Interaction Design Exam Paper

(Eksamensnummer: 51)

April 1, 2022

1 Question

a)

To account for the assumptions with regard to the users of the interface, as well as the tasks they seek to achieve by using `www.ikea.com/dk/da/` and the context of usage, I will primarily draw on the PACT-model (Hornbæk et al., 2022). In addition, the analysis of the users of the system will also include the *representative* user of the website in terms of the "user cube" and its three dimensions of the user's level of experience with the system in question (Nielsen, 1993).

1. **People:** The largest, or rather the typical, user base of the system at hand is IKEA customers with different income levels. In terms of the age range, it could vary from "18" to "60 and above", i.e. a typical customer is an adult person. In terms of the level of experience, the interface at hand is designed for *novices* rather than experts in that the website is built more like a "walk-up-and-use" system (Nielsen, 1993) that requires little reading of the instructions. Yet, within the "user's cube" model (Nielsen, 1993), the representative user would occupy the area somewhere around the origo of the coordinate system. On one hand, the interface at hand is designed in a way that requires from "minimal-to-some" experience on the part of the user: i.e. some "60 and above" or young users may be left out of the system as *complete* novices, not able to achieve their goals altogether. On the other hand, as already mentioned above, the system at hand is hardly meant for expert users either in that it does not contain, among other things, extensive, more complex menus that are usually targeted towards experts.

2. **Activities:** It is obvious that this system is meant for designing "individual" IKEA wardrobes, offering a large range of options for different wardrobe parts.

3. **Contexts of use:** In terms of the physical context of use, the system can in principle be accessed from anywhere — home, work, the street, IKEA physical stores etc. — since the only thing you would require to design your personal wardrobe is a laptop and Wi-Fi.

4. **Technologies:** The system at hand is an internet-based technology that is built around a single "short menu" (Nielsen, 1993) of the different wardrobe parts, which, in turn, implies a non-expert user-audience of this system.

b)

In terms of the preliminary evaluation of the system and its focus aspects listed above, the notions of *usability* and *user experience* come particularly handy. While this interface is clearly designed for one-time purposes, and, in this respect, adheres to such usability demands as <u>learnability</u>, it can still be a pretty time-consuming endeavour to design one's own closet, which, in turn, can easily end up as a pretty boring and tiresome experience. In this respect, therefore, we believe that the notion of <u>UX</u>, with its focus on such human values and needs as "[...] visual aesthetics and beauty, joy of use [...] or surprise" (Bargas-Avila & Hornbæk, 2011) are critical for the given system. In other words, the system should be <u>subjectively pleasing</u> (Nielsen, 1993) to use. Besides, a pleasant aspect is that the time issue has actually been taken care of by the system with its "Save the draft for later use", thereby enabling the user to get back to her wardrobe design project later on.

Moreover, the fact that the interface at hand is not intended for expert users, makes such elements of **usability** as *efficiency* and *memorability* relatively insignificant. Yet, the system should still be designed so that very few <u>errors</u> occur, while at the same time not allowing for irremediable

errors altogether. Otherwise, it is highly probable that a customer would quickly become irritated, demotivated and eventually drop the case.

To sum up, it seems that such aspects of **usability** as (1) *satisfaction* — which, in turn, is closely related to the notion of **UX** — as well as (2) *learnability* and (3) *few errors* are critical to the successful functionality of this website.

2 Question

(a)

According to Hornbæk et al. (2022), there is no such usability inspection method that can be characterised as "one size fits all". In other words, the choice of a specific evaluation method depends on many things, such as the type of the interactive system to be evaluated, user goals and the context of use. As far as the website at hand is concerned, such analytic methods as, say, heuristic evaluation could be a valid choice, because it is particularly suitable for relatively simple designs (Hornbæk et al., 2022), which, in turn, is the case with the IKEA's interface for designing wardrobes. Yet, it has been pointed out (Hornbæk, 2022b; Hornbæk et al., 2022) that one of its main weaknesses concerns the issue of *validity* of an evaluation: i.e. experts carrying out the evaluation would have a strong tendency of focusing on their own vision of potential usability problems and distancing themselves from a real user, eventually failing to identify real problems for real users. That is one of the reasons, why we have opted for the walkthrough evaluation method (Wharton et al., 1994), which, in contrast to heuristic evaluation, allows an expert to easily identify herself with a real user by focusing on concrete tasks.

