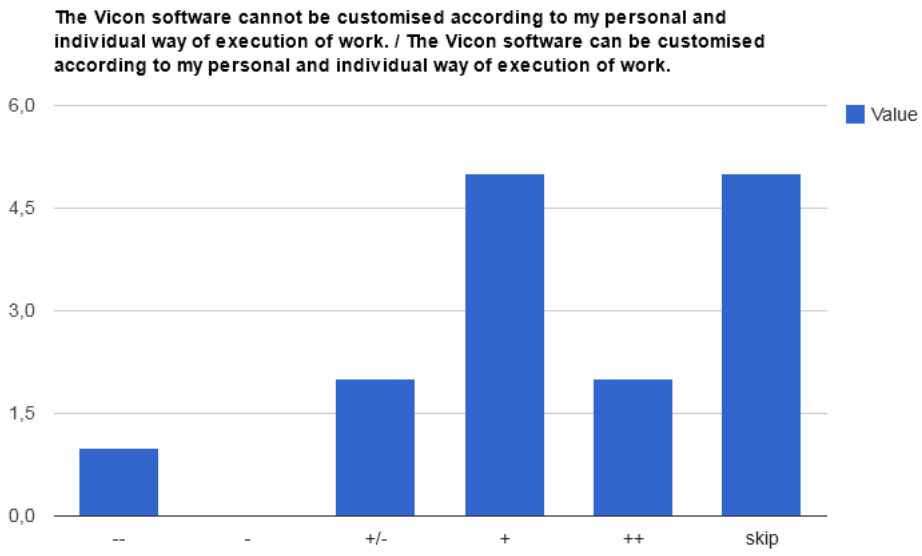


Figure 23 - Customization

Only 1-2 participants were not satisfied with the customization possibilities which the software offers.

Comment of subject 13: "The look and feel can be customized but only within a set of limited settings. These might cover a lot of possibilities but it would feel more customizable and personalized if I could move around the panels on my own and decide where to place them and how much space they take. Something like what happens on Eclipse or VS when we move panels around."

In the next section the focus is upon the analysis of the responses to the Virtex application.

4 Analysis of the responses to the Virtex application

A total of nine designers participated in the end-user evaluation of Virtex. APPENDIX D presents the collated responses to the questionnaire. Six of these participants had already taken part in the evaluation of the first two (Sketch and CAD) parts of the toolkit: 1 participant from DORO, 2 participants from Veriday, and 3 participants from Arcelik.

Table 2 provides an overview of the participant profiles for the Virtex application. Please note that the order in which they are presented here is different to the coding used in the results below (U1, U2, etc.) to keep the responses anonymous.

Table 2 – Overview of participant profiles for the VIRTEX application

Number	Category	Profile
1	VICON partner	Veriday designer
2	VICON partner	Veriday designer
3	VICON partner	DORO product manager

4	VICON partner	Arcelik designer
5	VICON partner	Arcelik designer
6	VICON partner	Arcelik designer
7	External participant	Designer, Innovation manager
8	External participant	Product developer, Designer
9	External participant	Designer

This section reports the analysis of the nine responses. It is structured into four subsections. The first three subsections address the three design principles according to the ISO 9241-110, which were selected as the main focus of the survey. The last subsection deals with further conceptual questions about Virtex. The analysis of the responses to VICON's virtual user concept is the subject of the next section (Section 5).

4.1 Suitability for the task

General impression

Three users of nine have strongly agreed and one has agreed with the statement that the Virtex application was usable. Two of them even explicitly noted that it was easy to use. User U8 responded: *"It was straightforward. It was generally very useful, and good to use. Looked interesting from the beginning, and it was not complicated."*

Three different users reported that Virtex was in general usable, they encountered however difficulties in use of certain parts of the interface. User U1 reported *"In general, I liked the function."* However *"It's a mix: some parts are user friendly, and some are not."*

One user's first impression of the usability of Virtex was: *"The interface should be better usable, better in line with the habits of the users."* Another criticised the usefulness of the implementation of the virtual simulation: *"It was nice as a simulation, but the text component is much more important than the visual one. Because some behaviour of elderly people is not really visualized: E.g. there were no shaking movements of hands. If you look at the 3d simulation, but it doesn't provide any information about the pros and cons of the usability of the product."*

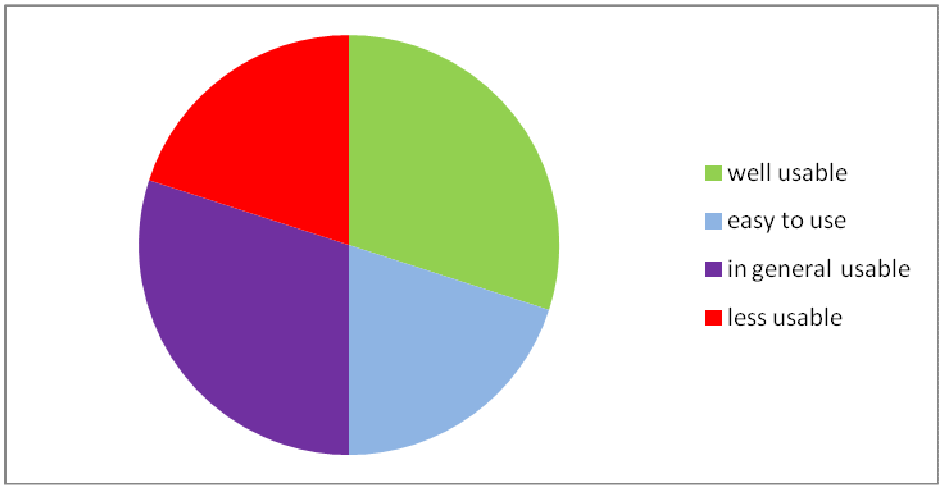


Figure 24 – General impression on usability of Virtex

One user disagreed with the first general usability statement with the comment, that the current virtual simulation does not provide a *"a good knowledge transport of the recommendations." "The recommendations should be better integrated into the simulations, not only the text form."*

Four users reported difficulties when changing from one product to another, and two users pointed out difficulties in starting a task simulation (for details see APPENDIX D).

Two users explicitly stated that they liked the functions and the general purpose of Virtex.

»Setup Evaluation« menu

The »Setup Evaluation« menu is the initial menu for selection of a product to be evaluated and of a usage context composed of a virtual user and environment (see B.3 **Virtex' user manual**).

Six of nine users have strongly agreed that it was easy to set up a product evaluation for a predefined usage context.

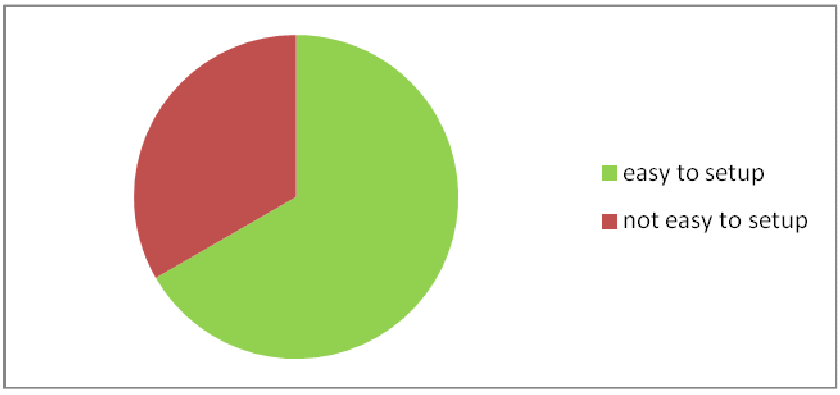


Figure 25 – Responses to the statement "It was easy to set up a product evaluation for a predefined usage context."

Two users repeated that they had already mentioned, in their comment to statement "1", that the selection of the product was not easy, and one user (U5) expressed that for the first time. Thus, altogether five users of nine expressed difficulties in using the product selection dialog.

For the same reason the two users rated the statement about the ease of use of the product evaluation setup provided by the »Setup Evaluation« menu as "agree" and "neither agree nor disagree". It is highly probable that this was also the reason for the rating given by user U4 "rather agree to some point".

User U6 commented: *"The selecting product was not easy, and the second part (Usage contest selection) was very easy to use."*

Product evaluation and its results

Most of the users reported that it was easy to start the simulation of a task, since it was implemented as a simple button click. However, the appearance of the buttons was not "button-like". Three users explicitly pointed that out. E.g. the user U3 said: *"It was not clear, that the task names were buttons. Only after I have hovered over them, I understood that they might be clickable."* Two users made the same proposal for improvement (here the suggestion of the user U6 is given): *"I would prefer that you mark/choose a task and then there is a "Start" button to begin the simulation."*

Another useful look & feel suggestion reported at this point by user U7 is the following: *"The task/subtask menu/window could be highlighted more, so it would have a better contrast to the background. So it could be better distinguished from the 3d stuff (so the grey is not a good choice and the semi transparency)."*

The virtual task simulation was accompanied by a 'Subtasks' list, which appears to the right of the screen and shows the progress of the task simulation. The feedback of the designers highlighted that the visual & interaction design of a progress visualisation should be revised considerably. The following criticisms have been noted:

- Missing possibility to stop the simulation process
- Layout of the 'Subtasks' list, e.g. *"separate the subtasks of one task from other subtasks"*
- Missing the task headings
- The animation and the display of progress is too fast, therefore it is missing the possibility to slow down, to pause the simulation at a single point of interest
- The meaning of the colours was not clear for the first run
- Automatic scroll down of the menu
- Information about the concept of independent subtask testing would be helpful
- Overview of the subtasks would be helpful
- Number of subtasks missing

These are issues that are related to the progress visualisation in form of a list. In addition, some responses suggested rethinking the manner in which the progress visualisation is integrated into the virtual simulation. So there would be a requirement to rework the concept of how the simulation progress is presented. E.g. the user U7 commented: *"There were two main activities happening at the same time on the different locations of the screen. That would be better either to combine them like augmented reality or to have controls like "Stop" and "Play"."*

The comment of the user U5 summarises the overall mood: *"The fact that the progress has been visualised was very useful, but the way how it has been realised is absolutely inconvenient."*

The general colour highlighting of the results received a positive response, but the graphic design and the layout was criticised by multiple designers. The use of icons for status visualisation and the use of different presentation forms for tasks, subtasks (i.e. headlines) and accessibility tests (i.e. clickable items of the results list) was suggested. It was advised by five users to make individual

items more distinguishable from each other. User U7 claimed: *"Clearer headlines, clearer main points, better layout."*

Furthermore user U5 emphasised: *"It is helpful to highlight with colours, but I need the connection to the moment in the 3d animation where the problems occur."*

The seven users said that the evaluation results report was easy to access. However, user U5 stated: *"It was not clear that I would get report in form of a text. So it was not clear, that I should click on the separate tests in order to open them."* And the user U6 suggested to close the single accessibility test reports automatically as soon they are out of focus in order to increase the overview. User U7 could only agree to some point that the results report was easy to access. This user also had difficulty with the overview. User U9 disagreed with the statement and commented: *"It was easy to access the report, but it was difficult to access the information in the report. First of all, none of the windows are scalable. Only small part of the screen is used to present the results. Some of the highlighted items cannot be opened, i.e. some cannot be clicked. Highlight the items which you can open and which not differently. The format that would allow opening the information in the full screen. No confirmation is given after pressing the "Save" button."*

All nine designers embraced the idea of an interactive results presentation. However the format in which it is currently realised has been criticised by six designers. The graphic design and the layout is one area for improvement, the other is the general format of presentation of the results. User U4 said: *"Little windows would be better. The idea of an interactive list is good, but the realisation isn't."* User U5 responded: *"I'm not sure if the list is the best way of presenting the results. As an overview it is not bad, but for working with this information I would choose another kind of presentation. (…) You can show all the possible issues as pictograms and then colour them according to their status. Or see Gapminder.org (animated chart representation)."*

Other missing features / interactions identified by participants included:

- Check mark (check icon) for already simulated tasks in the 'Tasks' menu
- Filtering for the results, e.g. filter out all successful tests / tasks / subtasks
- Feedback, after pressing "Save" (results) button, and providing information about the location where the results file can be found.
- Print out the full report as a MS Word document (or other editable format e.g. RTF) or PDF, so it can be further used for e.g. internal reports.
- Kind of batch processing or render list, that would help, if there are a lot of tasks and much more data
- Missing descriptions of the user and environment profiles (user U2 suggested: "It can be given in pop-up window, when mouse pointer over on them."
- Improved navigation
- Comfortable possibility for importing a new product meta file (the VSF file) e.g. via drag and drop
- The URLs in the test report should be clickable, the text should be copyable

All users agreed that a text report is useful to complement the virtual simulation.

Seven of nine users strongly agreed with statement 19: "The method of the virtual usage simulation can facilitate understanding what difficulties a user can possibly encounter with the product." One of these users commented however: *"If the picture would be more detailed, it would be very useful. Right now the virtual simulation doesn't look like that. The difficulties are currently not shown in the virtual simulation! The simulation doesn't show how difficult or easy is it for a user to perform a task. The degree of convenience in the usage of the product is not depicted."*

This comment probably reflects why the other two users could neither agree nor disagree with this statement. In addition user U7 commented: *"In my opinion it's too complicated to simulate the whole human behaviour including disabilities. Maybe it's nice to check the prototypes with the application, but it's more important to test with human users. I don't think it's possible to simulate a human. The idea is interesting, and the method is o.k., but I don't know to make it usable."*

4.2 Self-descriptiveness

General impression

Four of nine users agreed that the user interaction provided by Virtex was intuitive.

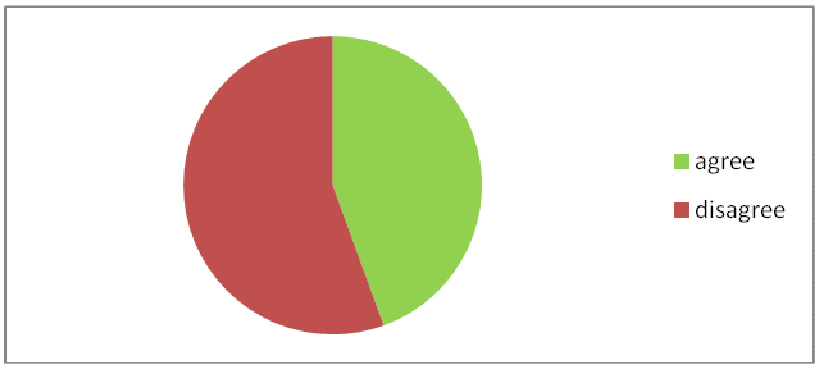


Figure 26 – Responses to the statement "The user interaction provided by Virtex was intuitive."

Two users agreed only to a certain point. So the product selection and task selection dialogs do not seem to be intuitive. One user could neither agree not disagree and in addition to the product selection dialog provided the following claim: *"The animation went too fast. I cannot follow the subtasks menu. It's about the design of the 'Subtasks' menu. See flow charts used in games on iPhone (like iOS games for children.)"* Two users disagreed with the statement. User U1 said that the way in which the tasks are highlighted is not intuitive. User U5 is unsatisfied with the realisation of the navigation within the application and states in addition: *"If you confront with a problem, it's an important moment to see and feel the difficulty. It should be celebrated, in order to reach the designer, so he/she will know how necessary it is to solve the problem. To feel into the person, and then the impulse for creating new solutions."*

Eight users were explicitly asked to give their opinion about the general evaluation workflow provided by Virtex, i.e. Product selection -> Usage context selection -> Virtual simulation scene and task selection -> View of the evaluation report -> Save report or go back to the virtual scene without saving. All users agreed that the workflow provided by Virtex is appropriate for the task of product evaluation. Hereby such adjectives as "*clear*", "*intuitive*", "*very good*", "*very nice*" and "*o.k.*" have been used to describe the acceptance.

Six of nine users never lost orientation within Virtex.

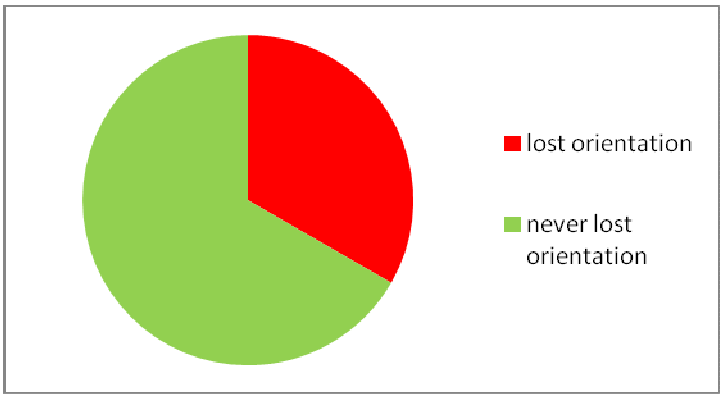


Figure 27 – Responses to the statement "I never lost orientation within Virtex."

However one of these users (the user U5) added: *"After I understood how I should navigate through Virtex, I could orientate well."* User U7 could rather agree that s/he never lost orientation apart from two conflicts: *"One was the conflict where the camera switched back, see 4. And the other, I lost orientation when there was a visual glitch of walls and the zoom behaviour was too confusing: sometimes it was too slow, sometimes too fast."* User U6 could neither agree nor disagree with the statement, because s/he said: *"I lost orientation a couple of times, maybe 3 or 4 times. One place is the list with the results: sometimes I didn't know what was I reading right now, which description belonged to which task."* User U4 rather disagreed with the statement, because s/he missed the 'Next' button in the evaluation setup menu and the 'Home' button to return from the virtual simulation scene to the evaluation setup menu. The same point of criticism of the navigation was given by two users, who both suggested to rename the 'Setup' to 'Go back' button.

»Setup Evaluation« menu

Only one user highlighted a layout issue in the setup menu: *"'Usage Context' menu: The VSF file is a bit long. Writing only the product name is better and a picture of the product would be nice."* Nobody else expressed dissatisfaction with the layout of the setup menu. However three designers used the opportunity to complain about the inconvenient product selection. Thus, the product selection has been identified as problematic.

Summing up, seven users confirmed that the menu was clearly laid out. Two users could not agree, mostly because of the poor usability of the product selection dialog.

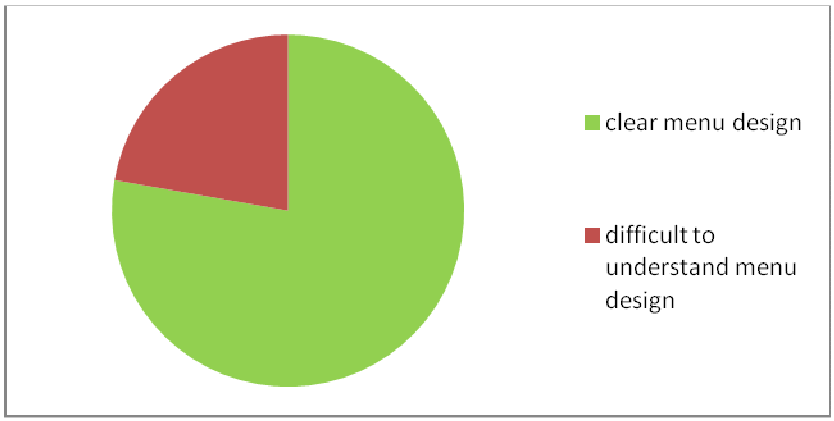


Figure 28 – Responses to the statement "The 'Setup Evaluation' menu was clearly laid out."

Product evaluation and its results

There were no points of dissatisfaction noted regarding the hierarchical presentation of the task structure. User U1 even explicitly noted that the hierarchical structure was understandable. And two other designers (U4 and U9) also commented that the structure was "o.k." or "good".

Three of nine users agreed with the statement that the evaluation results report was clearly structured. Four designers could agree with it to a point, however:

- The items should be more distinguishable from each other
- The overview is difficult to achieve
- White text on grey would be better
- More space between the different items
- The headlines should be highlighted, so they shouldn't be presented in the same way as the results of the tests

User U7 could neither agree nor disagree with the comment: *"It was o.k., but too much information for a single screen. Working with more fall down menus would be great."*

User U4 rather disagreed to the following points: *"When the user clicks a coloured tab, on the left or right there should be another window to show the suggestions. Also, the customer should click the URL's. I cannot differ between the different items: task, subtask, and test. Layout issue. You can click only the test. Why cannot I click the subtask? The structure is o.k. Why the subtask is red. It is not correct. The proportion of success could be different, e.g. the most of test are green and only one is red. Importance of the tests could be helpful. Maybe no putting any colours to subtasks."* S/he also said: *"Results window is very complicated. The results menu should be simpler. I got lost in the menu, especially in the results menu."*

To sum up, the structure of the results report was clear to all the users, however the design of the report was not clearly laid out, which led to users getting an insufficient overview of the presented results.

4.3 Conformity with user expectations

General impression

Three users agreed with the statement that, in general, Virtex's look and feel was pleasant. User U8 commented that it was very interesting to see some humans interacting with the products. User U6 commented: *"In general I like the software; I like how it looks. It was nice; it was like a game, which the first time I was asking myself whether it is actually professional software or a game. I'm not used to such pleasant and game-like looking of professional software. So it's a positive feedback, but I was asking myself how to make it to look like professional software. At the same time it was fun to use the software, so why not making professional software looking like a game in the future!?"*

Three users could agree with the above statement only to some point. User U5 commented: *"My expectations have been fulfilled. But it was nothing special. It was a little bit could, maybe too much cold. The look and feel didn't transport the mood of Mark or Gandalf. I could see the person who had a disability, but I couldn't feel it! I didn't feel the need to support the person I saw. But it was good, it was o.k."*

Two users could neither agree nor disagree, and one user has even strongly disagreed. User U7 commented: *"In my opinion the look and feel was not really up to date. A little old fashioned. I*

would prefer a text based solution of the software, because in my opinion the 3d animation is some kind of "eye candy". I would prefer if the 3d appearance would be reduced to the important items (no pictures on the wall, no furniture), so the environment should be reduced to more abstract representation, e.g. reduced only to the parameters the VUM really contains like lighting level, noise level etc. The representation of environment properties can be done using symbols/icons and number values. A lot of 3d presented information is not important or not used for the evaluation.
So it should be either very simple, so you will get the basic information, or it should be really fancy. By fancy I mean photorealistic, and the simulation would give you the feeling being the old person using the product." Furthermore *"the interface should be better usable, better in line with the habits of the users."* And user U9, who expressed the strong disagreement, commented *"that has more of old operating system, disharmony of everything, typo, graphics... It worked, but it was not pleasant look and feel."* S/he added, that the look & feel should be more updated, more modern, like a modern web page, and a graphic designer should intentionally have been designing it! Moreover the quality of the 3d representation should be higher.
User U4 also mentioned: *"As a software user there are a lot of interface controls, which are not suitable for me. As I am used to NX Unigraphics, it's like SolidWorks, where the menus are very functional. So this menu is out of borders."*

Four users agreed with the statement, that the Virtex application always worked as expected. User U7 commented: *"What was unexpected: In the evaluation view I had moved the camera during simulation of one task to a certain perspective and wanted to keep this camera setting for the following task, but it switched to a default position."*
Two users could rather agree to some point. User U3 claimed that the pressing button animation was not realistic. And user U6 reported strong difficulties in changing products.
User U4, who could neither agree nor disagree with the statement, claimed: *"I want an immediate feedback to my 3d model modifications. 3d Software -> upload it to Virtex -> than immediately run the Virtex and get the results. No other issues."*
User U5 *"expected something totally different." "Because I expected that you would use more 3d methods to explain the problems, the feelings of the users and the need that stands behind that."*

In a nutshell, for the look and feel of a software product it is critical to keep in mind that its users are designers. Designers are not only very sensitive to aesthetics and graphic design, but are also used to a certain look and feel to their own software tools, which they use every day. So, in order to be able to create a tool for designers, which they will accept, it is indispensable to hire graphic designers that will provide a desirable look and feel.