Another reason for choosing the walkthrough method relates to its focus on the *learnability* aspect of the usability concept (Wharton et al., 1994) — the aspect that has been identified in the section above as being *critical* to the successful functionality of the website in quesiton. And even though Wharton et al. (1994) argue that the use of the walkthrough alone would hardly produce valid results with functionally complex systems due to its focus on the ease of use of a given interface, the fact that the IKEA's online design program is a relatively simple system directed at customers with a minimal or medium computer experience makes, in actual fact, this argument irrelevant. Finally, the walkthrough is argued to be a simple question-and-answer process that could be used effectively without any specific expert knowledge or understanding of the theory behind cognitive psycology (Wharton et al., 1994).

(b)

Wharton et al. (1994) provide a detailed desciption of the walkthrough evaluation method, including the preparatory phase, the step-by-step analysis phase and general fixes for usability problems.

The preparatory phase comrises such aspects as: 1) representative users of the system; 2) representative collection of benchmark tasks; 3) a description of the sequence of actions for each task; and 4) the definition of the given interface.

As far as the representative user of the website at hand is concerned, it has been mentioned in question 1.a. that the system is primarily directed at IKEA adult customers with "minimal-to-some" computer experience.

The representative collection of tasks comprises a relatively large selection of IKEA wardrobes. For the purposes of the paper at hand, we have confined ourselves to one of such tasks, namely the design of a wardrobe (color: black, size: 58cm x 236cm, doors: 2, wardrobe accessories: one of the pre-designed combinaitons) and provided its detailed description in the Appendix A 6. The

usability problems that were encountered during the walkthrough evaluation (13 steps), as well as the definition of the IKEA interface can also be found in the Appendix A 6.

(c)

Among the most typical odds of using the walktrough mentioned in litterature relates to the aspect of time, i.e. it is often tedious and time-consuming (Wharton et al., 1994). In this respect, therefore, the level of detail that the walkthough allows for can be seen as a double-edged sword: it provides a much deeper level of analysis than other non-expert evaluation methods, while its cost in terms of the time invested in it can evenually be too high. And that is definitely something we can relate to after having carried out the evaluation (cf. the Appendix A 6).

Another trade-off with using this method that is mentioned in litterature concerns its "narrowness" (Wharton et al., 1994). Namely, the evaluator would typically confine herself to the evaluation of a single task, leaving the rest of the system unexplored. That was clearly the case with our one-scenario walktrough, where we chose to focus on the task of evaluating the design of one particular wardrobe — and not the implementation of the system in general. Besides, different evaluators — and users for that matter — with different level of knowledge and experience, would focus on different tasks and goals, thereby highlighting the issues that appear obvious to them and missing those that are not.

Probably, the major trade-off of the walkthrough relates to its focus on the learnability aspect alone. That implies that in most cases the method will give *negative* evaluation to more advanced features of the system that intend to enhance productivity and effectiveness (Wharton et al., 1994). That is exactly what we did at the step-by-step analysis phase, where our failure stories reflect to a certain degree the implementation of more "advanced" features of the interface (cf. the Step-by-Step analysis in the Appendix A 6).

(d)

After having carried out the evaluation of the IKEA design interface with respect to one task, we have detected four major usability issues (see a detailed description in the Appendix B 6). The two of them have been categorized as "cosmetic" problems after Nielsen (1993) and relate to the aspect of making meaningful labels, while the other two concern the "Undo"/ "Delete" as well as "Drag-and-Drop" features of the system that have been analysed as "minor" and "major" usability problems, respectively. The results of our analysis largely reflect the type of the user the website is intended for, which we have identified in question 1.a. That is, our analysis of the IKEA interface tends to give negative evaluation to more advanced features of the system, which, we presume, to (some of) the representative users of the program would stay elusive.

3 Question

(a)

Greenberg and Buxton (2008) have levelled criticism against the arguments advocating the ubiquitous and critical role of evaluation. According to them, evaluation can have a directly harmful effect on the system, if the evaluators behind the evaluation have been guided by "rules" rather than "thought". They have also argued that the spirit of conformity and adherence to the existing norms in academia can be a real "killer" of creativity and genius solutions, when evaluation is carried out at the early stage of system development. The same goes for evaluations of demo-versions of the systems containing radical innovations, that may, in actual fact, be discarded due to some imperfections and glitches characteristic for the initial development stage.

Sometimes, when evaluation is done with the purpose of validating an academic prototype, there is a danger of dismissing it altogether as "worthless" and non-convertible to everyday and practical purposes. Finally, the evaluators that ignore the important aspect of how cultures adopt technology over time would usually be inclined to overlook the potential possibilities of a given system.

(b)

Since Greenberg and Buxton (2008) arguments mainly concern prototype versions, the evaluation of which may sometimes endanger the potential release of the product, they can hardly be applied in relation to the evaluation at hand. Partly because the IKEA interface is a released product, and partly because it can hardly be characterised as a highly innovative or revolutionary system. At the same time, we do concur with Greenberg and Buxton that, as evaluators, we should be aware of the possible side-effects of "rigid", conformable evaluations and always strive at retaining openness and curiosity for those parts of a system that represent original ways of envisioning pleasant and meaningful user systems.

(c)

Hornbæk et al. (2022) advocate not merely for the importance of usability problem evaluation, but actually point out the necessity of iterative evaluations — at the preparatory phase, the development phase, and the pre-release phase. In other words, the authors claim that interactive systems should be subjected to continuous evaluation. The main rationale behind their view is beautifully expressed in the following quote:

> "Evaluation is an essential for a human-centered development process and, additionally, indispensable for research. The reason is that interactive systems are complex, and assuming that they work as intended by their design is naive."
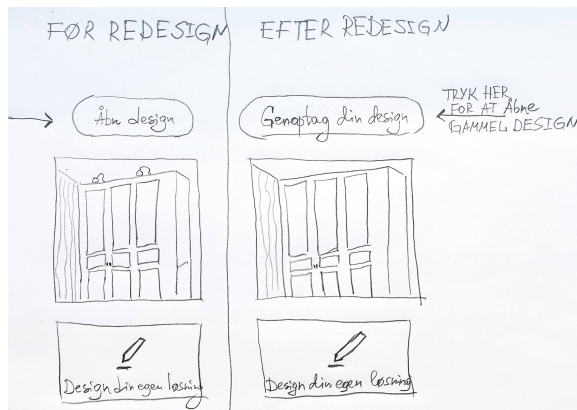>
> Hornbæk et al. (2022)

At the same time, Greenberg and Buxton (2008) do not argue againt the ideas advocated by Hornbæk et al. (2022). In actual fact, both Greenberg and Buxton (2008) and Hornbæk et al. (2022) seem to be on the same page with regard to the importance of matching the choice of evaluation methodology with the actual problem. And as long as the overwhelming majority of interactive systems are not objects of art, in which case the ensuing evaluation of the designer's intuition would be rather meaningless, conducting evaluation should be considered critical to any system at different stages of its development.
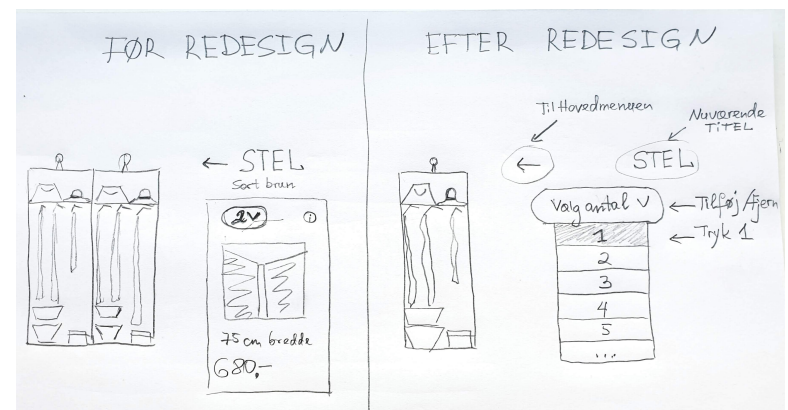
4 Question

(a)

In the following, we are going to present a low fidelity paper-prototype for redesign solutions of the four usability problems discovered during the walkthrough evaluation of the IKEA design interface.