»Setup Evaluation« menu

All users felt that the terminology used in the 'Setup Evaluation' menu was understandable. However, one designer reported, that s/he couldn't understand the term 'VSF file'. Another comment came from user U4: *"'Load file' button is not perfect."*

Product evaluation and its results

Two designers expressed difficulties in recognising that the task names were actually buttons. So the presentation of the buttons should be according to the conventions of a button-like appearance.

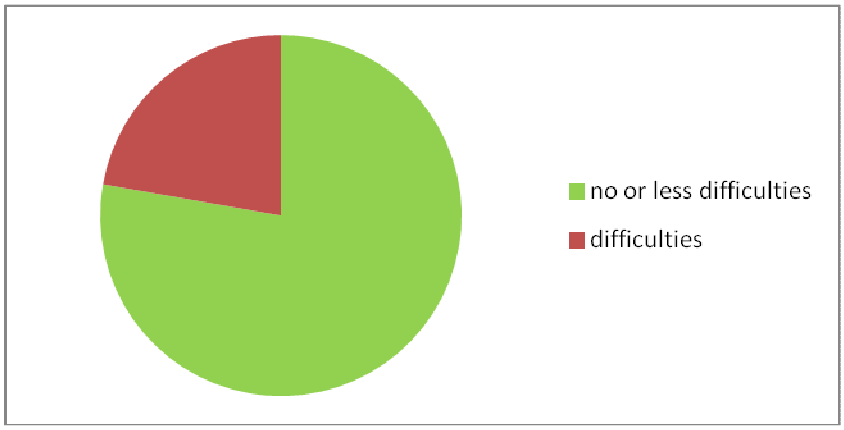


Figure 29 – Expressed usage difficulties while product evaluation and viewing the results report in favour of non-conformity with user expectations.

The 'Setup' button appeared to be misleading for two users. User U9 mistook the button for a 'Back' button.
Two users U4 and U6 suggested the following improvement for the interaction flow by starting the simulation of a task (in words of U6): *"I would prefer that you mark/choose a task and then there is a "Start" button to begin the simulation."*
User U5 claimed, that the wording used in the task selection dialog is not convenient and suggested to add something like 'Please choose' to the dialog.

All the designers agreed, that the colour coding used for the highlighting of the evaluation result statuses was intuitive. Two of them however could agree only to some point and commented as follows. User U6 said: *"At the beginning the colours should be explained. The colours themselves are intuitive, but how they were used was not intuitive. The colours should be used more precise. The difference between red and yellow. It was actually also not clear for red whether the user did it with difficulties or could not make the subtask at all."* User U8 commented: *"How it was used it was not intuitive, so there was not enough differentiation."*

The statement, that "the wording of the recommendations in the text report was understandable" also led to the overall agreement. User U1 commented, *"The reference information is really great!"*
Other comments are

- *"'Text' is not good title. Better would be 'Explanation' or simply put the text without a title."*
- *"The content of the recommendations should be made consistent."*
- *"'Id-Name' was confusing."*

Overall, the language was understandable. However there is a need to improve the language used in the navigation. In order to meet the expectations of designers in this matter, it is necessary to analyse the tools they are using every day with respect to conventions in navigation dialogs.

4.4 Further questions about Virtex

Context selection at the evaluation stage

With one accord all participants agreed that it is important to offer the option to select a usage context while evaluating a product.

Some users responded, that they actually don't get personas from their project managers, but, at the same time, the interfaces should be designed in such manner that they are usable for all users. The possibility to select the different usage contexts at the evaluation stage would be important in particular for this case.

Another comment on that is: *"Just to have a different perspective it is good to see from the perspective of a different user, in a different environment. It's a really good thing!"*

Users U3 to U9 were asked to agree or disagree with the following two statements:

"The selection of the usage context at the product evaluation stage …"

(1) "… helps in dealing with changing requirements."
(2) "… provides a possibility to evaluate a product for different usage context configurations (and not only for a single user in a single environment)."

All seven users agreed with these two statements.

Capability to improve design

All nine users answered "yes' to the question "Can you imagine that a tool like Virtex could help to improve design?"

User U1, who is very experienced in inclusive design, added: *"What strikes me is that you know all this stuff, but simply by the fact that you tend to forget it is good to be reminded of things!"*

Six users however added the following "ifs" and "buts":

- The system should be sufficiently implemented, i.e. all the look and feel issues of the current prototype, which have been described above, should be improved. (U4, U5)
- *"There has to be enough room for creativity. At least the usability wise."* (U8)
- *"I think that the design process before starting sketching and prototyping is much more important: The research, the learning to know the user, trying to think different (Wanna design a mobile, think about communication first!)."* (U7)
- *"But we think that it is very difficult to get all the small details that matters. There are so many details that you have to consider, it is very difficult to translate it into a mathematical equation. … But it can."* (U9)
- *"Meeting real users cannot be replaced by this kind of tool."* (U9)
- User U2 said, *"it could help to improve design a little"* for product designers, but it could help to design products *"truly suitable for old persons, and to reduce design time."*

Further missing features in Virtex

Eight of the nine users explicitly stated that they missed the following features in Virtex:

- Building own tasks
- Control of the evaluation process, e.g. via "Stop" and "Play" buttons
- Full screen
- "Go back" button
- Filtering in the text report
- Exporting the filtered text report into a formatted file for further use
- Show more physical data like dimensions of buttons, which is interesting for mechanical engineers

- More comfortable product selection, e.g. via selection from the list
- Improvement of the animations in terms of fine details
- Three designers noted issues related to the integration into/with the CAD software:
    - *"The big question is how to get this evaluation as early as possible. How to get the design into the system? How to get new products into the system?"* (U1)
    - *"I think Virtex should run like that: The software has to say me after my modifications that the design is OK or not. Real time suggestions!"* (U4)
    - *"That would be nice to change the product and get the evaluation results directly without going back to the CAD software. Virtex could be a plug-in for CAD software."* (U7)

The best and the worst of Virtex

The following aspects and features of Virtex were most popular with the users:

- The result list
- The references in the results
- *"It can be used as a good design guide"* (U2)
- *"The progress list of the subtasks, to follow the progress of the simulation and to know which subtask is currently active."* (U3)
- *"The fact that some visualisation has been provided. I liked the purpose of the software."* (U4)
- *"The diversity of usage scenarios, so I can observe a problem from different perspectives. And the fact, that I can select the context myself."* (U5)
- The virtual usage simulation
- "The possibility to move the camera around the person." (U7)
- "The virtual, but real looking people and real looking environment. So the visuals. If you don't have a background in inclusive design, that you get a feeling about a real person and an environment." (U8)
- User U9 liked *"the overall principle, that you have an idea of having a virtual user testing the product."* However, s/he was reflecting: *"Can I trust the evaluation?"* And s/he added that Virtex cannot replace the evaluation with real users, but probably can be used instead the expert evaluation.

To the question "What did you like less in Virtex?" the users answered the following:

- "There is some level of usability, which needs to be improved, and understanding the results list was also not easy at the beginning, but this is not the major issue. I'm noticing all these details, because I'm working with elderly users, for whom the interface should be very simple. Professionals however, like CAD designers, can accept the low level of intuitiveness." (U1)
- GUI: look & feel. Suggestion: *"The GUI should be similar to Photoshop; it should look clearer and more sophisticated. It shouldn't look like a game."* (U6)
- *"Better quality of the 3d graphics"* (U4)
- *"The quality of the 3d manikin, the animation. It was too coarse."* (U9)
- *"The textual presentation of the recommendations should be visualised, e.g. as charts or pictograms, icons."* (U5)
- *"The useless rendering of the virtual environment and the characters. Focus should be on the main parameters of the evaluation."* (U7)
- *"The application forms a stereotype of the environment and the person. The whole real situation transferred into a virtual situation. It's risky; because you might overlook that the*

real context is transformed into a virtual situation. You might be creating a stereotype." Suggestion: *"There needs to be a borderline, which clearly states, that that's not the reality, but only a virtual model. There has to be a certain level where people don't think that it is a replacement for a real testing."* (U8)

Standalone vs. CAD integration

Five of nine participants think that Virtex should remain a standalone application. The following comments were provided:

- *"I don't work on CAD. So from my perspective it should remain standalone. However I can imagine that it would be helpful to have both. So the CAD designer doesn't need to switch to another application."* (U1)
- "The visualisation can be standalone, but it would be helpful to have the text report within the CAD platform." (U4)
- *"If it would be integrated, it could be convenient. But I think that it is less important. I don't work in CAD environment any more. And I'm not working at the details level that I might be able to provide enough input."* (U9)

Four participants are of the opinion that, to ensure the maximum benefit from Virtex, it should be integrated into the CAD development platform the designers are using. One of these users noted that it would be helpful if there was a simulation package in which any CAD models could be loaded. S/he added that Virtex could be a plug-in of the VICON CAD Design application.

Three designers shared the opinion that Virtex shouldn't be dependent on any CAD development platform, however one of these designers added, *"I'm using SolidWorks. It could be a very helpful plug-in."*

Summarised opinion

Overall, all participants received Virtex positively, as a prototype showing an interesting concept for inclusive design support.

Two users stated that the design recommendations are very useful (U1, U4). The designer U1 emphasised that the general comments and references provided in the results report are especially helpful.

Based on the overall feedback we can assume that the direction in which the development of Virtex has gone so far is appropriate. Two users (U6 and U2) voiced this opinion explicitly. However user U2 thinks that Virtex is suitable to industrial designers/engineers, but not to the product designers or mechanical engineers. S/he explained that augmenting of physical data or constraints is important for work of the last two user groups, however it is not part of the Virtex's functionality yet. User U6 added, *"the stage of the development is not far enough to be useful to professionals."* The last statement is however not surprising, since the software is a rather limited prototype, which was announced to all participants at the beginning of the survey.

User U3 summarised that Virtex is easy to use and helpful in improving design. User U8 said *"Congratulation to you guys – it is amazing work you have done. It is great to have a tool for inclusive design. It is definitely helpful reminding myself while designing a product for certain groups. It is a fantastic tool, definitely. However, Virtex shouldn't replace the reality!"*

The last statement of user U8 corresponds to the opinion of user U9, who responded *"For us, it will be never enough to use a software tool to evaluate a product design, you need to evaluate it yourself and you need to hold it in the hand. The usage details, the small things."*

In summarizing their final thoughts, most of the participants expressed points of criticism as well as praise. The criticism expressed at this point of the questionnaire related to the virtual reality simulation, in particular to the graphic design vocabulary, i.e. the visual language used to depict particular usage aspects during the simulation, and to the authenticity of the simulation. In the following the critical feedback is presented in more detail.

User U1 criticised the fact that the usage visualisation provided only a single way of body pose or movement for each task, however in reality users can move in different ways. User U6 required a possibility *"to specify the user interactions the virtual user should perform. E.g. how the user should grip the product, with the right hand or with the left, etc."* The designer U1 concluded, *"the animation doesn't really add knowledge".*

User U5 questioned the authenticity of the simulation. User U7 revealed a potential reason for such an impression: *"There were a lot of work put into the virtual reality aspects, but it actually should focus on the integration of human data and a scientific visualisation. Maybe there could be produced an output in form of infographics."* Thus, for further development it is critical to overthink the concept of the data visualisation and the graphic design. It is required to find an unambiguous way to depict the nature of the data as well as the meaning of the product evaluation results. By achieving this, such criticism (like that expressed by U9) could probably be avoided: *"The major problem is that it is not have an artificial intelligence. … It could tell you some obvious things, but it could be helpful to designers without prior knowledge in inclusive design."*

5 Analysis of the responses to the VICON virtual user concept

Subsequent to the questions about Virtex the same nine users provided their opinion based on four general statements about VICON's virtual user concept. It is necessary to distinguish between the designers who were already familiar with the virtual user concept of VICON prior to the evaluation of the Virtex application and the designers who only used the Virtex application for the first time during this evaluation. We assume, that designers who are familiar with the concept are probably able to draw more sophisticated criticism than the designers who have only used the Virtex prototype for the evaluation part of the design workflow.

Five designers were already familiar with the virtual user concept of VICON prior to the evaluation of the Virtex application.

The responses of nine designers to four statements which were presented to them are collated below.

Statement 1: "The VICON virtual user concept is capable in supporting the designers in creating inclusive products."

Only one of the five users who are familiar with the VICON concept did not agree with this first statement. S/he explained, *"You could support, but only to a very limited amount. We believe that you need to meet the real users, and you cannot do that in a machine environment."* The explanation suggests that the user does not entirely disagree with the statement, but aims to emphasize the importance of combining the use of the toolset with testing with real end users (beneficiaries).

Another user (U1) replied to the statement: *"It will give a very good reminder to work on inclusive design. ... Also if the designer is well knowledgeable, s/he can forget! For designers with no experience it will be even bigger help."* This opinion suggests that the inclusive design support proposed by VICON may actually help designers to address inclusive design challenges and the implemented system prototype provides additional knowledge to the designers who are not familiar with inclusive design.

Three of four users, who only used the Virtex application, agreed with the statement above. User U6 added, *"If the model has a sufficient amount of parameters, then yes, i.e. all parameters you need to depict disabilities."* This might point out the necessity of further refinement of the VUM.

User U7 could neither agree nor disagree with the following comment. *"It's a tool that can help, but the designer should not trust the software in any case. Otherwise you'll get for ten years always the same stuff. I think inclusive products have to be innovative. And for innovation you need freedom. The database is limiting. Using VICON only as a support of the design process can work, but relying only on the VICON environment can be limiting."*

Statement 2: "The VICON virtual user concept can help to involve the user's perspective into the development process earlier."

Three of the five users, who are familiar with the VICON concept, agreed with this statement. One of these three users (U2) commented that s/he would strongly agree provided that the criticised aspects of the implementation have been addressed. Another user (U8) emphasised, it *"shouldn't*

solely rely on the virtual concept, instead of going to the real people. Inclusive design is not a group of people; you cannot summarize all the individuals! Of course there are personas and categories, but everyone is different."

One of the five users could neither agree nor disagree and commented: *"The sketch tool could have some help, it provide a list with recommendation. But we already have it."* Since this designer is already familiar with inclusive design, the design recommendations do not add knowledge for him/her.

One user, who is familiar with the VICON concept and very familiar with inclusive design, couldn't agree with the statement above. S/he explained, *"The problem is that the model is put rather late. So that is maybe too late or for some parts of the design maybe too late. Labelling and textures can still be adapted, but in order to change some forms there are not enough time and money usually available."* This explanation refers to the fact that in the current implementation of the virtual user concept the usage simulation is provided in a medium separate from the CAD design platform, i.e. in order to run the product evaluation for a product, s/he is designing in a CAD medium, the user has to switch to a standalone application representing another medium. However there is actually a possibility to apply the VICON's rule-based recommendations within the CAD platform. The fact that the user couldn't recall that replying to the statement is an indication that this functionality is probably not appropriately depicted in the VICON CAD design application and/or the entire recommendations-driven approach of VICON is not sufficiently clearly represented in the user interface of the prototypes.

Two users of four, who only used the Virtex application, strongly agreed with the statement. Another two agreed to a point. User U5 commented: *"The focus is not on the time, but on the complex information context, which I as a designer get. Things I have to consider are good packed, it's good platform where I could inform myself and get an overview, also before starting the design."* And User U7 responded: *"Yes, it can, but a good designer should always think about the user's perspective first, before beginning sketching. The question is: Is the data from the database really the user's perspective?"* The last question is probably related to the fact that the ontology does not contain any cognitive aspects and thus cannot provide a full user's perspective.

Statement 3: "The VICON virtual user concept is capable in product development acceleration."

Three of five users, familiar with the virtual user concept of VICON, agreed with this statement. One user could neither agree nor disagree and commented *"It may result even in deceleration. But this is not very negative. It will make better products and that's great! It will make better products, but it will not make it faster."* S/he explained, *"It's a matter of redoing things."* And one user (U9) responded with scepticism to this statement. Between the lines s/he agreed that the concept could lead to product development acceleration, but s/he suspects a simultaneous decrease of product design quality: *"We'll get not so good products, very fast"*. S/he explains, *"Currently the tool is oversimplifying the reality"*, and suggests, *"If you find a way to make it more accurate, some products could be helped, if they are easier to map."*

One of four users, who only used the Virtex application, has abstained. Another three users agreed with the statement. User U7 argued for it as follows: *"You can prevent big faults and big mistakes. You can save money and time by virtual prototyping."*

Statement 4: "The VICON virtual user concept provides knowledge concerning disabilities and derived requirements."

The response to this statement was clearly positive among all users except one, who neither agreed nor disagreed with the comment: *"Well, there was some really good knowledge. The list from the sketch tool is useful, but if you base test on the too limited data, it could mislead the designers in their process."*

Further suggestions for improvement & closing feedback

To complete the interview each participant was asked to share further suggestions for improvement. Six of nine users provided such feedback.

User U2 proposed, the possibility of VICON usage *"in any CAD software. VICON could give us physical data (dimensions, colours, if needs light and sound, forces, ...). This data must be given to the engineers during design (interactive) on time."* This leads to the following ideas for improvement:

1) The existing way of "applying the recommendations" on a given CAD product prototype doesn't provide an adequate support of the design process concerns, i.e. this functionality can remain an additional option. However it cannot be a single product data related information source, which depicts the concrete difference between the current product data and the recommended data.
2) Geometrical data, as a type of physical data, is eventually not properly depicted and accessible. However it is actually provided.
3) Certain standard settings coming from both the product geometry and the recommendations should be inherited by product annotations.
4) Since this question was part of a Virtex session, it may also mean, that to have the evaluation results within the CAD tool is preferable.

Suggestion 4 is supported by the feedback of user U5, who only used the Virtex application, *"I missed an active part of designing! E.g. if I would be designing a mobile phone, I would like to combine the designing part in the CAD program and directly get a visual feedback notifying me about some problems."*

Another user (U7), who also used only the Virtex application, suggested to make Virtex's virtual usage visualisation more abstract, i.e. the VUM data is very detailed so the information representation should be simplified. The product usage visualisation is currently implemented by means of the state-of-the-art 3d virtual reality engine "Unity 3d"[2].

User U6, who used only the Virtex application, missed the possibility in Virtex *"to adjust the parameters of the users, environments etc., i.e. to create your own profiles."* This designer works for small companies of less than 10 persons. There are not always personae defined by the marketing department and there is an easy way needed to define the profiles on the fly.

Another voice for making the VICON software available on multiple platforms comes from user U8: *"The CAD application had a lot of problems installing it. I wish the application would be more available to different platforms. OS X version would be also great! But, thank you to the project, it was an eye opener!"*

[2] http://unity3d.com/

A general suggestion, for improvement of the emerged VICON prototypes, was provided by user U9: *"Whenever there is risk that the information can be misguided, it is best to highlight it well."* S/he emphasised in addition: *"The tools are not able to replace the real user tests. But if you say, this is something that should point out the issues of a product, that need to be tested with real users, then the tool can be really useful."*

6 Conclusions & outlook

The feedback of the designers of both VICON industrial partners DORO and ARCELIK, as well as the external participants provided a valuable basis for ensuring a continuous improvement of the VICON toolset in the final stage of the VICON project.

Overall, both the virtual user concept of VICON and the VICON prototypic toolset were received positively among the designers who participated in the survey.

Two broad categories of information were collected from the participants. One was in relation to the usability of the VICON toolset and the format of presentation of information. The other was in relation to the actual content that the toolset presented to the user. Conclusions for these two categories are discussed below in Sections 6.1 and 6.2, respectively.

6.1 Usability of the VICON toolset

A number of usability issues were identified. Comments regarding the look and feel of the toolset highlight the fact that designers represent not only a very sensitive group of professionals, but also a user group that has learned certain visual language from specific softwares that they use every day for their professional needs, e.g. Adobe Photoshop or Siemens NX. Although the VICON CAD Design application uses the standard GUI elements of the NX environment, other VICON tools utilize their own interactive elements and thus, they look and feel different. The feedback of designers suggests that it is indispensable to hire graphic and interaction designers that will intentionally create the overall appearance of the software intended to be used by designers.

There are several concrete suggestions for improvement that have been proposed by the designers both for the entire virtual user concept and for the three prototypic applications.

Virtual user modelling provides a new yet relatively rare dimension to product development and the virtual user concept of VICON proposes a new approach for VUM application, namely recommendations-driven inclusive design support. So it is important to clearly highlight (by means of interaction and GUI design) the exact meaning of provided information and the significance of it for the product that is being designed. In order to avoid misguidance, it is important e.g. to clearly depict that the design support is driven by the recommendation during all design phases; it is important to highlight the precision of the data and the results as well as their exact meaning in the context of the VUM and the given product design. These are design tasks which can be considered in future work.

In the sketch and CAD phases the majority of the designers experienced minor technical problems while installing the software, mainly due to system compatibility issues. However, once these issues were addressed, the VICON sketch application and CAD annotation tool were considered easy to use by the majority of the users.

Although the design recommendations were overall perceived as useful for realising inclusive designs, further improvements of the VICON toolset can be achieved when the VICON profiles of the Virtual User Model would be organized and grouped in a more structured way. Another vital point, which can be taken into consideration for improving the Virtual User Model in future projects,

is that some redundancies have been identified for the design recommendation and as a consequence the same design improvements were recommended several times.

Another identified subject for improvement is that it took relatively long for the designers when going through the design recommendations list. For revising this matter, the participants suggested a more adequate approach for grouping or sorting the recommendations based on their properties, such as importance, in order to achieve a higher degree of comprehension and usability.

Besides some minor usability and look and feel issues, the evaluation application Virtex was generally well accepted. The majority of the designers found the textual evaluation report clear structured, understandable and informative. The references for further reading were appreciated. Some designers however criticised the virtual usage simulation and requested a more "scientific" visualisation, which would depict usage difficulties with exactly the same precision as the VUM provides. These designers explained their opinion with the example that the current virtual environment visualisation composes furniture, which is actually not part of the VUM and thus distracts the attention from the main data really used in the simulation. On the contrary other designers liked the 3d environment. It would therefore be feasible to rethink the concept of the product usage visualisation in future work.

One of the most important conclusions is that the VICON toolset integrates smoothly within the usual design workflow and is not cumbersome for designers in their work. A clear majority of the survey participants responded that the internal workflow of VICON toolset was clear and straightforward. However opinions on the idea of integrating the evaluation application Virtex, which is currently standalone, into the CAD design environment were divided. Since some designers don't work with CAD tools, they expect a standalone product evaluation tool. But some designers desire the product evaluation section to be integrated within their usual work environment, namely CAD, because they prefer immediate feedback to their product design modifications.

6.2 Evaluation of the content

It could be confirmed that when implementing inclusive designs, the VICON toolset provided an appropriate spectrum of information for most of the designers and product engineers who participated in the VICON evaluation. However it is important to note that VICON focussed only on hearing, vision and manual dexterity, so the information provided to designers only addressed inclusive design issues under those categories. Cognitive issues and the complex interaction between cognitive, sensory and physical inclusive design issues were not addressed.

Some of the designers' comments provide evidence that the inclusive design support proposed by VICON is actually able to help designers in addressing particular inclusive design challenges and the prototypic implementation provides additional knowledge to designers who are not familiar with inclusive design.

It should be noted that the VICON toolset is, in essence, an educational tool. It is presenting information to users (designers) that in some cases might be familiar and in other cases might be new. Approximately half of the participants considered themselves to be either "not at all familiar", "moderately familiar" or "slightly familiar" with inclusive design. Furthermore there was no way of confirming that those participants who claimed to be "familiar" or "very familiar" with inclusive design did indeed have a full understanding of inclusive design. Therefore the participant's opinion on what is a sufficient amount of information should be treated with caution.

As a number of designers emphasised that meeting real end users (beneficiaries) cannot be entirely replaced by software tools, we cannot omit this statement from our conclusion. The majority of the designers confirm our belief that the virtual user concept of VICON is capable of product development acceleration. However the risk of oversimplifying the reality should be considered. We believe that the VICON system is capable of assisting designers to avoid faults in inclusive design related to particular disabilities (i.e. in this case hearing, vision and manual dexterity). However, due to the complexity of interaction between a person and a product (relating to cognitive, sensory and physical end user attributes), it cannot be denied that product evaluation with real users is still necessary.

7 Acknowledgement

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APPENDIX A Questionnaire for the end-user evaluation of the Sketch & CAD Design applications

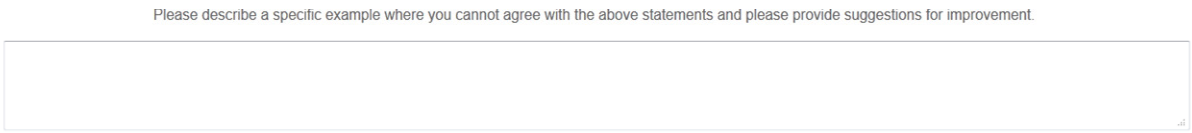
The evaluation questionnaire is based upon the ISO Norm 9241-110, but adapted to our special context. The ISO Norm 9241-110 questionnaire there exist 2 versions – a short version (ISO Norm 9241-110S) for a summative evaluation, and a long version (ISO Norm 9241-110L) for a formative evaluation. Since the evaluation takes place during the prototype phase of the VICON software development. The questionnaire is adapted according to the long version.

In the questionnaire, the requirements of the ISO/Norm 9241/110 will be concretized through descriptions.

For each answer, a five-rated color scheme is used, from very negative (red) to very positive (green). Here is an example:

Users also have the possibility to skip a question if they are not able to answer a certain question or if a question is not applicable for some reasons.

Finally, in order to pinpoint weaknesses concerning the items in the questions, the designers are asked to write down aspects of the software which, in their opinion, are subject to improvement.



When possible, a specific example was to be provided, accompanied by the specific suggestions for improvement.

In the following section the sequence of the questionnaire for the sketch design application and CAD application is introduced.

To enter the online questionnaire, the user is asked to use the following link:

http://134.102.95.211/eval/index.php

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Questionnaire for the evaluation of the VICON framework (sketch design and CAD phase)

This study is part of an european funded research project called VICON. The project is investigating the potential of user modelling for designing inclusive products.
This questionnaire is completely voluntary. You may decline to answer any question or stop filling in the questionnaire at any time and for any reason. When the data is shared, described or interpreted, there will be nothing on it to identify you or your company. All data will be held confidentially and anonymously.
It is not necessary to have any CAD software installed.
If you have any questions or additional feedback, don't hesitate to contact by E-Mail.

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Participation Agreement

Please indicate your agreement with the following by ticking Yes:

"I understand the information I have been given above and I am happy that the anonymous feedback I provide will be used for the VICON project."

- (•) YES
- ( ) NO

Date: Monday 25th February 2013

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Questions related to your company and pre-experience

The following questions will be used to determine the size of your company and your personal experience in the design field.

In which company do you work?
- ( ) Arcelik
- ( ) Doro
- (•) Other

How knowledgeable would you say you are in regard to inclusive design?
- ( ) not at all familiar
- ( ) slightly familiar
- ( ) moderately familiar
- (•) familiar
- ( ) very familiar

How knowledgeable would you say you are in regard to Virtual User Modelling (VUM)?
- ( ) not at all familiar
- ( ) slightly familiar
- ( ) moderately familiar
- (•) familiar
- ( ) very familiar

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Questions related to your company and pre-experience

The following questions will be used to determine the method of customer involvment.

Please choose the following options, if applicable. If there is no customer involvement, please continue.

- [x] We start with a check list for the design about what key features are needed and use this list through the complete design process (QFD).
- [ ] We create (non-functional) prototypes and evaluate them with our customers (user-oriented product development).
- [ ] We evaluate our first sketches with our customers directly (concept testing).
- [ ] We evaluate first functional prototypes with customers (beta testing).
- [ ] Groups of target customers create first designs with support by our designers (consumer idealized design).
- [ ] Users, who face needs directly and benefit most by our products, design our products (lead user method)
- [ ] We do not have any comitted designers at all and create the product design by other workers and customers (participatory ergonomics).

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Installation

In this step you can choose, if you want to install and use the software below or not. If not, you decide by using pictures of the appication.

1. Please download and install the software by starting the executable file.
2. If you do not have Siemens NX installed, the install wizard will present a warning during the installation. The software consists of the Sketch Application but also a integrated module within the CAD software Siemens NX.
3. You will need JAVA to be installed. You can download it from here
4. Start the software by using the installed start menu entry (Start > All Programs > Vicon Framework > Sketch Application).

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Installation

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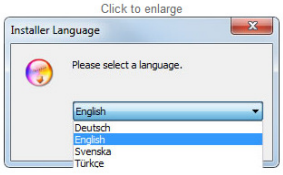

On the left side you can see the start of the Install-Wizard of the complete framework.
It was implemented with the fact, that the framework contains different parts and the user does not need to install every part manually.
In the first screen it is also possible to select a different language for the installer. The framework software is currently only available in english, the install languages are currently available german, english, swedish and turkish.

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Installation

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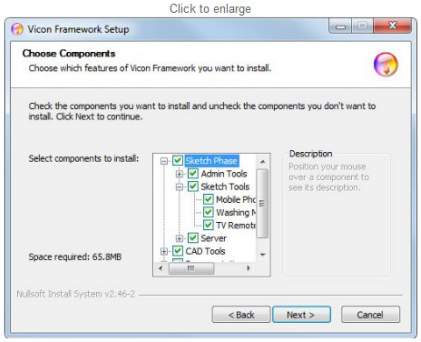

The user is also able to select each specific component for each software part of the system, which is necessary for their current work.
The selections are:

- Sketch Phase including Admin Tools to manipulate the ontology. This component also include the server which provides all information to each front end application
- CAD Tools, especially the integrated Plugin, which will only be installed, if the installer can find a working copy of Siemens NX
- End-User Documentation files, for each application PDF files can be included

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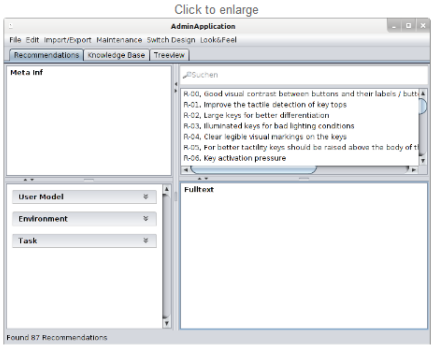
Sketch Design Application

Click to enlarge



The application is linked in the Start Menu *All Programs > Vicon Framework > Sketch Application*. It takes a while to start. Afterwards a new window should be presented, which looks similar to the left picture.

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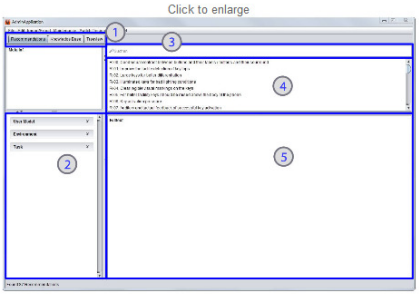
Sketch Design Application

Click to enlarge



The window is seperated as followed:

1. 3 Different tabs, for this evaluation only the *Recommendations* tab is relevant. *Knowledge base* is for the manipulation of the back end and *Treeview* for a visual representation of the current ontology behind
2. Your input. In this field you can select User Models as a representative for a target group, typical Environments and typical Tasks connected to the product. A multiselection is also possible.
3. This is the search field where you can search in the summary of recommendations for different tags (e.g. buttons).
4. A list including all recommendations based on the current selection of *User Model*, *Environment* and *Task*.
5. The full text of one single recommendation. In includes a name, required impairment profiles, source, summary and a text containing relevant information.

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Progress 33 %

Sketch Design Application

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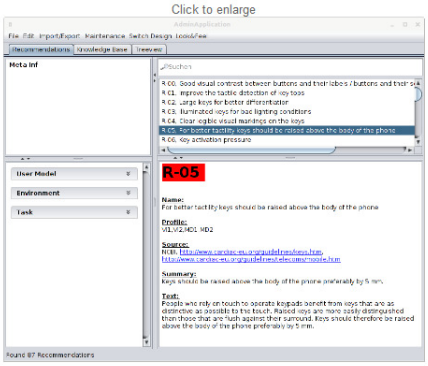

The left side presents a view on a single recommendation as previously mentioned. In this example, recommendation source is defined as: Cardiac-EU.

If you look at the source website, there is quite much information about user impairments and design guidelines. This data, which is based upon user studies, is extracted and included into the presented tool.

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Progress 37 %

Sketch Application

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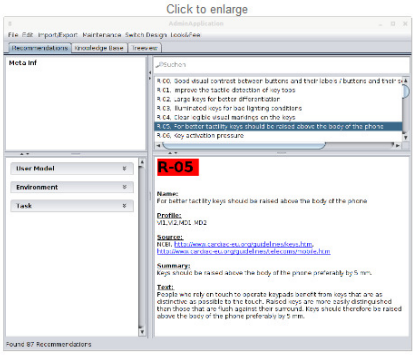

Imagine you are the lead designer of a **mobile phone product**, which should be especially designed for **moderate hearing and manual dexterity impaired** customers.

In the application, mass customization was used for the specification of different target groups of customers. This means, that each **User Model** contains average values for a specific target group (e.g. MDProfile2 means the average customer, which is moderate manual dexterity impaired, MDProfile1 is for mild manual dexterity impairments). The focus lies upon impairments of hearing (H), visual(V) and manual dexterity(MD).

The other user input deals with the selection of **typical environments**, where the product can be used and **typical tasks** which can be performed.

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Progress
41 %

Sketch Application

Click to enlarge

Eileen (69)

Eileen retired a few years ago, at the same time as her husband. She has mild/moderate hearing and manual dexterity impairments, but they don't affect her everyday life. She does not wear a hearing aid but is aware that she is listening to the TV much louder these days and would probably benefit from a hearing aid. She has no visual loss, so does not wear glasses or contact lenses.

Eileen is generally healthy and active. In the week she helps look after her young grandchildren and at weekends she enjoys travelling and gardening with her husband.

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Progress
44 %

Sketch Application

Click to enlarge

The User Model *Eileen* is used as a fictional representative for one specific target group of customers.

Now back to the question: You are the lead designer for a product for hearing and manual dexterity impairment people like *Eileen*. **How do you know what is important for the design, if you do not have any experience with products for impaired people?**

First option: You google it... Afterwards you will find websites like Cardiac EU.org which presents guidelines in relation to the design.

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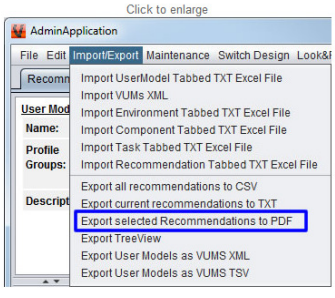
Progress
48 %

Sketch Application

Click to enlarge



Using the application, designers are able to get only important contextual information for their target customer group. In case of Eileen, who is the representative for the exact target customer group you deal with, you would get the current output from the Sketch Application: Get Recommendations as PDF.
The PDF File was exported using the feature *Export selected Recommendations to PDF* of the application. There are also other export options implemented, but these are currently not relevant.

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Progress
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Sketch Application Questions

Please take some time to answer the questions below. It is measured as a scale between the options on left and right.

The installation was simple and i could manage it without any problems	○	○	○	○	○	The installation was rather complicated	Skip ○
It was easy to start	○	○	○	○	○	I had problems with the start of the applications	Skip ○
I could use the software easily	○	○	○	○	○	I had problems using the application	Skip ○
I could manage to get the recommendations i needed	○	○	○	○	○	I could not manage to get the recommendations i needed	Skip ○
The software was very intuitive and i didn't need much time to master it	○	○	○	○	○	I needed a very long time to understand, how to use the software	Skip ○
It was easy to learn about user needs without prior knowledge	○	○	○	○	○	It was difficult to understand what was the aim of the software	Skip ○
I could use the software without the user manual	○	○	○	○	○	I would need an user manual to use the software	Skip ○
The look of the application was suitable and pleasant	○	○	○	○	○	The look and feel of the application inappropriate	Skip ○

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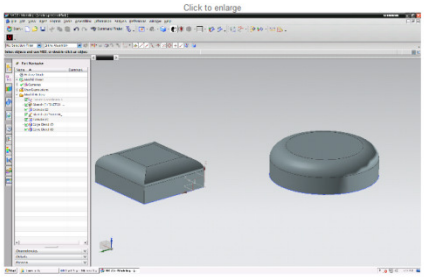
CAD Module

Click to enlarge



The CAD module, which is part of the software, is integrated into Siemens NX. The aim of the evaluation is to support designers during the whole product development process. Also one main aspect of this, is to be as unobtrusive as possible for the designers. So a module was implemented, using api (application programming interface) of Siemens NX to access and manipulate the virtual prototype.
The picture left presents the interface of Siemens NX when designing 2 different buttons. In the top bar, an icon was integrated to start the CAD module.

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Progress
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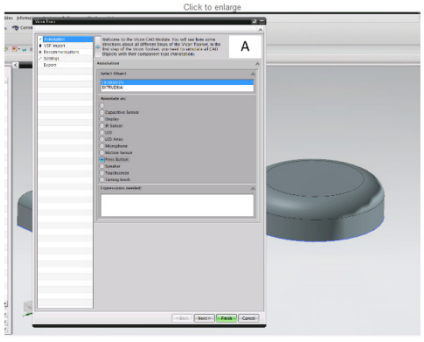
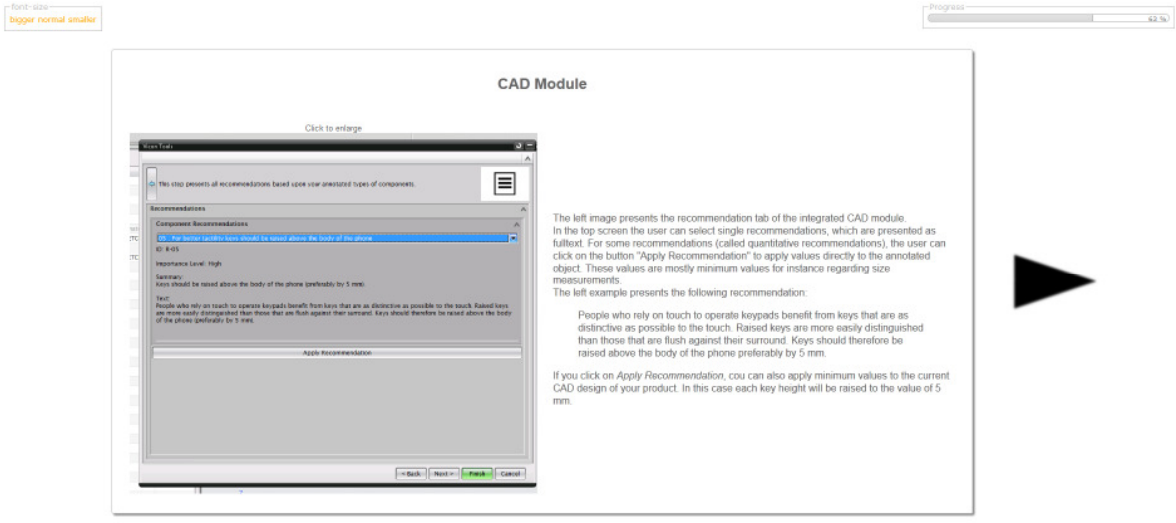
CAD Module

Click to enlarge



After clicking on the CAD module button, different views are available (for this questionairre only annotation and recommendation tab is relevant). In the annotation tab (left), the designer is able to connect the created virtual objects with a functionality. The steps are as following:

1. Start the module
2. Add context information about the functionality of different virtual objects (annotations)
3. Add context information about the selections of *User Model*, *Environment* and *Task* by importing a VSF file into the CAD module. These files can be exported from the Sketch Design Application.
4. From your selections, the recommendation list is populated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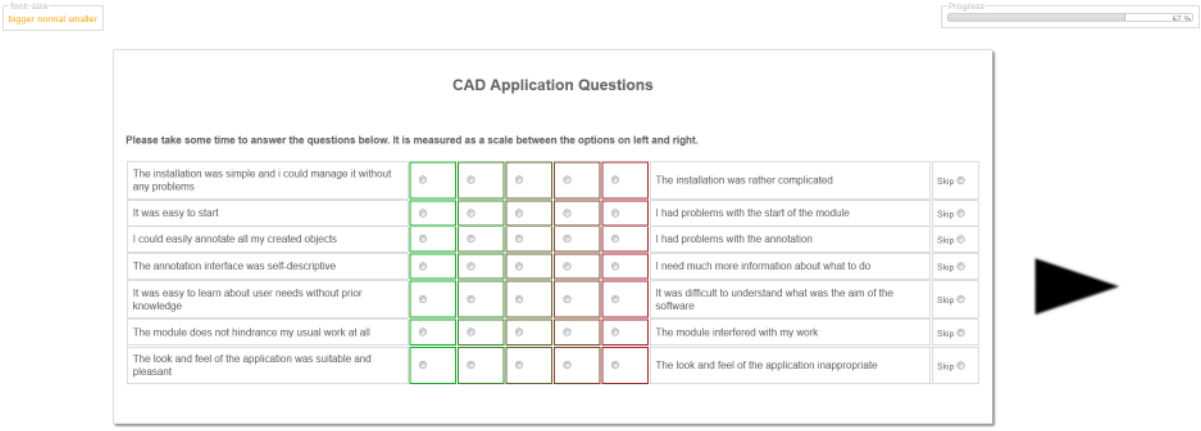
Progress
CAD Module
Click to enlarge
The left image presents the recommendation tab of the integrated CAD module.
In the top screen the user can select single recommendations, which are presented as fulltext. For some recommendations (called quantitative recommendations), the user can click on the button "Apply Recommendation" to apply values directly to the annotated object. These values are mostly minimum values for instance regarding size measurements.
The left example presents the following recommendation:
People who rely on touch to operate keypads benefit from keys that are as distinctive as possible to the touch. Raised keys are more easily distinguished than those that are flush against their surround. Keys should therefore be raised above the body of the phone preferably by 5 mm.
If you click on Apply Recommendation, cou can also apply minimum values to the current CAD design of your product. In this case each key height will be raised to the value of 5 mm.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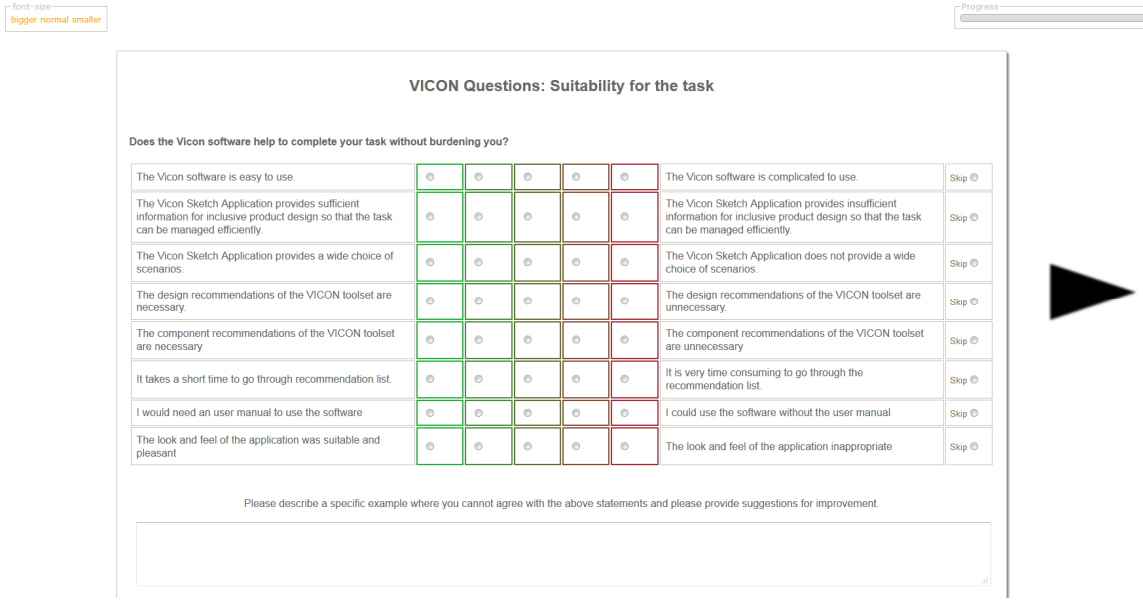
Progress
CAD Application Questions
Please take some time to answer the questions below. It is measured as a scale between the options on left and right.
The installation was simple and i could manage it without any problems
The installation was rather complicated
Skip
It was easy to start
I had problems with the start of the module
Skip
I could easily annotate all my created objects
I had problems with the annotation
Skip
The annotation interface was self-descriptive
I need much more information about what to do
Skip
It was easy to learn about user needs without prior knowledge
It was difficult to understand what was the aim of the software
Skip
The module does not hindrance my usual work at all
The module interfered with my work
Skip
The look and feel of the application was suitable and pleasant
The look and feel of the application inappropriate
Skip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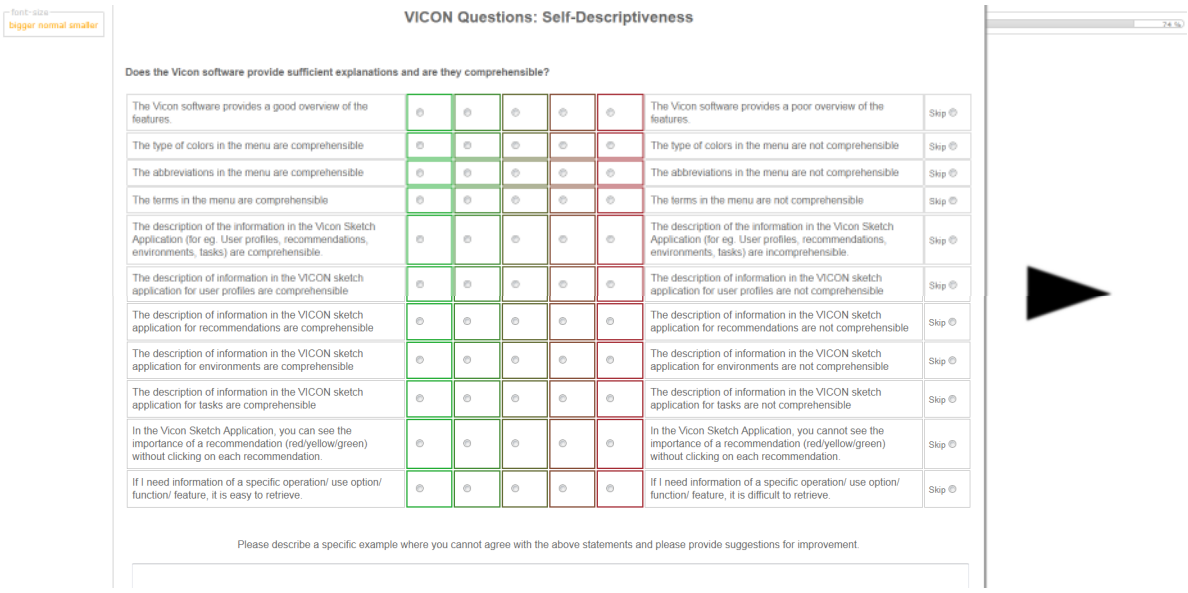
Progress
VICON Questions: Suitability for the task
Does the Vicon software help to complete your task without burdening you?
The Vicon software is easy to use.
The Vicon software is complicated to use.
Skip
The Vicon Sketch Application provides sufficient information for inclusive product design so that the task can be managed efficiently.
The Vicon Sketch Application provides insufficient information for inclusive product design so that the task can be managed efficiently.
The Vicon Sketch Application provides a wide choice of scenarios.
The Vicon Sketch Application does not provide a wide choice of scenarios.
The design recommendations of the VICON toolset are necessary.
The design recommendations of the VICON toolset are unnecessary.
The component recommendations of the VICON toolset are necessary
The component recommendations of the VICON toolset are unnecessary
It takes a short time to go through recommendation list.
It is very time consuming to go through the recommendation list.
I would need an user manual to use the software
I could use the software without the user manual
The look and feel of the application was suitable and pleasant
The look and feel of the application inappropriate
Please describe a specific example where you cannot agree with the above statements and please provide suggestions for improvement.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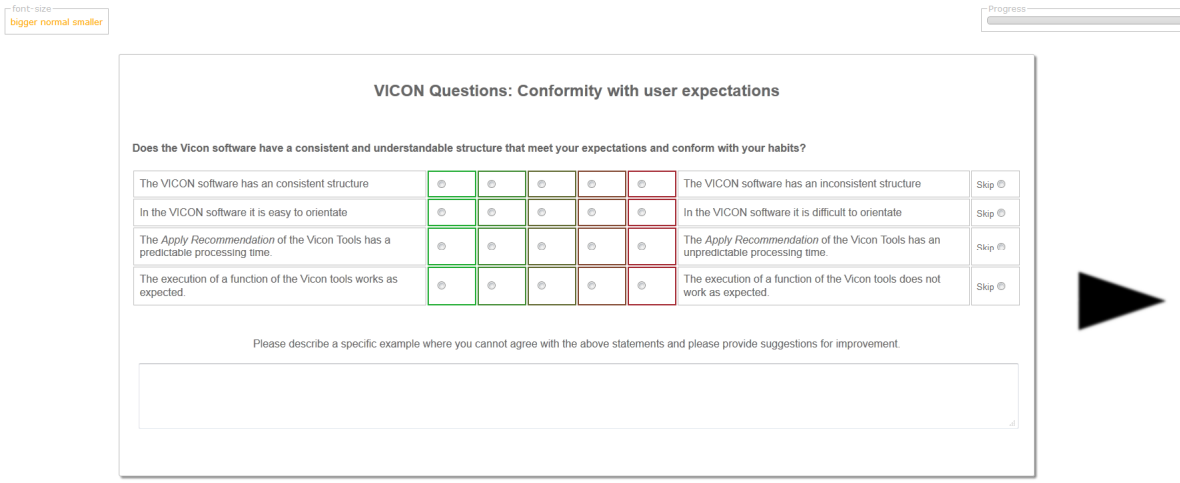
VICON Questions: Self-Descriptiveness
Does the Vicon software provide sufficient explanations and are they comprehensible?
The Vicon software provides a good overview of the features.
The Vicon software provides a poor overview of the features.
Skip
The type of colors in the menu are comprehensible
The type of colors in the menu are not comprehensible
The abbreviations in the menu are comprehensible
The abbreviations in the menu are not comprehensible
The terms in the menu are comprehensible
The terms in the menu are not comprehensible
The description of the information in the Vicon Sketch Application (for eg. User profiles, recommendations, environments, tasks) are comprehensible.
The description of the information in the Vicon Sketch Application (for eg. User profiles, recommendations, environments, tasks) are incomprehensible.
The description of information in the VICON sketch application for user profiles are comprehensible
The description of information in the VICON sketch application for user profiles are not comprehensible
The description of information in the VICON sketch application for recommendations are comprehensible
The description of information in the VICON sketch application for recommendations are not comprehensible
The description of information in the VICON sketch application for environments are comprehensible
The description of information in the VICON sketch application for environments are not comprehensible
The description of information in the VICON sketch application for tasks are comprehensible
The description of information in the VICON sketch application for tasks are not comprehensible
In the Vicon Sketch Application, you can see the importance of a recommendation (red/yellow/green) without clicking on each recommendation.
In the Vicon Sketch Application, you cannot see the importance of a recommendation (red/yellow/green) without clicking on each recommendation.
If I need information of a specific operation/ use option/ function/ feature, it is easy to retrieve.
If I need information of a specific operation/ use option/ function/ feature, it is difficult to retrieve.
Please describe a specific example where you cannot agree with the above statements and please provide suggestions for improvement.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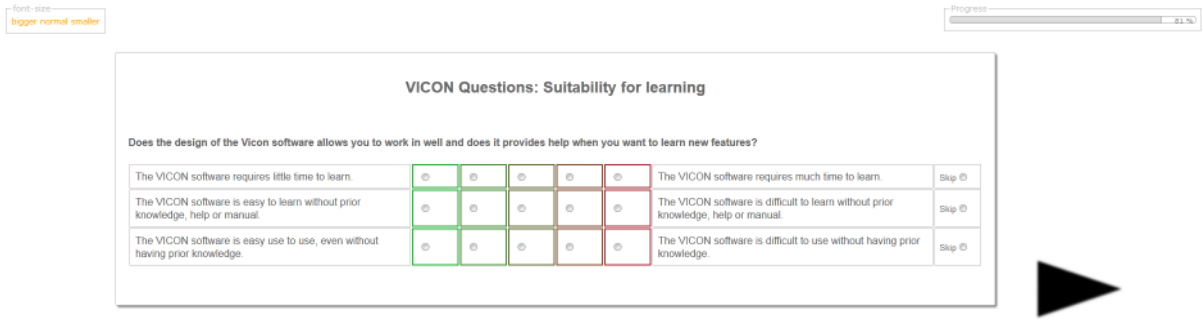
Progress
VICON Questions: Conformity with user expectations
Does the Vicon software have a consistent and understandable structure that meet your expectations and conform with your habits?
The VICON software has an consistent structure
The VICON software has an inconsistent structure
Skip
In the VICON software it is easy to orientate
In the VICON software it is difficult to orientate
Skip
The Apply Recommendation of the Vicon Tools has a predictable processing time.
The Apply Recommendation of the Vicon Tools has an unpredictable processing time.
Skip
The execution of a function of the Vicon tools works as expected.
The execution of a function of the Vicon tools does not work as expected.
Skip
Please describe a specific example where you cannot agree with the above statements and please provide suggestions for improvement.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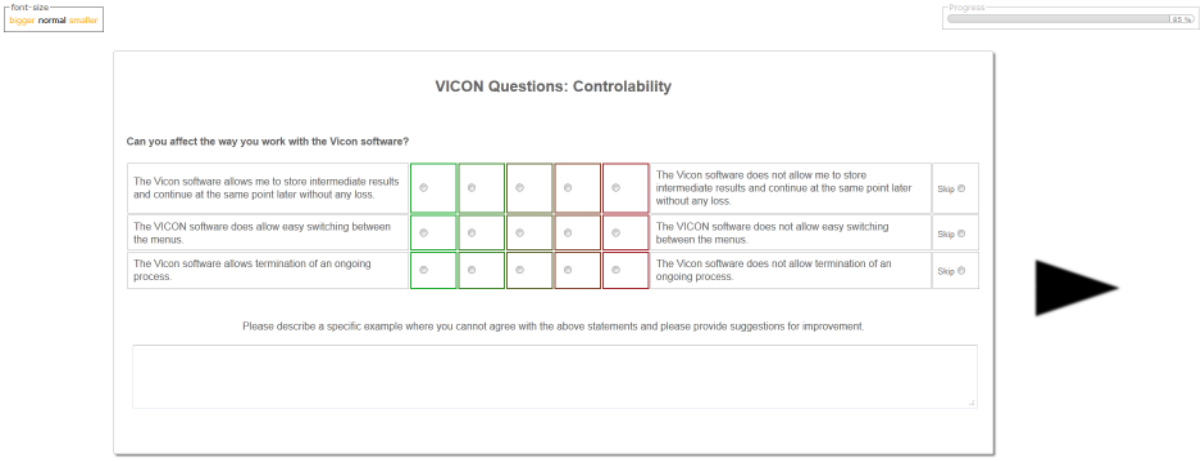
Progress
81 %
VICON Questions: Suitability for learning
Does the design of the Vicon software allows you to work in well and does it provides help when you want to learn new features?
The VICON software requires little time to learn.
The VICON software requires much time to learn.
Skip
The VICON software is easy to learn without prior knowledge, help or manual.
The VICON software is difficult to learn without prior knowledge, help or manual.
Skip
The VICON software is easy use to use, even without having prior knowledge.
The VICON software is difficult to use without having prior knowledge.
Skip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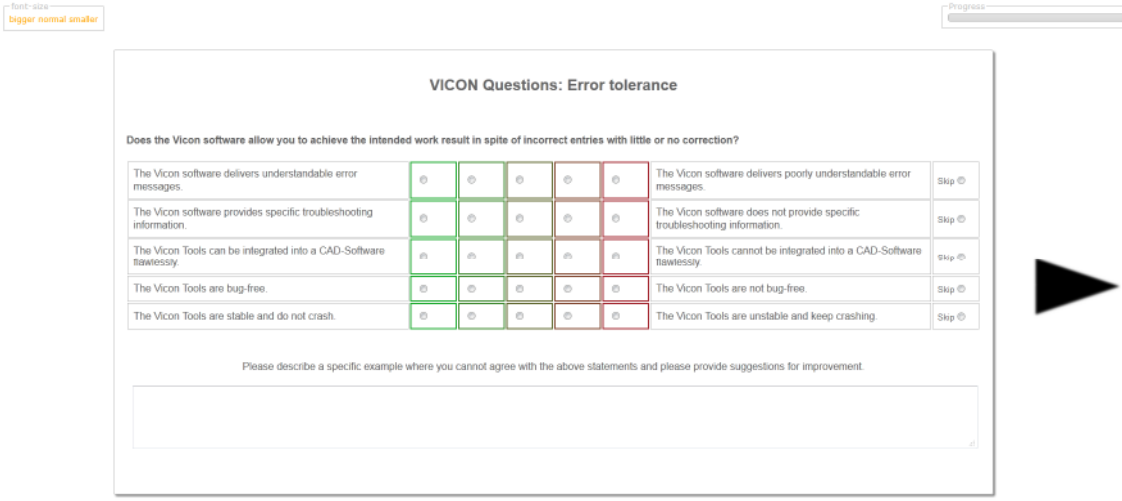
Progress
85 %
VICON Questions: Controlability
Can you affect the way you work with the Vicon software?
The Vicon software allows me to store intermediate results and continue at the same point later without any loss.
The Vicon software does not allow me to store intermediate results and continue at the same point later without any loss.
Skip
The VICON software does allow easy switching between the menus.
The VICON software does not allow easy switching between the menus.
Skip
The Vicon software allows termination of an ongoing process.
The Vicon software does not allow termination of an ongoing process.
Skip
Please describe a specific example where you cannot agree with the above statements and please provide suggestions for improvement.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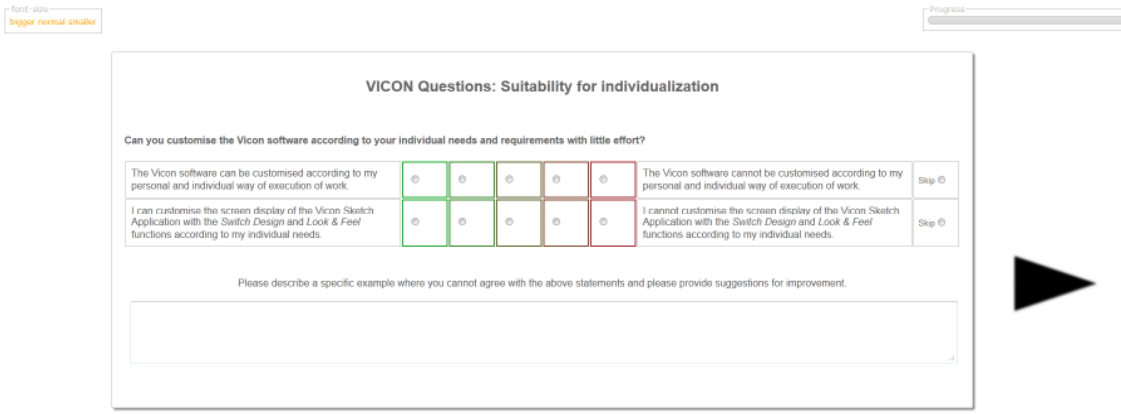
Progress
VICON Questions: Error tolerance
Does the Vicon software allow you to achieve the intended work result in spite of incorrect entries with little or no correction?
The Vicon software delivers understandable error messages.
The Vicon software delivers poorly understandable error messages.
Skip
The Vicon software provides specific troubleshooting information.
The Vicon software does not provide specific troubleshooting information.
Skip
The Vicon Tools can be integrated into a CAD-Software flawlessly.
The Vicon Tools cannot be integrated into a CAD-Software flawlessly.
Skip
The Vicon Tools are bug-free.
The Vicon Tools are not bug-free.
Skip
The Vicon Tools are stable and do not crash.
The Vicon Tools are unstable and keep crashing.
Skip
Please describe a specific example where you cannot agree with the above statements and please provide suggestions for improvement.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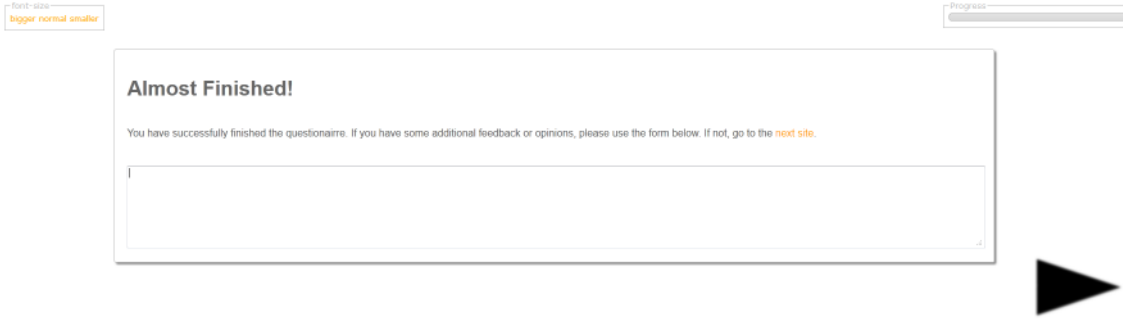
Progress
VICON Questions: Suitability for individualization
Can you customise the Vicon software according to your individual needs and requirements with little effort?
The Vicon software can be customised according to my personal and individual way of execution of work.
The Vicon software cannot be customised according to my personal and individual way of execution of work.
Skip
I can customise the screen display of the Vicon Sketch Application with the Switch Design and Look & Feel functions according to my individual needs.
I cannot customise the screen display of the Vicon Sketch Application with the Switch Design and Look & Feel functions according to my individual needs.
Skip
Please describe a specific example where you cannot agree with the above statements and please provide suggestions for improvement.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Progress
Almost Finished!
You have successfully finished the questionairre. If you have some additional feedback or opinions, please use the form below. If not, go to the next site.

APPENDIX B Questionnaire for the end-user evaluation of the Virtex application

The Virtex questionnaire served as a basis for the telephone interviews, in order to collect qualitative feedback on the application and on the general VICON virtual user concept.

B.1 Virtex questionnaire part I (screening)

This questionnaire has been handed out to the designers prior to the testing of the software.

VICON Task 4.2 Questionnaire Virtex Evaluation by End-Users (Part I)

This study is part of a European funded research project called VICON. The project is investigating the potential of user modelling for designing inclusive products.

This questionnaire is completely voluntary. When the data is shared, described or interpreted, there will be nothing on it to identify you or your company. All data will be held confidentially and anonymously.

The questionnaire is about convenience of the virtual user approach and its prototypic software realisation for the design process. In particular it is about the convenience of the product evaluation prototype called *Virtex*, which evaluates a product design for inclusion.

The questionnaire consists of two parts: (I) the present part is about the participant's background, (II) and the second part aims to collect feedback to the software prototype the participant has tested. The part I of the questionnaire is filled out before participants begin testing the software.

7.1.1.1 Please indicate your agreement with the following by ticking "Yes":

"I understand the information I have been given above and I am happy that the anonymous feedback I provide will be used to inform the VICON project."

Yes ☐

No ☐

Date:

What is your position at your company:

Please choose **one or more** options

- ☐ Product developer
- ☐ Designer
- ☐ Usability engineer
- ☐ Project manager
- ☐ Quality manager
- ☐ Head of department
- ☐ Head of business unit
- ☐ Research and technology
- ☐ Other, please state:

How long have you been working in this field?

Years

What is the size of the company you work for?

- ☐ < 10
- ☐ < 50
- ☐ < 250
- ☐ > 250

---

1. How knowledgeable would you say you are in regard to inclusive design?

   Please choose only **one option**:

   - ☐ not at all familiar
   - ☐ slightly familiar
   - ☐ moderately familiar
   - ☐ familiar
   - ☐ very familiar

2. How knowledgeable would you say you are in regard to virtual user modelling (VUM)?

Please choose only **one option**:

☐ not at all familiar
☐ slightly familiar
☐ moderately familiar
☐ familiar
☐ very familiar

B.2 Instructions for testing Virtex

The instructions have been given to the designers in order to guide them during the evaluation and provide a certain level of similarity in the overall evaluation.

VICON Task 4.2 Instructions

Introduction

The general objective of T4.2 is to evaluate the usability and the functionality of the prototypic VICON software tools and to propose suggestions for improvement.

The Vicon software is a prototype of a comprehensive framework for inclusive design support. It currently provides designers with three software applications. Each application aims to support a designer at a specific stage of the design process:

(1) The standalone VICON Sketch Application provides inclusive design recommendations at the sketch stage.

(2) The VICON CAD Application, which is integrated into the CAD software SiemensNX, provides inclusive design recommendations based upon an existing 3d product prototype at the CAD design stage.

(3) The standalone Virtex application (stands for VIRTual EXperience) aims to support the product design refinement iterations by offering a virtual usage simulation of the 3d product design.

All these three tools are connected to a virtual user model (VUM), which contains software models of real world users, environments and product components connected by certain relationships. They can be used to assess potential usability issues of prototype products for various user groups. The VUM in VICON is limited to usability aspects of elderly population.

The objective of this particular questionnaire is to evaluate only the prototypic usage simulation software of the VICON approach, i.e. the Virtex application.

Evaluation procedure

The section *Instructions* defines testing scenarios. They should help you to evaluate the Virtex application and provide certain similarity in the overall evaluation. So please follow these scenarios. Afterwards please feel free to explore the software further.

Each testing scenario defines an initial situation and a task you have to accomplish.