In the picture 1a, we have attempted to come up with a better design solution for Problem 1 (cf. the Appendix 6), which addresses the usability issue of "poor" labelling:

(a) "Åbn design" vs. "Genoptag din design"

(b) None vs. Drop-down menu

Picture 1b demostrates a redesign solution of the usability Problems 2 and 4 in the Appendix 6 that addresses the issue of the quite unintuitive functionality of reducing the number of the chosen elements in the right-hand side of the interface (for Problem 2) and the principle of proximity (for Problem 4). As far as the former is concerned, the redesign above proposes the use of the drop-down menu instead of the tick-box and a number of elements, that in the original interface can only go up. As for the latter, the redesign offers to disambiguate the two icons — the arrow for going back to the Main menu and the title of the given menu-section "Stel" — by enlarging the distance between them.
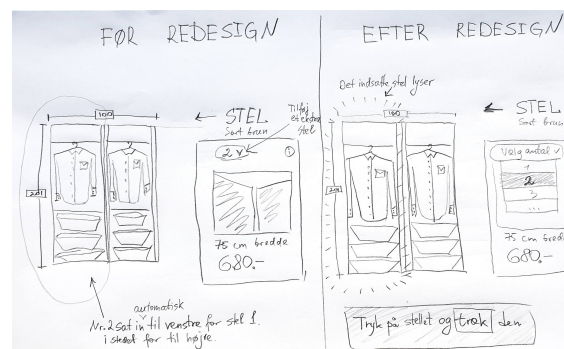

Figure 2: Drag-and-drop functionality

Picture 2 illustates the redesign solution for Problem 3: i.e. the drag-and-drop feature of the interface that allows moving the elements (in our case, a closet frame), by clicking on them and pressing the mouse while dragging them. The redesign proposes an additional visual highlighting of the chosen element: i.e. the added element lights up and blinks at the same time as the window with the "helper"-text "Tryk på stellet og træk det" appears in the proximity of that element.

(b)

First and foremost, all the four redesign solutions build upon the *learnability* aspect of usability (Nielsen, 1993) and are supposed to be the "improvements" intended for *novice users* of the interface at hand. The redesign solution for Problem 1 is related to the *usability of icons* (Nielsen, 1993), and mends for the possible confusion of the two labels "Åbn design" and "Design din egen løsning".

The redesign solution for Problems 2 and 4 addresses the Gestalt principle of proximity (Johnson, 2021). Concerning Problem 2, in the IKEA's website, the "Undo"/ "Delete" button(s) is placed in the left side of the interface, whereas the "Add" button is placed in the immediate proximity of the given element in the right side of the interface. In other words, the distance between them is too high and might lead to usability issues (Johnson, 2021). In terms of the redesign solution for Problem 4, the distance between the two buttons — the arrow for going back to the Main menu and the title of the given menu-section — is too small and might be perceived as a single feature, "Go back to Main menu", rather than two.

The redesign solution for Problem 3 similarly addresses the Genstalt principle of proximity in that the functionality of adding elements is mainly placed in the right side of the website, while the drag-and-drop is available in the left side of the interface. In other words, the distance is too large and to mend for that, we have made use of the principle of perception (Johnson, 2021) and offered to highlight the added element and add a text-helper that would prompt the user to perform the desired action.

(c)

We believe that our redesign proposal is better than the existing IKEA interface due to the following reasons: (1) It is more effective because the total time of completing the chosen task is smaller with the redesign version (T = 46.25s) than with the original website (T = 66.9s); (2) it takes into account the skills and the level of computer experince of the representative users; (3) it addresses such usability problems as "poor" or ambiguous labelling; and finally (4) it reduces the mental burden of users considering the aspect of proximity, by placing related functionalities (fx Add/Delete items) close to each other and separating those that are unrelated (e.g. "Go back to Main menu" and the title of the currect menu-option).

The detailed KLM analyses — one for the task with the original interface and the other one with the redesign proposal — can be found in the Appendix C 6.

(d)

In actual fact, the present KLM analysis of the redesign version of the interface does not cover the solution of Problem 3 and the benefits of the improvement of the drag-and-drop feature, both in terms of *learnability* and *satisfaction*, in that the task at hand has been defined for a wardrobe consisting of the two frames, which, in turn, makes swapping them rather meaningless. The same goes for Problem 4, because the KLM approach does not really provide the tools for detecting visual/cosmetic improvements that are related to a better *user experience*. In this respect, we assume that eye-tracking or interview evaluation methods would be much more effective and reliable.