Instructions

Scenario A

Initial situation

Imagine that your company has engaged you to design a mobile phone, which should be accessible by elderly users with mild to moderate hearing, vision and manual dexterity disabilities. The mobile phone should also be accessible for users wearing hearing aids. This user group is represented by the virtual user 'Mark' of the VICON's virtual user model.

You have already created a sketch and a 3d CAD design using the two VICON tools: the VICON Sketch Application and the VICON CAD Application. The data coming from the VICON CAD Application is saved in the file **DoroVICON.xml**.

Task

Please evaluate the 3d mobile phone design with the working name "DoroVICON" for the virtual user Mark in the environment 'Living Room'. Please let Mark simulate the task "Receive a phone call".

Scenario B

Initial situation

Imagine that you have been designing a washing machine with the support of the VICON software prototype. The target user group are the users with moderate manual dexterity disabilities and vision loss. The virtual user 'Gandalf' has accompanied you along with the first two design phases.

The target environment for the washing machine is 'Bathroom'.

The data coming from the VICON CAD Design Application is saved in the file **ArcelikVICON.xml**.

Task

Please evaluate the 3d washing machine design with the working name "ArcelikVICON" for the virtual user Gandalf and the task "Set wash programme 'Hand Wash'".

B.3 Virtex' user manual

The user manual for Virtex has been handed out to the designers as part of the software. See next page.

VIRTEX
USAGE HINTS

System Requirements

- Windows XP or later
- Pretty much any 3D graphics card

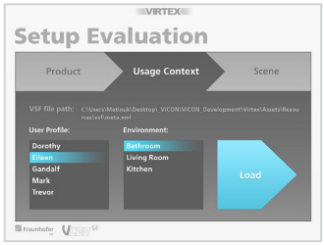
Starting Application

To run the VIRTEX application please ensure that both *Virtex.exe* file and *Virtex_Data* folder are placed in the same directory.

Using the »Setup Evaluation« Menu

The main menu consists of three screens in a sequence:
1) *Product* data specification
2) *Usage context* selection
3) Loading *scene* screen showing a summary of selected data while a scene is loading

The following three figures show the three screens of the *Setup Evaluation* menu.



The *Setup Evaluation* menu is used for linking the evaluation procedure to a product and its usage context.

Product Data Specification

In the first menu screen a user can specify a product to be evaluated. This is done by specifying a file path of the product's meta data file, created by the *VICON CAD Design Application*, in the *VSF file path* text input field.

The abbreviation *VSF* stands for *Vicon Status File*. In the current version of the software the VSF is a XML file. So the software expects the file name ending "**.xml**".

By default, the file path is preset to the meta data file of the Doro VICON prototype.

HINT
To edit the name of the file in the »VSF file path« text input field please **click twice** on the text position where you want to start editing.

Currently Available Products
There are three products available at the moment: one washing machine and two mobile phones. Their exemplary product data are stored in the meta-files available in the folder *Virtex_Data/Resources*. For the names of the files please refer to the table below.

Product Description	VSF File Name
Arcelik VICON prototype of a washing machine	**ArcelikVICON.xml**
Doro VICON prototype of a mobile phone	**DoroVICON.xml**
Doro 332gsm mobile phone	**Doro332gsm.xml**

After the meta data file of the product is specified, it can be loaded by pressing *Load File* button. As soon as the file is loaded the application can connect to the VICON's ontology server and retrieve all available user and environment profiles.

Current Limitations
No cursor symbol appears in the VSF file path input field while it has been activated by a mouse click.

Usage Context Selection and Loading the Evaluation Scene

The second *Setup Evaluation* menu screen is used for selecting one user and one environment from two appropriate lists. A user and an environment together are forming the *usage context* of the product. The personas for the five available virtual users are described in the Appendix of this document.

After the product and its usage context have been specified, a 3d evaluation scene can be loaded. While this is happening the *Scene* screen is shown.

Task Simulation

The task simulation can be started within the 3d scene by selecting a task from the interactive *Tasks* list. The progress of the simulation is presented in the two 3d views – 3rd-Person-

Perspective and 1st-Person-Perspective – as well as in the *Subtasks* list, which appears after the simulation has started.

You can enlarge the smaller 3d view in the top left corner by pressing the button with the magnifie symbol : 

The *Subtasks* list shows an ordered sequence of subtasks composing the selected task. Each subtask represents an evaluation unit, which is independent from other subtasks.

During the simulation the subtasks, which have been already tested are highlighted according to the status of the simulaiton result. Currently processed subtasks are highlighted white. Successful subtasks are highlighted in green. Subtasks, for which potential usability issues have been identified, are highlighted in red. Subtasks with only a number of warnings for possible difficulties are marked yellow.

Camera Controls

Within the 3d scene there is a control for the 3rd-Person-Perspective camera provided. The camera is focused on a virtual user and can be drawn nearer to a virtual user or be departed from it. Furthermore it is possible to fly around the virtual user. The camera is controlled via keyboard shortcuts and mouse as described in the following table.

Camera Control Intent	Action
Zoom in	**W** or **UP-ARROW** or **MOUSE WHEEL**

Camera Control Intent	Action
Zoom out	**S** or **DOWN-ARROW or MOUSE WHEEL**
Fly around the object	Right mouse button + mouse movement

Evaluation Principles

For the purpose of the product evaluation in a specified usage context there are a number of tasks provided, which a user can complete with the given product. Each task is composed of a number of subtasks.

VIRTEX processes two types of subtasks: *unimodal* and *multimodal*. Each unimodal subtask is related to a single disability type (visual or auditive or manual dexterity) and to a number of accessibility tests. Each multimodal subtask consists of two or three unimodal subtasks. *Accessibility test* is a binary function, which aims to identify potential usage difficulties (in a given usage context) from the perspective of one single usage aspect of the product. Hereby the usage context is a combination of a user and an environment.

Each of the accessibility tests are depending on one or more inclusive design *recommendations*.

There are two types of such recommendations: *informative* and *rule-based*. The last are such recommendations, which contain a quantitative relationship between the usage context and certain measurable properties of the product. Informative recommendations instead don't provide any measurable relation to the product. They are included into the evaluation results report every time the context is in a particular critical state.

HINT

Only the accessibility tests dependent on a rule-based recommendation can identify usage difficulties with a sufficient confidence. The tests dependent on informative recommendations provide indications for possible difficulties by relying only on the usage context, since no product related rules for the particular usage aspects are available.

Evaluation Results

The last step of the evaluation procedure for a selected task is a detailed overview of the results. The results are available after all the subtasks have been tested. They can be accessed by pressing the *Results* button of the Subtasks panel and are shown in a separate *Evaluation Results* window.

The results follow the structure of the particular task.

For each accessibility test of a subtask you can access a textual report providing the recommendations, to which the test is related, as well as further test specific details.

You can save the results by pressing the *Save* button. The results are saved in a file into a *VICON_RESULTS* folder, which you will find in the installation folder of the Virtex application.

After saving or discarding the results the task selection menu is shown again. The success statuses of the already simulated tasks are highlighted.

Current Limitations

Because the real annotation of the products is currently not available and a dummy data used instead the evaluation results may be inaccurate.

Appendix

User Personae

These descriptions of the personae have been taken from the document *VICON D2.2 Virtual user model (final release)*.

Trevor (65)

A recently retired man with no hearing, visual nor manual dexterity impairments. He does not wear a hearing aid, glasses or contact lenses.
Trevor is generally fit and healthy and leads an active life. He does not see himself as being old and is starting to enjoy his retirement and having more time for his garden and family.

Eileen (69)

Eileen retired a few years ago, at the same time as her husband. She has mild/moderate hearing and manual dexterity impairments, but they don't affect her everyday life. She does not wear a hearing aid but is aware that she is listening to the TV much louder these days and would probably benefit from a hearing aid. She has no visual loss, so does not wear glasses or contact lenses.
Eileen is generally healthy and active. In the week she helps look after her young grandchildren and at weekends she enjoys travelling and gardening with her husband.

Mark (72)

An elderly man with mild/moderate hearing, visual and manual dexterity impairments. Mark has two, new digital hearing aids but normally only uses them when out of the house or on the phone. He wears glasses, but mainly for reading small writing such as with his mobile phone, the newspaper or packaging. He has some stiffness in his fingers, but this doesn't affect his main hobby which is fishing.
Mark enjoys his life and always keeps busy, he is involved with many local organisations and helps run his local angling and allotment associations.

Dorothy (76)

Dorothy has a moderate hearing loss and has had hearing aids for 12 years. She doesn't find them very comfortable to wear so usually only wears them if she has company, to use the phone or if she is leaving her home. She copes well with her hearing loss but now tends to avoid socialising in noisy places. She has worn glasses all her life but has recently developed

mild macular degeneration making it harder for her to see things clearly. Dorothy has no problems with manual dexterity and still enjoys knitting and going to bingo with her daughters.

Gandalf (80)

Gandalf is an active older gentleman who refuses to let his age stop him from doing things. He has a moderate/severe hearing loss and wears digital hearing aids all day long. He can follow conversations in quiet places without them but the aids make his life much easier. Due to his moderate visual impairment he wears his new varifocal glasses all of the time. Moderate arthritis in both hands does not stop him doing things but can cause him discomfort, especially in cold weather. So he often wears gloves in all seasons except the height of summer.
Gandalf still drives a car and enjoys walking his Labrador dog. He lives alone he tries to go to as many daytime social events as he can, for company and entertainment.

B.4 Virtex questionnaire part II

This questionnaire has been handed out to the designers with the software and the instructions for testing Virtex.

VICON Task 4.2 Questionnaire Virtex Evaluation by End-Users (Part II)

In the following you will find statements about Virtex. Please rate each statement on the scale below the statement by choosing a number between 1 for "full agreement" and 7 for "strong disagreement". Please click on the box below the number that most closely matches your opinion. We are also interested in any comments you would be willing to share with us to support your rating.

Section 1. General impression of Virtex

1. "Overall, the Virtex application was well usable."

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

2. "In general, Virtex's look and feel was pleasant."

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

3. “The user interaction provided by Virtex was intuitive.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

4. “The Virtex application always worked as expected.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

5. “I never lost orientation within Virtex.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

Section 2. ‘Setup Evaluation’ menu

6. “The ‘Setup Evaluation’ menu was clearly laid out.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

7. “The terminology used in the ‘Setup Evaluation’ menu was well understandable.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

8. “It was easy to set up a product evaluation for a predefined usage context.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

Section 3. Product evaluation and its results

9. “It was easy to start the simulation of a task.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

10. “The ‘Subtasks’ list showing the progress of the task simulation was useful.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

11. “The colour highlighting of the evaluation result statuses was helpful.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

12. “The colour coding used for the highlighting of the evaluation result statuses was intuitive.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

13. “The evaluation results report was easy to access.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

14. “The evaluation results report was clearly structured.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

15. “The presentation of results report in form of an interactive list was helpful.”

strongly agree strongly disagree

1	2	3	4	5	6	7

☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

16. “The wording of the recommendations in the text report was understandable.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

17. “The descriptions of the identified potential usage difficulties in the text report were informative.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

18. Do you think that the text report is a useful complement of the virtual simulation?

Your comment:

19. "The method of the virtual usage simulation can facilitate understanding what difficulties a user can possibly encounter with the product."

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

Section 4. Miscellaneous

20. Do you think offering the possibility to select a usage context while evaluating a product is important?

Your comment:

21. Can you imagine that a tool like Virtex could help to improve design?

Your comment:

22. Did you miss any features in Virtex?

Your comment:

23. What did you like the most in Virtex?

Your comment:

24. What did you like less in Virtex?

Your comment:

25. To ensure the best benefit of Virtex do you think the following is necessary?

Please choose **one or more options**:

Virtex should ...

☐ ... remain a standalone application.

☐ ... not be dependent on any CAD development platform.

☐ ... be integrated into our CAD development platform.

☐ Others; please specify below:

26. Please summarise your overall opinion of Virtex:

Section 5. Virtual user concept of VICON

27. Have you been already familiar with the virtual user concept of VICON prior to the evaluation of the Virtex application?

☐ Yes
☐ No, I only used the Virtex application.

If yes, please go to the number 28.

If no, please read the following first and then go the number 28.

The VICON virtual user concept suggests supporting product designers during the entire design process by a set of software tools. These tools are connected to a special knowledge base, containing information about users, usage environments, possible product components and tasks a user can conduct with these components as well as a set of design recommendations. This knowledge base is called Virtual User Model.

The virtual user model of VICON contains the knowledge about age related disabilities and accessibility issues elderly users can possibly encounter with products. The VICON system provides support for inclusive design, i.e. *design for all*.

The VICON system provides the designers with three applications:

(1) Sketch Application – to be used at the sketch design phase;

(2) CAD Design Application – to be used at the CAD design stage;

(3) Virtual Experience Simulation (Virtex) – to be used after the CAD design phase for virtual evaluation of a product design.

The VICON system is able to support iterative design process.

Based on what you know about the VICON virtual user concept now, please answer the following questions.

28. “The VICON virtual user concept is capable in supporting the designers in creating inclusive products.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

29. “The VICON virtual user concept can help to involve the user’s perspective into the development process earlier.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

30. “The VICON virtual user concept is capable in product development acceleration.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

31. “The VICON virtual user concept provides knowledge concerning disabilities and derived requirements.”

strongly agree strongly disagree

1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Comments in support of your opinion:

32. If you have further suggestions for improvement, please share them in the following.

Thank you for your participation.

Would you like to be informed about the results of this study?

Yes ☐

No ☐

If yes, please fill in your email address for sending information:	

APPENDIX C Responses to the questionnaire regarding the Sketch & CAD Design applications

Suitability for the task

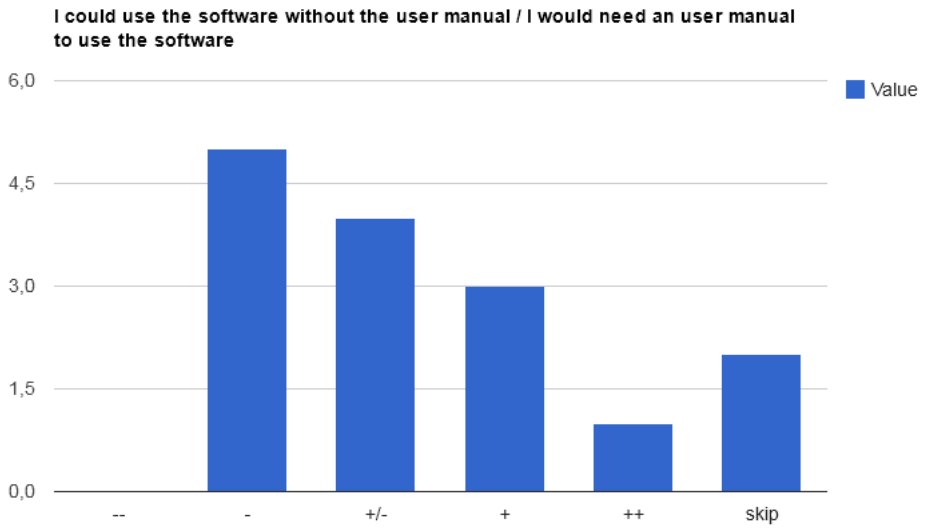


Figure 30 - Need for user manual

Self-Descriptiveness

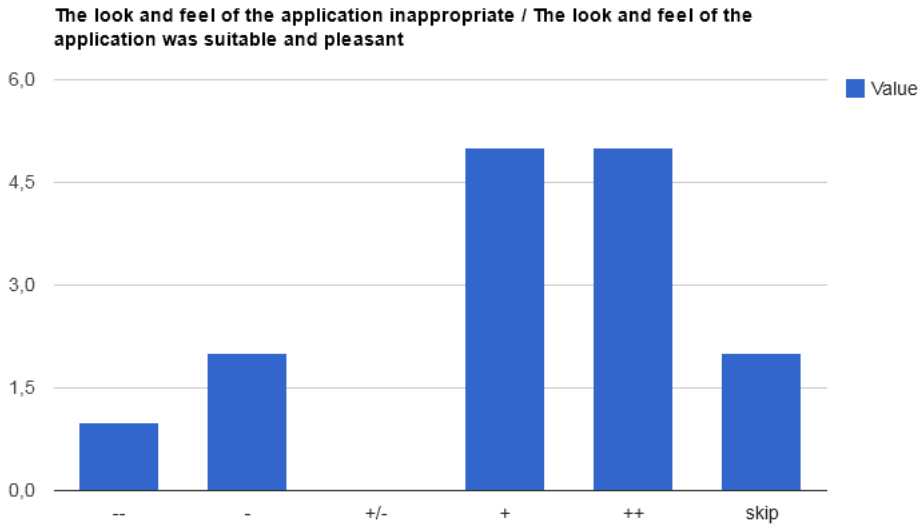


Figure 31 - Feature overview

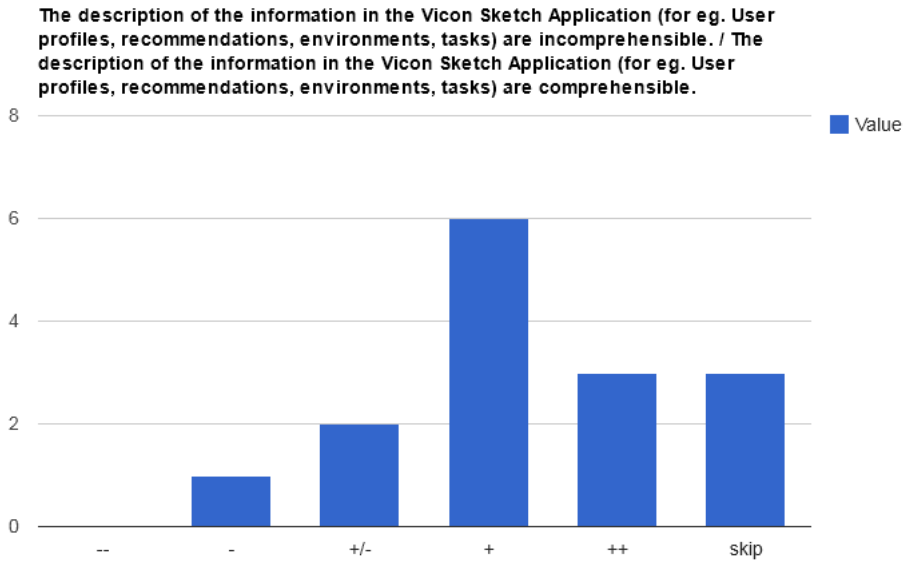


Figure 32 - Information comprehension - overall

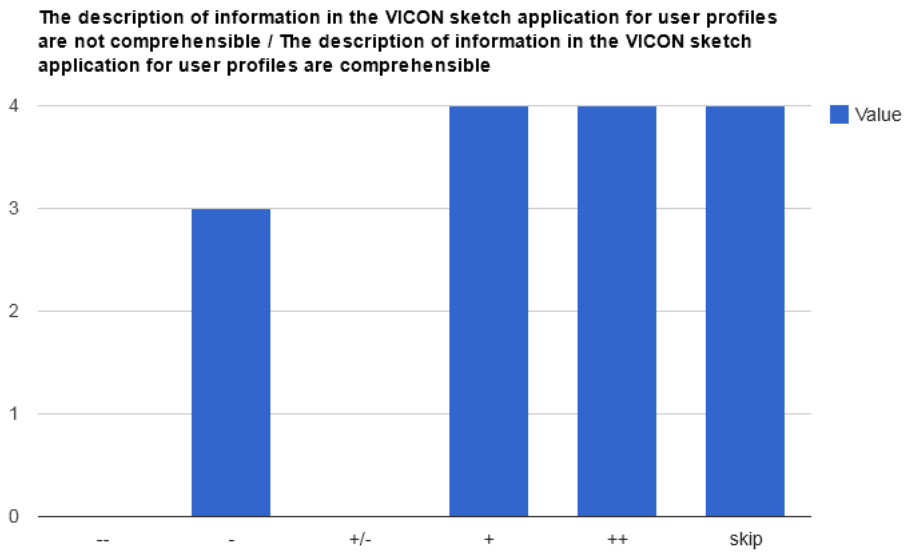


Figure 33 - Information comprehension - user profiles

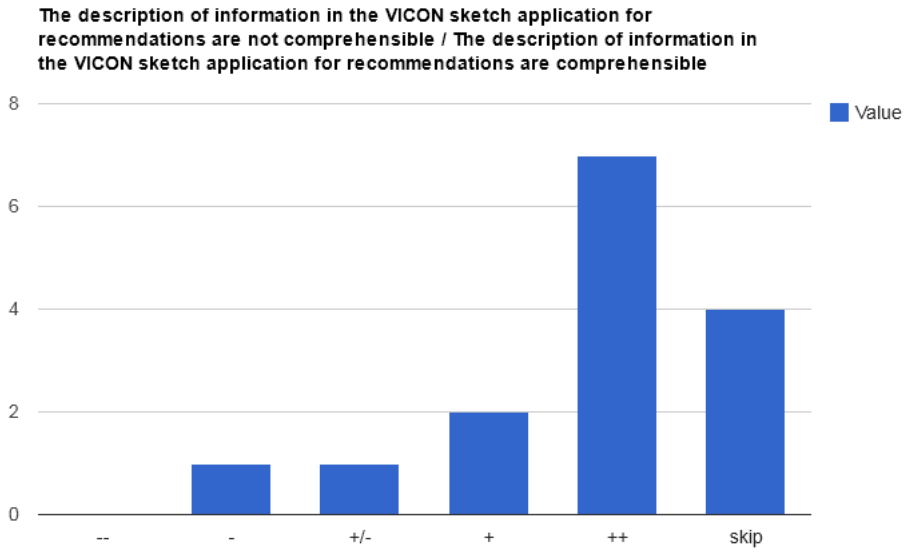


Figure 34 - Information comprehension - recommendations

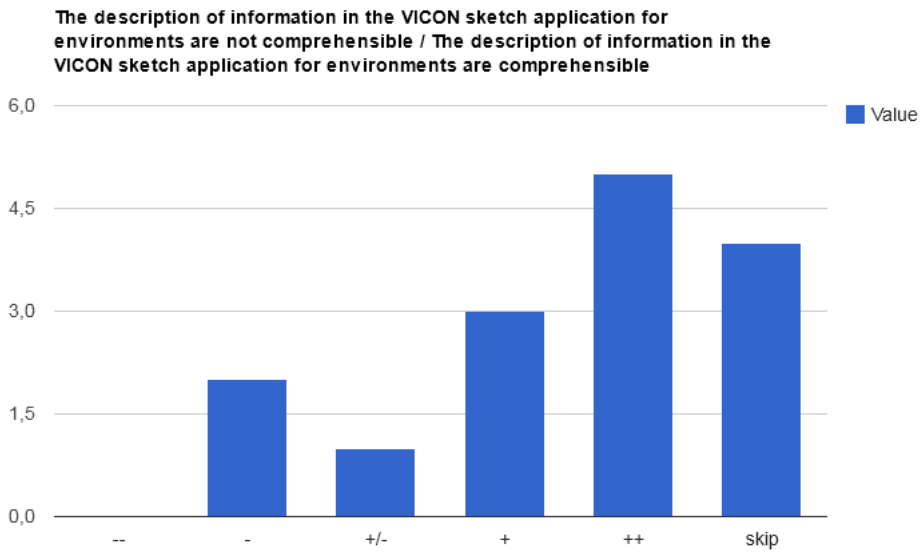


Figure 35 - Information comprehension - environments

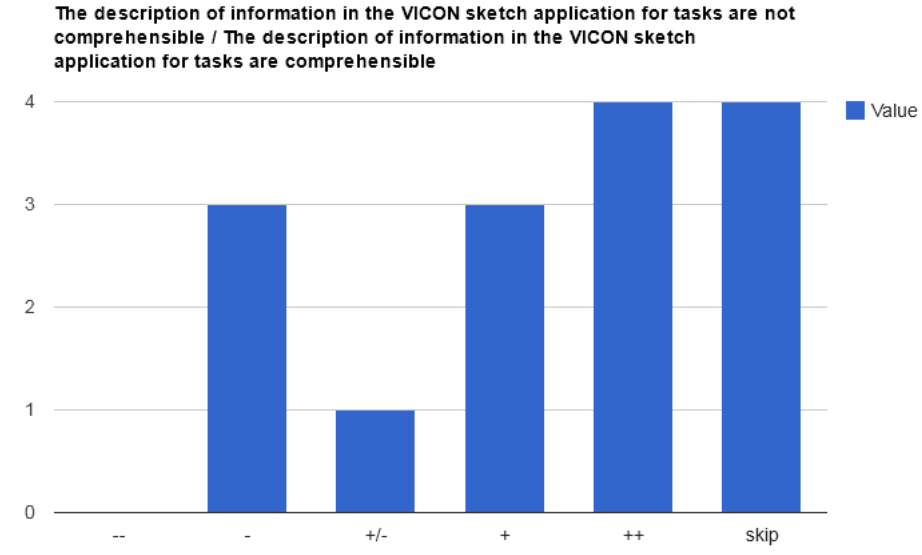


Figure 36 - Information comprehension - tasks

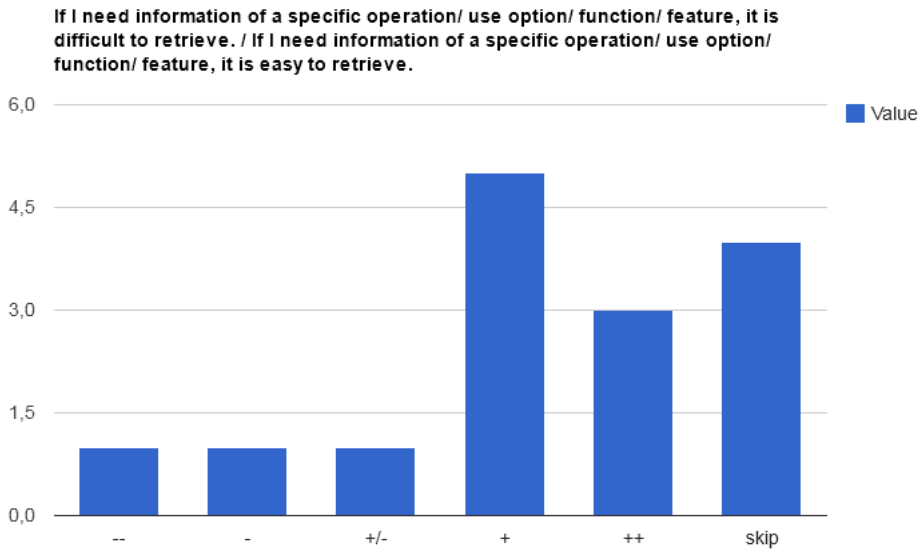


Figure 37 - Ease of information retrieval

Conformity with user expectations

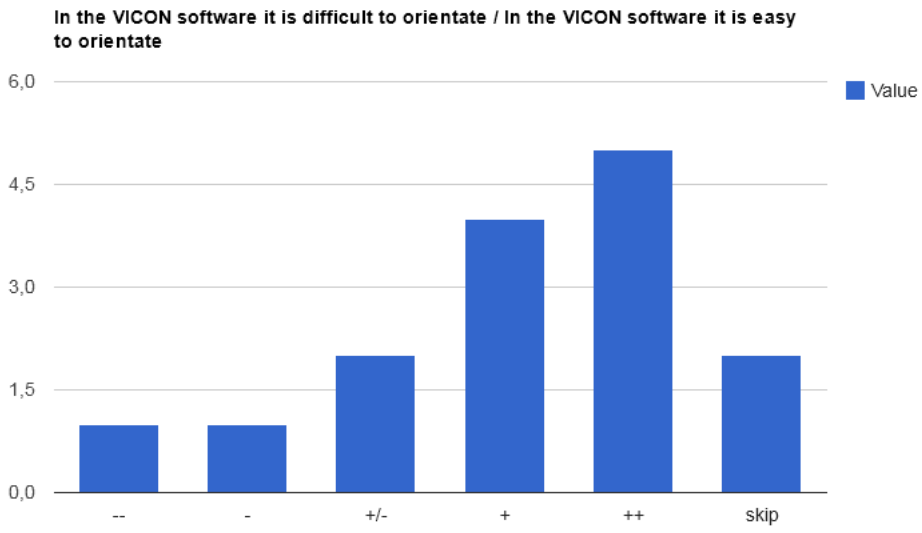


Figure 38 - Ease of orientation

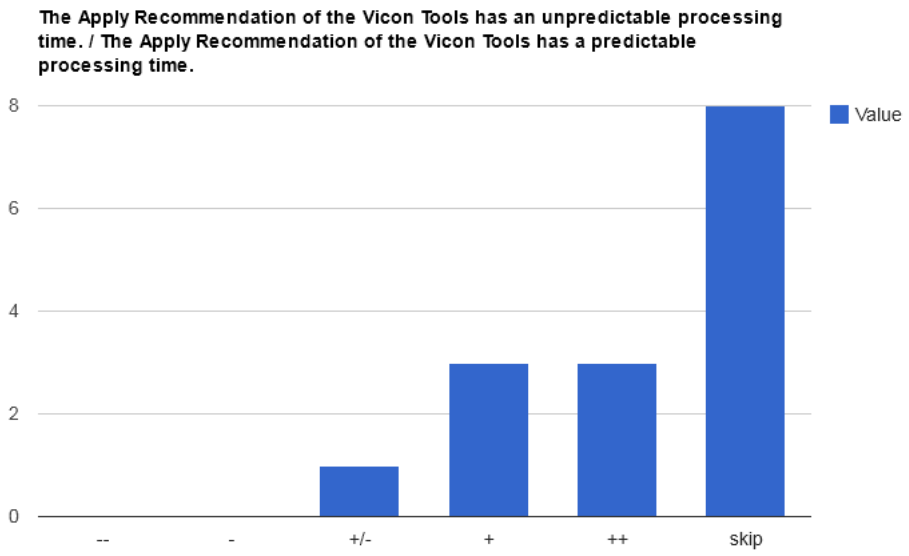


Figure 39 - Predictability of processing time

Suitability for learning

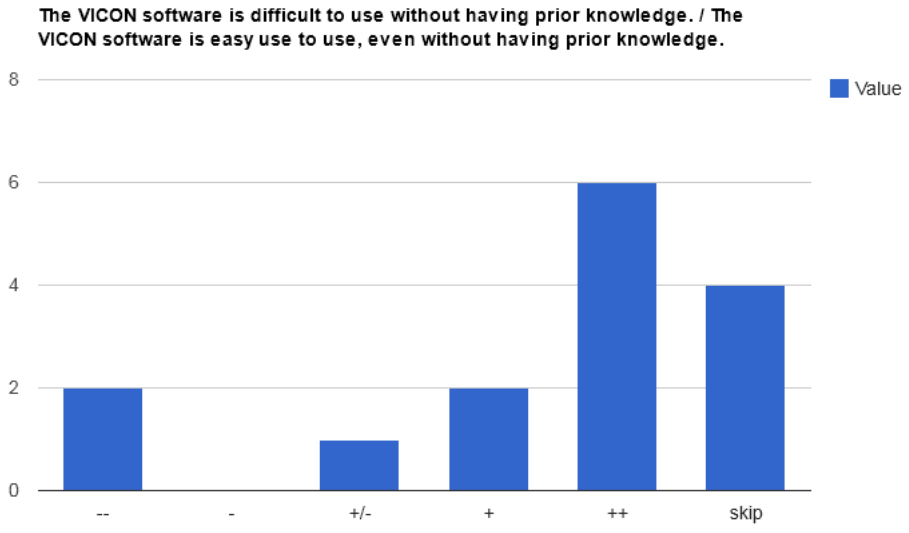


Figure 40 - Using without prior knowledge

Controllability

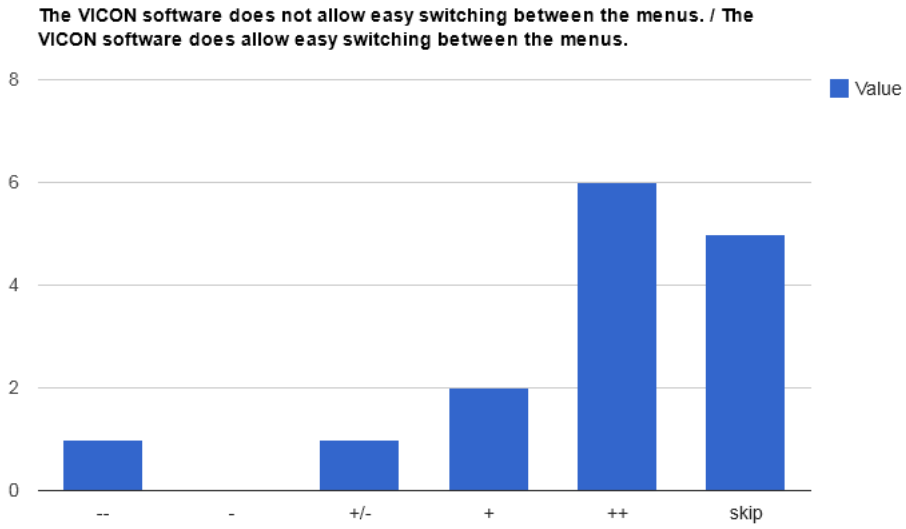


Figure 41 - Menu switching

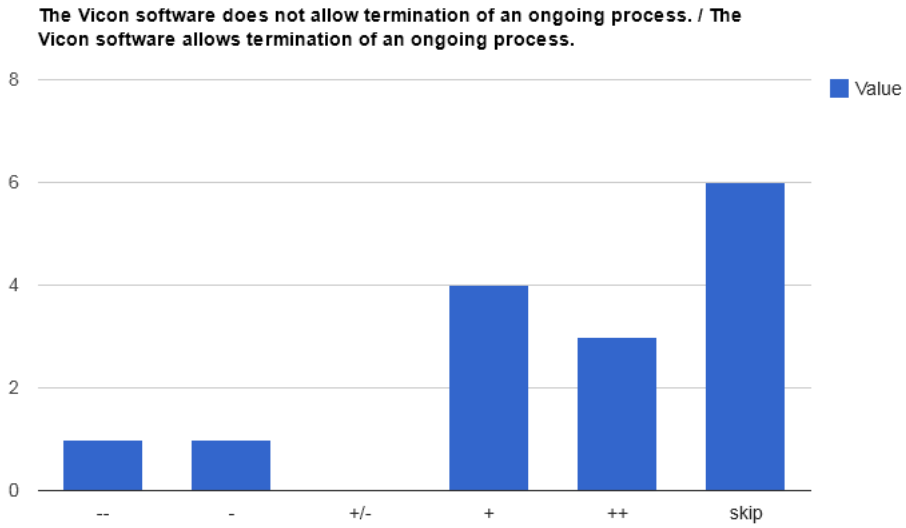


Figure 42 - Process termination

Error tolerance

Figure 43 - Error messages

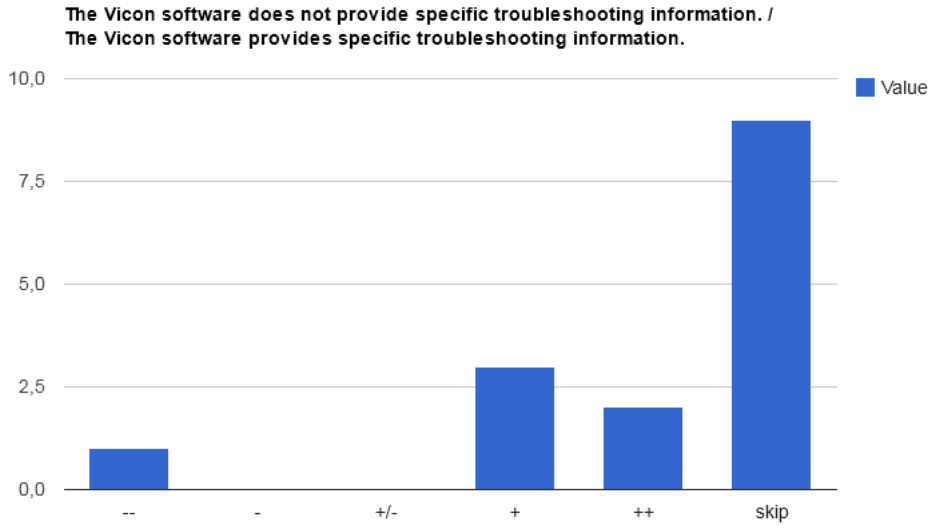


Figure 44 - Troubleshooting information

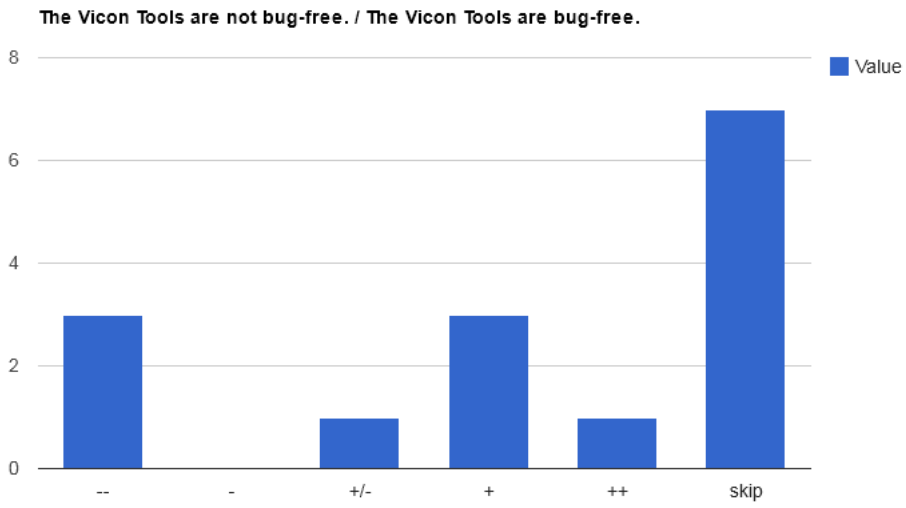


Figure 45 - Frequency of software bugs

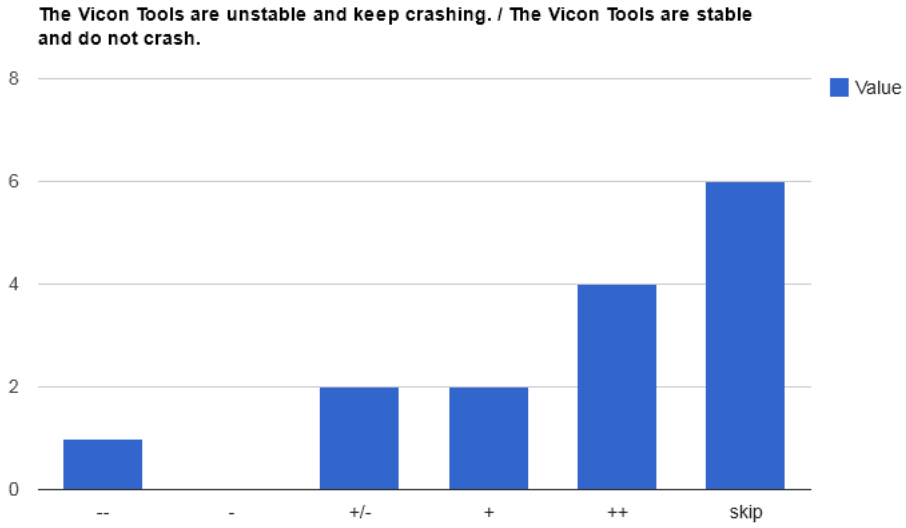


Figure 46 - Software stability

Suitability for individualization

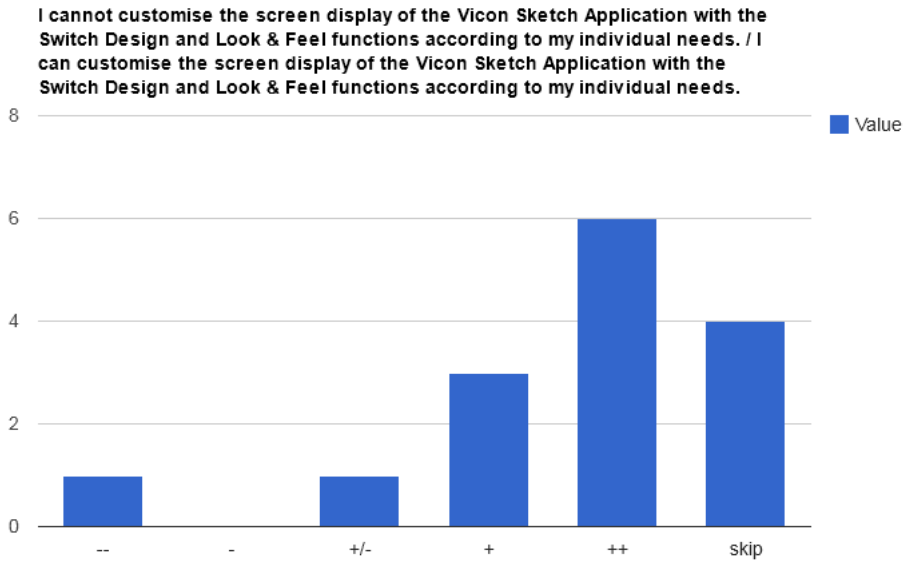


Figure 47 – customization – Look & Feel

APPENDIX D Responses to the questionnaire regarding the Virtex application

This appendix presents all the responses we got from the designers to the questionnaire regarding the Virtex application and the virtual user concept of VICON.

End-User (Designer) ->	U1	U2 All the answeres were given by this user offline via the filling in the questionnaire and answering additional questions.	U3
Initial questions asked before testing	**Answers**		
What is your position at your company?	Project manager	Designer	Designer
How long have you been working in this field? (in Years)	30	20	5
What is the size of the company you work for?	< 250	> 250	> 250
How knowledgeable would you say you are in regard to inclusive design?	very familiar	familiar	not at all familiar
How knowledgeable would you say you are in regard to virtual user modelling (VUM)?	slightly familiar	slightly familiar	not at all familiar
Section 1. General impression of Virtex **Statements**	**Ratings** 1 = strongly agree, 2 = agree, 3 = rather agree to some point, 4 = neither agree nor disagree, 5 = rather disagree to some point, 6 = disagree, 7 = strongly disagree		
1 "Overall, the Virtex application was well usable."	4	1	1
Comment:	Difficult to answer for a demo... A part of it is not user friendly: changing from one product to another was difficult. On some aspect: some default settings were good. In general, I liked the function. It's a mix: some parts are user friendly, and some are not.	Using the application was easy.	

2	"In general, Virtex's look and feel was pleasant."	3	3	2
	Comment:		Graphical interface can be improved. (S: 2.1 Which improvements exactly should be done from your point of view?) The Physical characteristics of the persons in "User Profile" are unknown. (Old, capabilities, insufficiencies...). It can be given in pop-up window, when mouse pointer over on them. (S: 2.2 Please describe how Virtex's look and feel should be!) Graphics resolution could be increased; in software pop-up windows could be used for comments.	I don't think that graphics/the visualisation are strong important. The test report is good. The items in the text report should be better distinguishable. It was hard to see which was task 1 which was task 2.
3	"The user interaction provided by Virtex was intuitive."	6	2	2
	Comment:	Changing between the products wasn't intuitive. Red colour: headlines become red all the time! Headlines should be only headlines. (S: Headlines in the results view should appear differently from the tests.) Composed task got red, which was not clear. That it is possible to click the lines (S: with test results) was not clear.	"VSF file" for product selection could be select from library/folder by mouse. In demo Virtex, we could only write in path. The general evaluation workflow was intuitive, it isn't permitting to make mistake by user.	I understood what I need to do; I understood the stage 1, i.e. the setup menu, and stage 2. i.e. the simulation and results part. The workflow was very good.
4	"The Virtex application always worked as expected."	2	1	3
	Comment:			I know that this is the first version of the software, so I think the further versions could be improved. But it was good as expected.E.g. the Mark was pressing some buttons it was not realistic.
5	"I never lost orientation within Virtex."	2	1	1
	Comment:	Because it's quite basic.		It was easy to use.

Section 2. 'Setup Evaluation' menu				
6	"The 'Setup Evaluation' menu was clearly laid out."	4	1	1
	Comment:	To change the product took a couple of reading in the manual. There is no marker for the cursor visible. I.e. the feedback (S: that I clicked on the text field was missing). So, the first page is a nightmare, the second page is great! Choosing the profiles was good; however you can't stop something and get back.		It was very easy to use.
7	"The terminology used in the 'Setup Evaluation' menu was well understandable."	2	1	1
	Comment:	No problem.		Was very good.
8	"It was easy to set up a product evaluation for a predefined usage context."	1	1	1
	Comment:	To find a product was not very easy. (S: the product selection)		
Section 3. Product evaluation and its results				
9	"It was easy to start the simulation of a task."	1	1	2
	Comment:			When I finished the setup screen and the task window had appeared, it had a "Setup" button, and I clicked the Setup button, but then I got back to the first menu again, that was unexpected... The "Setup" button could be smaller. So the task buttons appear more important. It was not clear, that the task names were buttons. Only after I have hovered over them, I understood that they might be clickable.