5   Question

(a)

The IKEA website is a combination of the two types of graphical user interfaces (GUI). Its left-hand part represents the so-called *direct manipulation* interface and its right-hand part — a *menu navigation* interface. The former adheres to the main principles of direct manipulation described in Shneiderman et al. (2016), such as: 1) visual representation of objects and actions; 2) physical actions or presses of labelled interface objects instead of complex syntax; and 3) rapid, reversible actions whose effects on the objects are visible right away. Moreover, it can be characterized by the following main attributes: 1) it is especially suitable to novice users (i.e. the representative users of the website at hand); 2) the response of the system to the user's action is directly and immediately visible; and 3) users experience less anxiety and more pleasure as the interface is comprehensible.

The latter is characterized by a text-based list of organized menu-sections and subsections as well as visual representation of different design options/objects (Hornbæk, 2022a). Besides, it incorporates a scroll functionality that is also typical of menu interfaces.

(b)

Even though dealing with visual representations of objects is claimed to be more "natural" for humans (Shneiderman et al., 2016), one of the main possible challenges with using direct manipulation interfaces relates to the fact the meanings of visual representations and graphic icons are not necessarily always intuitive and may require learning. That is related to another issue with using direct manipulation. As Shneiderman et al. (2016) point out, visual representations may sometimes be deficient, or in the worst case — misleading, because the titles or "helper"-messages that appear on icons, when the cursor is pointing at them, usually offer only a partial solution.

And one of the main challenges with using menu navigation interfaces concerns the difficulty of presenting numerous options on a limited screen space (Hornbæk, 2022a).

(c)

Our findings with respect to Problem 2 and 3 (cf. Appendix B 6) support the major challenge with using direct manipulation interface mentioned above. To be more specific, the analysis revealed that some graphic features of the website are less intuitive than one would expect it and, in the worst case scenario, could be misunderstood by novice users, especially elderly ones and those with minimal computer experience. That means, that it would require additional learning on their part to be able to reach the goal and finish the design of a wardrobe. That is also in line with our critique of some of the labels of the interface (cf. Problems 1 and 4 in Appendix B 6) that might be rather confusing for a user. Finally, the analysis at hand discovered the issue of the deficiency of some of the visual representations of the interface. Namely, the system allows a user to directly interact with it, by, among other things, highlighting the element with a blue circle in the middle of the chosen object. Yet, the circle is not accompanied by a meaningful information that might help a novice user and guide her in the right direction. In this respect, therefore, we believe that the redesign solution proposed in the paper at hand is a good alternative to the missing features of the IKEA interface.

6 Appendices

Appendix A

Consider a detailed description of the preparatory phase of the walkthrough process as well as the step-by-step analysis of each step in the pictures below. Notice, that the former highlights only those steps that might be prone to potential usability problems.
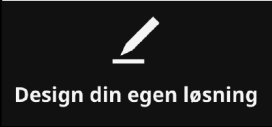
Task: I want to use IKEA's website to design my own, unique wardrobe. It should be black, 58 cm wide and 236 cm high, two doors, with wardrobe accessories (drawers, hangers and shelves).	
Interface: A website for designing a wardrobe from IKEA (www.ikea.com/dk/da.	
Action sequence	**Step-by-Step Analysis Phase**
Click on the button below and begin designing your wardrobe. ✎ **Design din egen løsning** 1 Wedsite: Fowarded to IKEA's design program	*Criterion:* Will the User Know That The Correct Action Will Achieve The Desired Effect? **Failure story:** I clicked on the button at the right-hand corner of the screen and found that the option was not for a "new design". (**Åbn design**)
Choose one of the 1) three colour options, 2) depth and hight, and 3) the desired wardrobe frame, 4) the desired number of frames and 5) click on the button "Frame" above to go back to the main menu.	*Criterion:* Will the User Know That the Correct Action Is Available? **Failure story:** I chose a wrong frame, but didn't know tha to delete the chosen frame, one should either click on the picture of the frame itself

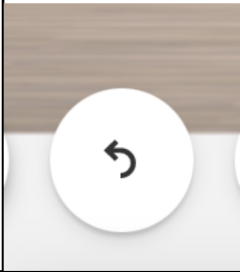Figure 3: Preparatory phase and Step-by-step analysis

2	Hvad vil du gerne tilpasse? Stel > Døre > Greb > Indretning >	 or by clicking on the "regret" button under the picture.
		Criterion: Will the User Know That the Correct Action Is Available? **Failure story:** I combined the chosen frame with another frame, but the program set it in on the wrong side of the 1st frame. I didn't know that I could use the "drag-and-drop" function and the mouse to move the different elements in the picture.