10	"The 'Subtasks' list showing the progress of the task simulation was useful."	4	1	2
	Comment:	It should be possible to stop this process: an escape key would be great there!		It was useful. But it could be better to separate all the subtasks from each other, there must be space between them.
11	"The colour highlighting of the evaluation result statuses was helpful."	2	1	4
	Comment:	Definitely useful, but with exception that the headline (S. for tasks/subtasks) should be another colour. (S: It took me a bit, till I discovered that I can open the results of the tests by clicking on them.)		I tried to distinguish items, it was hard. The items should be separated. If there would be more space between the items, it would help.
12	"The colour coding used for the highlighting of the evaluation result statuses was intuitive."	1	1	1
	Comment:			Colours were o.k.
13	"The evaluation results report was easy to access."	1	1	1
	Comment:			
14	"The evaluation results report was clearly structured."	3	1	1
	Comment:	It's not bad, but the layout could be better. E.g. white text on gray E.g. more space between the different items. E.g. the headlines (S: of tasks/subtasks) are the same colour as the text, they are not really highlighted. (S: the task/subtask headlines are presented in the same way as the results of the tests, which make them difficult to differentiate.) The structure as a hierarchy of tasks/subtasks was understandable.		

15	"The presentation of results report in form of an interactive list was helpful."	1	1	3
	Comment:	Very useful, but a little disturbing layout: The colour goes into the text, no divider between the actual text (layout issue). Need to scroll in order to see the entire text -- that's not comfortable. The format can be slightly improved, by lines or other background colour.		Items are not separated, which makes the overview complex. The spacing between the items. That the items were clickable was good. So interactivity is very good.
16	"The wording of the recommendations in the text report was understandable."	2	1	1
	Comment:	The reference information is really great!		
17	"The descriptions of the identified potential usage difficulties in the text report were informative."	2	1	1
	Comment:	Could be quite vital to provide some kind of indication (S: for the tests, which cannot actually detect a problem, but only give an indication of some potential difficulties). Indication like: "it's not good, but also not bad" (S: for a design aspect) -- that was not totally intuitive! For yellow: a clear indication, that this is not a detected problem, but only a potential problem.		
18	Do you think that the text report is a useful complement of the virtual simulation?	The text report is everything! Strongly agree. This is the key, otherwise it (S: the evaluation) is not useful.	Yes, it is useful for product development reports.	Yes, I read all the text reports. The separation of the items would make the readability better.

19	"The method of the virtual usage simulation can facilitate understanding what difficulties a user can possibly encounter with the product."	1	1	1
	Comment:			I saw all the movements of the users and it helped in understanding how a person will try to reach the items. So it was useful.
Section 4. Miscellaneous				
	Open questions	**Answers**		
20	Do you think offering the possibility to select a usage context while evaluating a product is important? In additon U3-U9 have been asked: Would you agree with the following? "The selection of usage context at the product evaluation stage ..." 1) "... helps in dealing with changing requirements." 2) "... provides a possibility to evaluate a product for different usage context configurations (and not only for a single user in a single environment)."	It's the key that you know that for whom you are designing. I think that's important.	Yes, of course.	Yes it is important. Ant it is helpful in understanding the differences in usage for different users. For me it' enough to select the predefined the living room, I don't need to create another environment at the stage of the evaluation. Agreed with 1 and 2.
21	Can you imagine that a tool like Virtex could help to improve design?	Yes. What strikes me is that you know all this stuff, but simply by the fact that you tend to forget it's good to be reminded of things!	In my opinion, it could help to improve design a little, but it could help to make true design, i.e. that the designed product is truly suitable for old persons, and to reduce design time. "A little", because it would help only a little for "product designer". Because product designers want to take design constraints before/during design. Not after product design finished.	Yes, it could help to improve design.

22	Did you miss any features in Virtex?	The big question is how to get this evaluation as early as possible. How to get the design into the system? How to get new products into the system? It would be good to build your own task!	It could give more physical data for mechanical engineers. (For example, dimensions of buttons and between buttons, colors...)	I don't think I miss any feature.
23	What did you like the most in Virtex?	The result list and the references.	It can be used for good design guide.	The progress list of the subtasks, to follow the progress of the simulation and to know which subtask is currently active.
24	What did you like less in Virtex?	There is some level usability which needs to be improved and understanding the results list was also not easy at the beginning, but this is not the major issue. (S: I'm noticing all these details, because I'm working with elderly users, for whom the interface should be very simple.) Professionals however, like CAD designers, can accept the low level of intuitiveness.	As I said before, graphical interface.	Suggestions, because all the suggestions were about the brightness of the buttons. When I see the suggestions were related to brightness of buttons. There were some suggestions which were related to the same thing: to the brightness. But I didn't click all of them.
25	To ensure the best benefit of Virtex do you think the following is necessary? Virtex should ... 1) ... remain a standalone application. 2) ... not be dependent on any CAD development platform. 3) ... be integrated into our CAD development platform. 4) Others; please specify.	1) remain a standalone application	3) be integrated into our CAD development platform.	1) remain a standalone application
	Comment:	I don't work on CAD. So from my perspective it should remain standalone. However I can imagine that it would be helpful to have both. (S: so the CAD designer doesn't need to switch to another application.)		I'm not sure about integration into our CAD.. It doesn't have to be integrated into the CAD.

26	Please summarise your overall opinion of Virtex:	In general, positive. I especially appreciate the general comments and references, where you can find the full information, in the result report. I don't really care about the visualisation. In general, the animation was not very useful. In the reality there are many ways how a user can hold a phone, but in the simulation -- only one. The evaluation result was useful! Animation however does not really add knowledge.	I think this version of Virtex demo application is suitable for industrial design engineer. It must be improved for product design or mechanical engineer. (See item 22.)In my opinion:1. Physical data/constraints is base and more important for product designer or mechanical engineer (dimensions, force, color, lighting,..)(may be in Vicon)2. And "Item 1 " must be given product designer or mechanical engineer before/during design.	It's easy to use; I can see all the subtasks progressing. The Virtex would be helpful to improve design.
Section 4. VICON's Virtual user concept				
27	Have you been already familiar with the virtual user concept of VICON prior to the evaluation of the Virtex application? 1) Yes. 2) No, I only used the Virtex application.	Yes	Yes	No, I only used the Virtex application.
	Statements	**Ratings** 1 = strongly agree, 2 = agree, 3 = rather agree to some point, 4 = neither agree nor disagree, 5 = rather disagree to some point, 6 = disagree, 7 = strongly disagree		
28	"The VICON virtual user concept is capable in supporting the designers in creating inclusive products."	2	3	1
	Comment:	It will give a very good reminder to work on inclusive design. After all, you have all the documents, you have no knowledge. Also if the designer is well knowledgeable, he/she can forget! (S: The system would remind him/her on inclusive design challenges.) For designers with no experience it will be even bigger help.	Yes, if it could give more physical data for mechanical engineers.	

29	"The VICON virtual user concept can help to involve the user's perspective into the development process earlier."	5	3	1
	Comment:	I'm more hesitant for this statement. The problem is, that the model is put rather late. So that is maybe too late, or for some parts of the design maybe too late. Labeling and textures can still be adapted, but in order to change some forms there are not enough time and money usually available.	This is my opinion for this version of VICON. If Vicon is developed and included my opinions above (in your question 26) it will be "strongly agree	
30	"The VICON virtual user concept is capable in product development acceleration."	4	1	1
	Comment:	No, I don't think so. (S: Thinking on evaluation. However also after I told about Sketch Application the opinion still remained that the acceleration cannot be reached.) It may result even in deceleration. But this is not very negative. It will make better products and that's great! It will make better products, but it will not make it faster. It's a matter of redoing things. (S: It can lead sometimes to redoing things.)		
31	"The VICON virtual user concept provides knowledge concerning disabilities and derived requirements."	1	1	1
	Comment:	Yes, it's what it is about.		It provides me with this knowledge.
32	If you have further suggestions for improvement, please share them in the following.		Usage of VICON in any CAD software; 1. VICON could give us physical data (dimensions, colours, if needs light and sound, forces, ...) 2. This data must be given to the engineers during design (interactive) on time.	I don't have any other suggestions.
	Comment:	See comments above.		

End-User (Designer) ->	U4	U5	U6
Initial questions asked before testing			
What is your position at your company?	Designer	Designer, Other: Innovation management	Product developer, Designer
How long have you been working in this field? (in Years)	3	12	9
What is the size of the company you work for?	> 250	< 250	< 10
How knowledgeable would you say you are in regard to inclusive design?	very familiar	moderately familiar	moderately familiar
How knowledgeable would you say you are in regard to virtual user modelling (VUM)?	familiar	not at all familiar	not at all familiar
Section 1. General impression of Virtex **Statements**			
1 "Overall, the Virtex application was well usable."	4	6	4
Comment:	Product menu is bad. As a software user there are a lot of interface controls, which are not suitable for me. As I am used to NX Unigraphics, it's like SolidWorks, where the menus are very functional. So this menu is out of borders. But in spite of the purpose of Virtex it (S: the overall usability) is actually o.k. For benchmarking of these products... For this purpose it is usable.	In general, it was not well usable. Not a good knowledge transport of the recommendations during the simulation. The recommendations should be better integrated into the simulations, not only the text form.	In general, it was usable, but I had some difficulties regarding choosing the product and a slight small point at starting a task, where I first didn't know how actually to start a task/how to begin the simulation. There was not clear that the tasks in the Task menu were buttons to start a task.

2	"In general, Virtex's look and feel was pleasant."	4	3	2
	Comment:	Results window is very complicated. The results menu should be simpler. I got lost in the menu, especially in the results menu. But when I see virtual person on the screen, I feel that's good.	The look and feel was o.k. My expectations have been fulfilled. But it was nothing special. It was a little bit could, maybe too much cold. The look and feel didn't transport the mood of Mark or Gandalf. I could see the person who had a disability, but I couldn't feel it! I didn't feel the need to support the person I saw. But it was good, it was o.k.	Well, according to the stage of the software, which is only a prototype, I actually could not agree with this statement. But in general I like the software; I like how it looks like. It was nice; it was like a game, which the first time I was asking myself whether it is actually professional software or a game. I'm not used to such pleasant and game-like looking of professional software. So it's a positive feedback, but I was asking myself how to make it to look like professional software. At the same time it was fun to use the software, so why not making professional software looking like a game in the future!?
3	"The user interaction provided by Virtex was intuitive."	4	6	3
	Comment:	Some menus could be clearer for the users, e.g. the product selection menu. For instance, you can use pull-down menus. The overall structure was not bad. The workflow was o.k. The animation went too fast. I cannot follow the subtasks menu. It's about the design of the Subtasks menu. See flow charts used in games on iPhone (like iOS games for children.)	When you have the possibility of a 3d surrounding, you have to use it. But only very simple form of visualisation has been used: text. Animation for problems would help. If you confront with a problem, it's an important moment to see and feel the difficulty. It should be celebrated, in order to reach the designer, so he/she will know how necessary it is to solve the problem. To feel into the person, and then the impulse for creating new solutions. And another point was the navigation within the application.	According to my point in the comments to the statement number 1, the usability of the software was not good at some points. It is intuitive at some points and at some is points not. But there were more points which were intuitive.
4	"The Virtex application always worked as expected."	4	6	3
	Comment:	I want an immediate feedback to my 3d model modifications. 3d Software -> upload it to Virtex -> than immediately run the Virtex and get the results.No other issues.	I have expected something totally different. Because I expected that you would use more 3d methods to explain the problems, the feelings of the users and the need that stands behind that.	According to the word "always" I would disagree. Unexpected was that I could not choose the second product (Washing Machine Arcelik VICON) and had strong difficulties in changing products.

5	"I never lost orientation within Virtex."	5	2	4
	Comment:	Next" button in the menu, "Home" button for the first screen, return to the Usage Context selection from the evaluation scene. "Stop" button for cancelling the evaluation was missing!	After I understood how I should navigate through Virtex, I could orientate well. The entire evaluation workflow was clear.	I lost orientation a couple of times, maybe 3 or 4 times. One place is the list with the results: sometimes I didn't know what was I reading right now, which description belonged to which task. "Go Back" button is missing for returning one step back. The overall workflow was understandable.
Section 2. 'Setup Evaluation' menu				
6	"The 'Setup Evaluation' menu was clearly laid out."	5	1	1
	Comment:	In the setup evaluation menu there should be an import menu. So, the user can import the VSF file. "Load file" is not a suitable button. After import there can be a "next" button to proceed. Change to another product is very difficult. The second "Usage Context" menu: The VSF file is a bit long. Writing only the product name is better and a picture of the product would be nice. The usage context selection menu is good. But information about users and environments would be good to add, i.e. the descriptions of the profiles. The screen "Scene" disappears too fast (I have a fast computer), it might be good to show information about the selected product and environment on it. On the "Product" menu you can put a box menu to select it. So, user can select the related product. Scene menu is useless. It just used for loading screen.		
7	"The terminology used in the 'Setup Evaluation' menu was well understandable."	2	1	1
	Comment:	"Load file" button is not perfect.		

8	"It was easy to set up a product evaluation for a predefined usage context."	3	2	4
	Comment:	It's very clear. (S: "2" is probably meant)	Selecting the product was difficult.	The selecting product was not easy, and the second part (Usage contest selection) was very easy to use.
Section 3. Product evaluation and its results				
9	"It was easy to start the simulation of a task."	3	4	2
	Comment:	It's very easy. It's just click the task and then it's automatically. Better would be to select the task and then to press a "Start"/"Go"/"Play" button. (S: "2" is probably meant.)	It was not really easy. It was o.k. But it was not clearly described, it was not intuitive. Wording is not convenient. "Please choose" would be better. The moment where I can click is not really good designed. The task title looks not like a button. Very "computer science" solution.	After I figured out, how to start a task, that it is done by pressing the task title "button", it was very easy to start a task. Suggestion: I would prefer that you mark/choose a task and then there is a "Start" button to begin the simulation.

10	"The 'Subtasks' list showing the progress of the task simulation was useful."	5	7	1
	Comment:	It is not a clear menu. You can show the subtasks step clearer. I'm missing the main tasks. You can group the tasks better; separate the subtasks of one task from other subtasks. Actually the colouring of subtasks is good, but the layout confuses me. In general the highlighting of the results is useful. The menu should scroll down automatically.	The fact that the progress has been visualised was very useful, but the way how it has been realised is absolutely inconvenient. It was too fast, not integrated into the simulation etc.	The list itself is very helpful, but the way it is made, provide some misunderstandings. It is useful, but in detail I would like to have it a bit different as it is right now. The progress is shown very fast. It was not understandable what the colours mean. Later you know, but first time you don't know what the colours mean. I would suggest doing the colouring only in the results, maybe. Maybe it's good to have a progress list and having icons for the subtasks like "check" icon for successful subtasks and "exclamation mark" for unsuccessful ones. You should separate the progress visualisation from the results. However it is helpful to have certain visualisation of the convenience of the subtasks, but in a different way as it is done now. The visualisation of the difficulties by the virtual user was not in line with the actual success status. E.g. if the subtask "Identify button" got red, the user still have pressed the button. (S: This behaviour is correct. The fact that the user is wondering about that means, that the GUI doesn't provide enough information about the concept of independant subtask testing.)

11	"The colour highlighting of the evaluation result statuses was helpful."	3	2	2
	Comment:	The user should group colours. If you can put a filter it will become handy. Result Menu: the green highlighting is not very important, but the red is important. So filtering would be helpful. Task selection: Check mark (check icon) for already simulated tasks.	It is helpful to highlight with colours, but I need the connection to the moment in the 3d animation where the problems occur. The highlighting is very good, but the connection to the 3d should be there. And more slowly and one after each other.	Highlighting in general is of cause helpful, but I'm not sure if the colour highlighting is a good solution I don't know. Maybe highlighting by symbols/signs is better. Symbols and colours together work best! In the results list the titles of the tasks/subtasks should be presented in a different way as the tests. I mean the headlines of the tasks look the same as other lines and so on. They should be better distinguished from the sub headlines and these should be different from the tests.
12	"The colour coding used for the highlighting of the evaluation result statuses was intuitive."	2	1	3
	Comment:	Yes.	O.k. it's universal.	At the beginning the colours should be explained. The colours themselves are intuitive, but how they were used was not intuitive. The colours should be used more precise. The difference between red and yellow. It was actually also not clear for red whether the user did it with difficulties or could not make the subtask at all.
13	"The evaluation results report was easy to access."	2	2	2
	Comment:	Yea. Because it comes directly to your face.	It was not clear that I would get report in form of a text. So it was not clear, that I should click on the separate tests in order to open them.	It's o.k. but it could be better. After a test is gone from your point of view, it should be closed automatically. Otherwise you end up with a very long list of opened test results, which you have to close first before you can get an overview again.

14	"The evaluation results report was clearly structured."	5	2	3
	Comment:	When the user clicks a coloured tab, on the left or right there should be another window to show the suggestions. Also, the customer should click the URL's. I cannot differ between the different items: task, subtask, and test. Layout issue. You can click only the test. Why cannot I click the subtask? The structure is o.k. Why the subtask is red. It is not correct. The proportion of success could be different, e.g. the most of test are green and only one is red. Importance of the tests could be helpful. Maybe no putting any colours to subtasks.	It was easy to understand.	Visually the task/subtask hierarchy is not well layouted/subdivided. It's a layout issue.
15	"The presentation of results report in form of an interactive list was helpful."	4	5	2
	Comment:	Little windows would be better. The idea of an interactive list is good, but the realisation isn't.	Interactive?! It's a very strong word for it. I'm not sure if the list is the best way of presenting the results. As an overview it is not bad, but for working with this information I would choose another kind of presentation. The appearance / the design was not appealing. You can show all the possible issues as pictograms and then colour them according to their status. Or see Gapminder.org (animated chart representation)	It was good.
16	"The wording of the recommendations in the text report was understandable."	2	2	2
	Comment:	It was very clear.		Yes. "Text" is not good title. Better would be "Explanation" or simply put the text without a title. The content of the recommendations should be made consistent.

17	"The descriptions of the identified potential usage difficulties in the text report were informative."	2	2	2
	Comment:	Yes, very informative. The references are very helpful.	I don't like the question. The text descriptions are good, but it should not be in a text form. So it's a pity that I can't choose between different representations of the results.	They were informative, yes, of cause. They could however be a bit better written.
18	Do you think that the text report is a useful complement of the virtual simulation?	I absolutely agree with this statement.	I my eyes it's not a complement, is a main transport medium. If it would be just a complement it would be fine.	Yes, of cause. It is useful to explain in words what exactly went wrong. It would be good to show, to visualise a possible solution to the identified problem.
19	"The method of the virtual usage simulation can facilitate understanding what difficulties a user can possibly encounter with the product."	1	4	1
	Comment:	Agree.	The main idea is good. Of cause with help of a simulation you can understand what the problem is. So the method is good, but it is not good realised.	If the picture would be more detailed, It would be very useful. Right now the virtual simulation doesn't look like that. The difficulties are currently not shown in the virtual simulation! The simulation doesn't show how difficult or easy is it for a user to perform a task. The degree of convenience in the usage of the product is not depicted.

Section 4. Miscellaneous Open questions				
20	Do you think offering the possibility to select a usage context while evaluating a product is important? In additon U3-U9 have been asked: Would you agree with the following? “The selection of usage context at the product evaluation stage ...” 1) “... helps in dealing with changing requirements.” 2) “... provides a possibility to evaluate a product for different usage context configurations (and not only for a single user in a single environment).”	Yes, as a designer I can say that Virtex has to offer some criteria during product design. We are designing a wm interface and it should be usable for all! We don't get personas from the project manager. Yes, it is important. Agreed with 1 and 2.	Yes. Even just to have a different perspective it is good to see from the perspective of a different user, in a different environment. It's a really good thing! Agreed with 1 and 2.	Yes, of cause it's good to evaluate your product to evaluate the product for different scenarios. E.g. the living room was dark, and the bathroom was bright, so it was good to show how the environment would affect the usage of the phone. It was good to "through" the user in different environment. And also it would be very helpful to have a descriptions/or summaries of disabilities of the users in the setup menu, where they can be selected. Agreed with 1 and 2.
21	Can you imagine that a tool like Virtex could help to improve design?	Yes, but there some points which need to be improved.	If that's sufficiently realised, yes.	Yes, it could.
22	Did you miss any features in Virtex?	I think Virtex should run like that: The software has to say me after my modifications that the design is OK or not. Real time suggestions!!	Such controls like "Stop", "Play" so I can control the evaluation process myself.	It would be very good to have Virtex, which contains information not only about the elderly people, but about all possible people. So it would really provide evaluation for inclusive design.
23	What did you like the most in Virtex?	Visual graphics. (VR), The fact that there some visualisation has been provided. I liked the purpose of the software.	The diversity of usage scenarios, so I can observe a problem from different perspectives. And the fact, that I can select the context myself.	I like very much when the old man was sitting on the bath tub. I liked the virtual simulation.
24	What did you like less in Virtex?	3d graphics are very good, but the textures, the lighting effects are not so good. Better quality of the 3d graphics would be preferable. Graphics details, user interface layout.	The text presentation of the recommendations should be visualised, e.g. as charts or pictograms, icons.	The graphic user interface was not perfect, especially at the beginning. The usability and the beauty were not sufficient. The GUI should be similar to Photoshop; it should look clearer and more sophisticated. It shouldn't look like a game.

25	To ensure the best benefit of Virtex do you think the following is necessary? Virtex should ... 1) ... remain a standalone application. 2) ... not be dependent on any CAD development platform. 3) ... be integrated into our CAD development platform. 4) Others; please specify.	1) remain a standalone application 3) be integrated into our CAD development platform	3) be integrated into our CAD development platform	2) not be dependent on any CAD development platform 4) Others: I'm using SolidWorks. It could be a very helpful plug-in.
	Comment:	The visualisation can be standalone, but it would be helpful to have the text report within the CAD platform.		Standalone or not doesn't make any difference to me. If the standalone application works well on the OS you are using, it doesn't matter if it's standalone.
26	Please summarise your overall opinion of Virtex:	Virtex will be great software after some fixes I guess. It is very useful to see the design criteria at all. The recommendations are the design criteria.	I like the idea of be confronted with usage problems in form of 3d simulation. But I am questioning/challenging the authenticity of the re-enactment scene and thus the right to exist in this form, so in form of 3d simulation. Probably it is then more suitable to use videotaping?	It could be an interesting and helpful tool, the direction it goes is appropriate. The stage of the development of Virtex is not far enough to be useful to professionals. More features would be appreciated. There should be a possibility to specify the user interactions the virtual user should perform. E.g. how the user should grip the product, with the right hand or with the left, etc.
Section 4. VICON's Virtual user concept				
27	Have you been already familiar with the virtual user concept of VICON prior to the evaluation of the Virtex application? 1) Yes. 2) No, I only used the Virtex application.	Yes	No, I only used the Virtex application.	No, I only used the Virtex application.