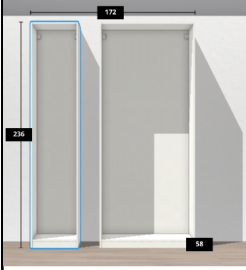Figure 4: Preparatory phase and Step-by-step analysis

		Criterion: Will the User Know That the Correct Action Is Available? **Failure story:** I didn't know that the button "Stel" would forward be to the main menu. ← **Stel**
3	Choose the next option on the menu (Doors) and click on it.	
	Choose the desired door option and click on it.	*Criterion:* Will the User Know That the Correct Action Is Available? **Failure story:** I didn't know that to change the design of one of the doors, I could just click on the door I want to change and then click on a new door design in the door-menu.

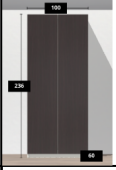Figure 5: Preparatory phase and Step-by-step analysis

4		
5	To go back to the main menu, click on the "Door" button above.	
6	Click on the "Handles" option and add a door handle to your wardrobe.	
7	Go through different options and choose the desired one.	
8	To go back to the main menu, click on the "Handles" button above.	
9	Click on the "Room design" option to go to the room-design menu.	

Figure 6: Preparatory phase and Step-by-step analysis

10	Choose the pre-designed option by clicking on it. **Færdige kombinationer** Indretningsliste	
	Click on the frame in the picture to add a desired room design.	**Success story:** I chose the desired room design for my wardrobe by simply clicking on its menu option.

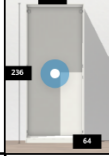Figure 7: Preparatory phase and Step-by-step analysis

11		
12	Finish the design by clicking on the blue button in the right-hand corner. **1.690**.- **Færdiggør →**	
13	Put the wardrobe into the busket or save it for later. **PAX** Garderobe, 100x58x236 cm **1.690**.- Pris inkl. moms **Læg i indkøbskurv** Gem til senere	

Figure 8: Preparatory phase and Step-by-step analysis

Appendix B: The list of usability problems

1. **Problem description**: The failure story in Figure 3 concerns the front page with two buttons: "Design din egen løsning" and "Åbn design". The labelling can be confusing for a person that uses the interface for the first time, in that both of them imply a kind of a next step in the design process.

   Problem analysis: The "Åbn design" button is presumably called so because it presupposes that the user has a work-in-progress design and prompts her to proceed to the already existing project, rather than beginning one from scratch.

   Severity rating: In terms of the five-point rating scale adopted from Nielsen (1994), this problem can be qualified as a "Cosmetic problem". It would require little time and a simple reformulation of the "Åbn design"-label to amend it.

2. **Problem description**: The failure stories in Figures 3 and 4 exemplify a potential usability problem the user might encounter when she wants to delete a chosen item — be it a wardrobe frame, a door, a handle, a wardrobe accessory, etc. The functionality of "Delete" or "Go Back"/"Undo" options does not seem to be implemented in a way that is obvious for some novice users of the interface, especially those categorised as *novice users of system* in Nielsen (1993).
   The option of directly choosing particular elements in the picture by clicking on them might be obvious for some users with medium-to-extensive computer experience, and less obvious for the users with minimal computer experience (Nielsen, 1993).

   Problem analysis: There seems to be a discrepancy between the expectations to the level of experience of the representative user the interface and the actual implementation of the given functionality. That is, the latter clearly requires a higher level of experience than that of the

typical users the website is otherwise intended for.

Severity rating: Yet, on the severity scale from 1 to 5, we would classify this type of problem as a "Minor usability problem", in that the user might still be able to reach her goal, even though it may end up being a frustrating and time-consuming experience.

3. **Problem description**: The failure story in Figure 5 is another example of a potential usability issue that goes hand in hand with the level of computer (or this particular interface) experience of the user. Namely, the website allows for changing and adding different elements of one's design, but it does it in a random manner, which can evoke frustration and irritation, unless the user knows that she can avoid that "irritating behaviour" on the part of the system by simply clicking on the particular parts of the wardrobe directly in the picture.