	Statements			
28	"The VICON virtual user concept is capable in supporting the designers in creating inclusive products."	2	2	2
	Comment:			If the model has a sufficient amount of parameters, then yes. I.e. all parameters you need to depict disabilities.
29	"The VICON virtual user concept can help to involve the user's perspective into the development process earlier."	2	3	1
	Comment:		The focus is not on the time, but on the complex information context, which I as a designer get. Things I have to consider are good packed, it's good platform where I could inform myself and get an overview, also before starting the design.	Yes.
30	"The VICON virtual user concept is capable in product development acceleration."	2		2
	Comment:		I cannot say.	I could imagine that it would accelerate. It depends on the realisation.
31	"The VICON virtual user concept provides knowledge concerning disabilities and derived requirements."	2	1	2
	Comment:			
32	If you have further suggestions for improvement, please share them in the following.		I missed an active part of designing! E.g. if I would be designing a mobile phone, I would like to combine the designing part in the CAD program and directly get a visual feedback notifying me about some problems.	Sometimes there is no target user group specified, so it would be helpful to have a possibility to adjust the parameters of the users, environments etc. i.e. to create your own profiles.
	Comment:			

End-User (Designer) ->		U7	U8	U9
Initial questions asked before testing				
	What is your position at your company?	Designer	Designer	Designer
	How long have you been working in this field? (in Years)	7	4 1/2	12
	What is the size of the company you work for?	< 10	< 250	< 250
	How knowledgeable would you say you are in regard to inclusive design?	slightly familiar	moderately familiar	familiar
	How knowledgeable would you say you are in regard to virtual user modelling (VUM)?	not at all familiar	slightly familiar	moderately familiar
Section 1. General impression of Virtex **Statements**				
1	"Overall, the Virtex application was well usable."	5	1	2

	Comment:	The interface should be better usable, better in line with the habits of the users. To use the operations, the steering like in the popular computer games, that most of the people know. It was nice as a simulation, but the text component is much more important than the visual one. Because some behaviour of elderly people is not really visualized: E.g. there were no shaking movements of hands. If you look at the 3d simulation, but it doesn't provide any information about the pros and cons of the usability of the product. The software has some bugs: 3d interaction bugs and software programming.	It was straightforward. It was generally very useful, and good to use. Looked interesting from the beginning, and it was not complicated.	It was a bit difficult to use it: Opening another xml file (Product selection), and it was crashing. The computer is slow when Virtex is opened. Starting a task was not intuitive. The "Setup" button was misleading.
2	"In general, Virtex's look and feel was pleasant."	4	2	7

	Comment:	The coloured result items in the results view were not easy to overview. There was description of the colours, but the main information/results were sometimes hard to get. In my opinion the look and feel was not really up to date. A little old fashioned. I would prefer a text based solution of the software, because in my opinion the 3d animation is some kind of "eye candy". I would prefer if the 3d appearance would be reduced to the important items (no pictures on the wall, no furniture), so the environment should be reduced to more abstract representation, e.g. reduced only to the parameters the VUM really contains like lighting level, noise level etc. The representation of environment properties can be done using symbols/icons and number values. A lot of 3d presented information is not important or not used for the evaluation. So it should be either very simple, so you will get the basic information, or it should be really fancy. By fancy I mean photorealistic, and the simulation would give you the feeling being the old person using the product.	The idea having the virtual user model, it was very interesting to see some human to see interaction. To see virtual user trying the product model. Overall, it was very good.	Well, it is an impression that is more of old operating system, disharmony of everything, typo, graphics... It worked, but it was not pleasant look and feel. Who will be the final software user, and what the software look they used to are important questions here. It should be more updated, more modern, like a modern web-page; it was not intentionally designed by a graphic designer. Overall, the interface should be a bit more simplistic, simpler. The design of the setup menu looks like as a power point presentation. The 3d environment is quite rough and coarse; the most recent games have a better resolution. The animation of a single press of a button, which was very coarse. The quality of the representation should be better. And it's probably the next step on the improvement of the software.
3	"The user interaction provided by Virtex was intuitive."	2	2	3

	Comment:	If you are common with computer games and user interfaces it is clear how to use it. The workflow was very nice. If you get more tasks and more data, so the task simulation takes very long, it would be helpful to get kind of batch processing or render list.	There was no actual feedback, when I was saving the results. (No feedback after pressing "Save" button.) And some of the lines show red, but some red highlighted tasks were not really bad. I'm not sure how intuitive the result presentation was. The highlighting of the tasks (results red, green) as a whole line was too unclear. It should be more differentiated between the tests with their results and the tasks/subtasks. The evaluation workflow: yes. 2 (The workflow was clear.) The same designers not always sketch and CAD model. So the program should be able to be kind of standalone. In the beginning of the program there were a number of users and environments, but there were no descriptions of them. If you need to use the program without to use other previous programs, that could be a problem.	It wasn't difficult. I think it was pretty o.k. The workflow was very clear, until I had the 3d environment und I started to read the instruction. I was misguided by the "Setup" button. "Setup the Scene" or maybe just a "Back" button would be better. The tasks are presented not as a clickable buttons. It's about the consistency how the things are presented on the screen.
4	"The Virtex application always worked as expected."	2	1	
	Comment:	There are some software bugs.What was unexpected: In the evaluation view I had moved the camera during simulation of one task to a certain perspective and wanted to keep this camera setting for the following task, but it switched to a default position.	I didn't have many expectations.	No. It didn't. It is difficult to give an overall evaluation. The first two pages were intuitive, but then it became more difficult. It was not very difficult, I could find my way. But there are some parts that could be better.
5	"I never lost orientation within Virtex."	3	1	2

	Comment:	Not really. One was the conflict where the camera switched back, see 4. And the other, I lost orientation when there was a visual glitch of walls and the zoom behaviour was too confusing: sometimes it was too slow, sometimes too fast.	--	I never lost orientation. The "Setup" was in my world the "Back" button.
Section 2. 'Setup Evaluation' menu				
6	"The 'Setup Evaluation' menu was clearly laid out."	2	1	1
	Comment:	Text entry is really old fashion (in the "Product" selection). I would prefere something like drag and drop.		
7	"The terminology used in the 'Setup Evaluation' menu was well understandable."	2	1	2
	Comment:	I didn't have any problems with understanding.		I'm not really sure about "VSF file". Is this something I should know?
8	"It was easy to set up a product evaluation for a predefined usage context."	1	1	1
	Comment:			
Section 3. Product evaluation and its results				
9	"It was easy to start the simulation of a task."	1	1	4
	Comment:	Yes, it was. The task/subtask menu/window could be highlighted more, so it would have a better contrast to the background. So it could be better distinguished from the 3d stuff (so the grey is not a good choice and the semi transparency).	It was very easy.	The first time it was difficult. I clicked on the "Setup" button first.
10	"The 'Subtasks' list showing the progress of the task simulation was useful."	5	2	2

	Comment:	It was too much happening. The list was more like a status. The status was nice, like to know that the simulation is still running. It was good, but there were two main activities happening at the same time on the different locations of the screen. That would be better either to combine them like augmented reality or to have controls like "Stop" and "Play".	There was no problem. I didn't know how many subtasks were there. An overview of all the subtasks would be helpful.	I'm not sure how useful it was, I didn't look at that. It was good to have. Another consistency issue: when I was performing the test, at the end is the "Result" button, which is not clickable first and become clickable as soon as the simulation was over. It was not clear enough, that the button is greyed out and not clickable. (The waiting till the simulation is over was not good.)
11	"The colour highlighting of the evaluation result statuses was helpful."	2	3	1
	Comment:	In the results view it would be good to have a filter to see the results in other ways.	It was useful, but it was a little bit confusing, or misleading.	In general, it was good.
12	"The colour coding used for the highlighting of the evaluation result statuses was intuitive."	1	3	1
	Comment:	Yes, I think it was clear.	How it was used it was not intuitive, so there was not enough differentiation.	
13	"The evaluation results report was easy to access."	3	1	5

	Comment:	Sometimes I lost a little bit the overview. It was easy to access, but if you are testing the product for a short time, then it sometimes happens that youloose the overview. Maybe improving the text and the typography could help to get the results easier. Clearer headlines, clearer main points, better layout. The transparent background doesn't make any use, it only makes it more complicated to read.	There was saved in the separate folder. The location was not clear enough.	It was easy to access, but it was not accessible! It was not the best way how to present it. It was easy to access the report, but it was difficult to access the information in the report. First of all, none of the windows are scalable. Only small part of the screen is used to present the results. Some of the highlighted items cannot be opened, i.e.some cannot be clicked. Highlight the items which you can open and which not differently. The format that would allow opening the information in the full screen. No confirmation is given after pressing the "Save" button.
14	"The evaluation results report was clearly structured."	4	3	3
	Comment:	It was o.k., but too much information for a single screen. Working with more fall down menus would be great.	It was clear, but the layout should be better designed. There is a little bit of differentiation I can see, but it is not clear enough.	The structure was good. It is difficult to get an overview. But is you go to the results you can find the information. Task by task represented. Sources were good to have. I couldn't copy text or click on the link.
15	"The presentation of results report in form of an interactive list was helpful."	2	1	1
	Comment:	It is much better as having the entire information visible on one screen. However this can be improved, see 14.	I immediately noticed that I can extend each of the categories when I hovered over.	It was. Not to have to look at green one at all. I like the interactive list, but how it was done it was not helpful. Given the long task it a good idea to print out the full report. In a word form would be helpful, where you can edit the text. It would be helpful to use it for internal reports. The next step is to make the print materials to use afterwards, e.g. for internal reporting or planning.

16	"The wording of the recommendations in the text report was understandable."	2	2	1
	Comment:	I didn't have any problems with wording. "Id-Name" was confusing.	If somebody is not really familiar with inclusive design, if he/she would understand it well. But I think it is not difficult to understand.	There was nothing what I didn't understand. I have experience with working with this kind of the products. It was good.
17	"The descriptions of the identified potential usage difficulties in the text report were informative."	2	2	2
	Comment:	I'm not in the field of producing mobile phones or washing machines, so I cannot really say whether it was informative enough for engineering professionals. For me it was informative. For me it was god, it was clear. The form "That's good!" doesn't sound scientific to me. So personal comments shouldn't be given by software.	The same as above.	It is very, very difficult to good an overall answer. I think it was informative. I think it is a little bit repetitive, but it has to be in a way... There would be way to reduce.
18	Do you think that the text report is a useful complement of the virtual simulation?	Yes, it's the most important part of the Virtex application.	Yes, definitely.	Yes, absolutely. The virtual simulation doesn't tell me anything without report.
19	"The method of the virtual usage simulation can facilitate understanding what difficulties a user can possibly encounter with the product."	4	1	1
	Comment:	The method is o.k., but the most you can learn by looking at real users. And working too much on the computers, you forget to think about the individual human beings. In my opinion it's too complicated to simulate the whole human behaviour including disabilities. Maybe it's nice to check the prototypes with the application, but it's more important to test with human users. I don't think, it's possible to simulate a human. The idea is interesting, and the method is o.k., but I don't know to make it usable.		This is the difficult question. If this is well done, that would be definitely useful. But the quality of the virtual simulation was not good; it was too coarse, to big polygons. But the method is capable, that's number 1! But the actual realisation is number 6. It isn't really looking as it would be giving me anything, the animation is useless. You should be able to have a possibility to skip the animation step.

Section 4. Miscellaneous Open questions				
20	Do you think offering the possibility to select a usage context while evaluating a product is important? In additon U3-U9 have been asked: Would you agree with the following? “The selection of usage context at the product evaluation stage ...” 1) “... helps in dealing with changing requirements.” 2) “... provides a possibility to evaluate a product for different usage context configurations (and not only for a single user in a single environment).”	That's great. It makes the software more flexible. Agreed with 1 and 2.	The usage context has to be considered during entire design process. Agreed with 1 and 2.	It's really important, as long as you can transport all the nuances in the simulation. The possibility is important, if you want to have real quality. In all products the requirements are a changing factor. Agreed with 1 and 2.
21	Can you imagine that a tool like Virtex could help to improve design?	Yes, but I think that the design process before starting sketching and prototyping is much more important: The research, the learning to know the user, trying to think different (Wanna design a mobile, think about communication first!).	Yes, it is helpful. There has to be enough free room for creativity. At least the usability wise.	Well, yes it could. But we think that it is very difficult to get all the small details that matters. There are so many details that you have to consider, it is very difficult to translate it into a mathematical equation. I don't know if it will. Because it is so much of algorithms that are important. But it can. Meeting real users cannot be replaced by this kind of tool.
22	Did you miss any features in Virtex?	Full screen! That would be nice to change the product and get the evaluation results directly without going back to the CAD software. Virtex could be a plug-in for CAD software.	Oh, yea: "Go back" button!	The report: filtering, the easiest way would be exporting it into a format I can use. To type the file path is tiresome, but to select it from the list would be better. Small improvements of the animations. How the hands are moving. Small fine details are missing.
23	What did you like the most in Virtex?	The possibility to move the camera around the person.	The virtual, but real looking people and real looking environment. So the visuals. If you don't have a background in inclusive design, that you get a feeling about a real person and an environment.	The overall principle, that you have an idea of having a virtual user testing the product. Can I trust the evaluation? To evaluate with real users. This is not instead of user evaluation; this is instead the expert evaluation.

24	What did you like less in Virtex?	The useless rendering of the virtual environment and the characters. Focus should be on the main parameters of the evaluation.	The application forms a stereotype of the environment and the person. The whole real situation transferred into a virtual situation. It's risky; because you might overlook that the real context is transformed into a virtual situation. You might be creating a stereotype. It's good but it is also dangerous. There needs to be a borderline, which clearly states, that that's not the reality, but only a virtual model. It has to be (S: or clearly represent) a certain level where people don't think that it is a replacement for a real testing.	The quality of the 3d manikin, the animation. It was too coarse. The overall look and feel. As a prototype I'm totally o.k. with the look and feel. The export function.
25	To ensure the best benefit of Virtex do you think the following is necessary? Virtex should ... 1) ... remain a standalone application. 2) ... not be dependent on any CAD development platform. 3) ... be integrated into our CAD development platform. 4) Others; please specify.	3) be integrated into our CAD development platform 4) Others: * Simulation package, where you can load any CAD models. * Virtex should be a plug-in of VICON CAD application.	1) remain a standalone application 2) not be dependent on any CAD development platform	1) remain a standalone application 2) not be dependent on any CAD development platform
	Comment:			If it would be integrated, it could be convenient. But I think that it is less important. I don't work in CAD environment any more. And I'm not working at the details level that I might be able to provide enough input.

26	Please summarise your overall opinion of Virtex:	Interesting idea, but missing the "wow" effect. The realisation could be improved. There were a lot of work put into the virtual reality aspects, but it actually should focus on the integration of human data and a scientific visualisation. Maybe there could be produced an output in form of infographics.	Congratulation to you guys – it is amazing work you have done. It is great to have a tool for inclusive design. It is definitely helpful reminding myself while designing a product for certain groups. It is a fantastic tool, definitely. However, Virtex shouldn't replace the reality!!	It's only a prototype, which shows an interesting concept, where you can perform predefined expert evaluation on your own. For us, it will be never enough, to use a software tool to evaluate a product design, you need to evaluate it yourself, and you need to hold it in the hand. The usage details, the small things. The major problem is that it is not have an artificial intelligence. I think it a very long future it cannot provide enough feedback. It could tell you some obvious things, but it could be helpful to designers without prior knowledge in inclusive design.
Section 4. VICON's Virtual user concept				
27	Have you been already familiar with the virtual user concept of VICON prior to the evaluation of the Virtex application? 1) Yes. 2) No, I only used the Virtex application.	No, I only used the Virtex application.	Yes	Yes
	Statements			
28	"The VICON virtual user concept is capable in supporting the designers in creating inclusive products."	4	2	6
	Comment:	It's a tool that can help, but the designer should not trust the software in any case. Otherwise you'll get for ten years always the same stuff. I think inclusive products have to be innovative. And for innovation you need freedom. The database is limiting. Using VICON only as a support of the design process can work, but relying only on the VICON environment can be limiting.		I don't think, so you could support, but only to a very limited amount. We believe that you need to meet the real users, and you cannot do that in a machine environment.

29	"The VICON virtual user concept can help to involve the user's perspective into the development process earlier."	3	2	4
	Comment:	Yes, it can, but a good designer should always think about the user's perspective first, before beginning sketching. The question is: Is the data from the database really the user's perspective?	This shouldn't solely rely on the virtual concept, instead of going to the real people. Inclusive design is not a group of people; you cannot summarize all the individuals! Of course there are personas and categories, but everyone is different.	The sketch tool could have some help, it provide a list with recommendation. But we already have it.
30	"The VICON virtual user concept is capable in product development acceleration."	2	2	6
	Comment:	You can prevent big faults and big mistakes. You can save money and time by virtual prototyping.	I think it's really good.	If it does, it would probably accelerate in the wrong direction. So we'll get not so good products, very fast. If you find a way to make it more accurate, some products could be helped, if they are easier to map. The mobile phones are more complex that the tool currently can handle. Currently the tool is oversimplifying the reality. There might be products, where it could help, but for mobile phones it is too simple.
31	"The VICON virtual user concept provides knowledge concerning disabilities and derived requirements."	2	2	4
	Comment:	You learn a lot about humans with disabilities. The text is always about humans and devices.		Well, there was some really good knowledge. The list from the sketch tool is useful, but if you base test on the too limited data, it could mislead the designers in their process.

32	If you have further suggestions for improvement, please share them in the following.	Make Virtex (S: primary the Virtex' virtual environment is meant) more abstract! Simplify the information.	The CAD application had a lot of problems installing it. I whish the application would be more available to different platforms. OS X version would be also great! But, thank you to the project, it was an eye opener!	Whenever there is risk, that the information can be misguided, it is best to highlight it well. The tools are not able to replace the real user tests. But if you say, this is something that should point out the issues of a product, that need to be tested with real users, then the tool can be really useful.
	Comment:			

APPENDIX E Task 4.3 Ethics Protocol

Resources

The Ethical Issues in VICON were identified using the following resources:

- The VUMS Cluster Ethics activities (http://www.veritas-project.eu/vums/)
- The Research Ethics Guidebook (http://www.ethicsguidebook.ac.uk/)
- British Psychological Society Code of Conduct: Ethical Principles for Conducting Research with Human Participants (http://www.bps.org.uk/the-society/code-of-conduct/support-for-researchers_home.cfm)
- Ethical Review in FP7: European Commission Guidance for Applicants – Informed Consent (ftp://ftp.cordis.europa.eu/pub/fp7/docs/informed-consent_en.pdf)
- Ethical Review in FP7: European Commission Guidance for Applicants – Privacy (ftp://ftp.cordis.europa.eu/pub/fp7/docs/privacy.doc)

Before User Testing

Issue 1: Ethical Sourcing of End Users

FIT and UoB will test the VICON toolset with the industry partners (DORO and Arcelik) and will source additional end users from their own network of contacts. Ethical principles of respective organisations will be followed when sourcing individuals for the tests.

User Testing

Issue 2: Consideration of the Consequences of the Research

In VICON it is necessary for investigators dealing with end users to consider the ethical implications and psychological consequences for the participants in their research. The investigation will be considered from the standpoint of all participants; foreseeable threats to their psychological well-being, health, values or dignity will be eliminated. Since the questionnaire does not require personal or private information issues are not foreseen.

Issue 3: Consent

Whenever possible, the investigator will inform all participants of the objectives of the investigation. The investigator will inform the participants of all aspects of the research or intervention that might reasonably be expected to influence willingness to participate. The investigator will explain all other aspects of the research or intervention about which the participants enquire. An Informed Consent section on the questionnaire will be completed by participants prior to testing.

Issue 4: Welfare and dignity of the participants.

Investigators should realise that they are often in a position of authority or influence over participants who may be their employees or clients. This relationship must not be allowed to pressurize the participants to take part in, or remain in, an investigation.

Issue 5: Debriefing

Following the research it is important to debrief the end user. In the case of VICON the opportunity will be given to the end user to ask questions following the user test or interview.

Issue 6: Withdrawal from the Investigation

At the onset of the investigation investigators will make plain to participants their right to withdraw from the research at any time. The investigator must attempt to ensure that participants know of their right to withdraw.

In the light of experience of the investigation, or as a result of debriefing, the participant has the right to withdraw retrospectively any consent given, and to require that their own data, including photographs or recordings, be destroyed.

Issue 7: Confidentiality

Information obtained about a participant during an investigation is confidential unless otherwise agreed in advance. Participants in the research have a right to expect that information they provide will be treated confidentially and, if published, will not be identifiable as theirs. All participants will be assured of this.

Issue 8: Protection of participants

Investigators have a primary responsibility to protect participants from physical and mental harm during the investigation. Normally, the risk of harm must be no greater than in ordinary life, i.e. participants should not be exposed to risks greater than or additional to those encountered in their normal lifestyles.

Participants will be informed of procedures for contacting the investigator within a reasonable time period following participation. Where research procedures might result in undesirable consequences for participants, the investigator will detect and remove or correct these consequences.

Where research may involve behaviour or experiences that participants may regard as personal and private, the participants will be protected from stress by all appropriate measures, including the assurance that answers to personal questions need not be given. There will be no concealment or deception when seeking information that might encroach on privacy.

Issue 9: Observational research

Studies based upon observation must respect the privacy and psychological wellbeing of the individuals studied. VICON requires that the participants give their consent to being observed. The nature of the observation will be made clear to the participants prior to the user tests.

After User Testing

Issue 10: Data privacy

During each user test, each participant will be assigned a unique code. To ensure that the participant's identity is only known by the investigator, all data will be anonymised and linked to that code.

Issue 11: Storing personal information

Any personal information collected during the user tests (in electronic or printed format) will be stored appropriately, so that it can only be accessed by direct members of the research team for T4.2.

Issue 12: Using user data in the Virtual User Model

Any user data collected during the course of the project, which is used to inform the development of the VICON toolset, will be completely anonymised.