   Problem analysis: The character of the problem at hand resembles that of the previous problem. Namely, the functionality of manipulating the elements in the picture does not seem to be rather intuitive. On the contrary, it requires from some to substantial experience and knowledge about how the system works.

   Severity rating : On the scale from 1 to 5, we would classify this usability issue as a "Major usability problem". It seems very unlikely that some of the users of the website (mostly elderly ones) would be able to reach their goal without getting help from "another human being" (Nielsen, 1994).

4. **Problem description**: The failure story in Figure 5 exemplifies a seemingly recurring potential issue with the website at hand. Notably, there are different labels for going back to the main menu such as, say, "Stel". That logic can be confusing for a user that has finished designing her wardrobe frame and wants to go back to the main menu — not the "Frame" section again.

   Problem analysis: We believe that the designers of the interface were guided by the idea that aesthetics wins at the expense of functionality. That is, it would kind of "pollute" the layout if the title of the respective subsection was accompanied by an additional label "Main Menu" instead of a laconic icon — the "left-pointing arrow".

   Severity rating: The usability problem at hand is clearly of the "cosmetic" type that can easily been fixed by rethinking the layout in terms of what labels should be placed and where.

Appendix C

To test the efficiency of the website, we apply the KLM analysis presented in MacKenzie (2013) that is used to predict the amount of time required for a given task by separating it into a series of predefined primitive operations or subtasks. Each of these subtasks has an average time requirement, which often depends on the user's level of experience in using the given interface. These time requirements can then finally be added together to predict the total time requirement of the whole

task. The model separates various motor-control operations that are required to operate a compute. For the purposes at hand, our KLM analysis will include only the three of them: keystroking(K), pointing(P), and mental operator (M) that stands for human response time.

Each P-operation is assigned a value according to the skill of the user. As far as the representative user of IKEA's design website is a user with "minimal-to-some" computer experience, we employ the tP = 0.28 s that corresponds to an "average non-secretary typist" (MacKenzie, 2013). Both the pointing operator and the mental operator are assigned constant values based on Fitts' law: tP = 1.1 and tM = 1.35. The two analyses below account for the task of designing a wardrobe, delineated above 6:

- **The KLM analysis of the existing interface**:

Nr. ste	Subtasks	Operators for each subtask
1	Click on "Åbn design"	P K M
2	Click to go back to the front page	P K M
3	Click on "Design din egen løsning"	P K M
4	Choose color	P K M
5	Click on "Fortsæt"	P K M
6	Click on "Stel"	P K
7	Click on "75 cm bredde"	P K M
8	Click on "75 cm bredde" to add another frame	P K
9	Click on "75 cm bredde" to remove the added frame	P K
10	Click on "Undo" to go back to two frames	P K
11	Click on "<-" to go back to the main menu	P K
12	Click on "Døre" to choose a door	P K M
13	Click on "RAINSVOLL"	P K M
14	Click on "<-" to go back to the main menu	P K
15	Click on "Greb"	P K
16	Click on "ENERYDA"	P K M

17	Click on "<-" to go back to the main menu	P K
18	Click on "Room design"	P K M
19	Click on 1st frame	P K M
20	Choose the desired design	P K M
21	Click on 2nd frame	P K M
22	Choose the desired design	P K M
23	Click on "<-" to go back to the main menu	P K
24	Click on "Færdiggør"	P K M

To calculate the total time it takes to complete the task at hand we insert the values from the tables above into the formula:

$$t_{execute} = 24P + 24K + 15M = 1.1s \cdot 24 + 0.28s \cdot 24 + 1.35s \cdot 15 = 66.9s$$

- **The KML analysis of the redesign**:

Nr. ste	Subtasks	Operators for each subtask
3	Click on "Design din egen løsning"	P K M
4	Choose color	P K M
5	Click on "Fortsæt"	P K M
6	Click on "Stel"	P K
7	Click on "75 cm bredde"	P K M
8	Click on "Vælg antal" to add another frame	P
10	Click on "2"	PK
11	Click on "<-" to go back to the main menu	P K
12	Click on "Døre" to choose a door	P K M
13	Click on "RAINSVOLL"	P K M
14	Click on "<-" to go back to the main menu	P K
15	Click on "Greb"	P K
16	Click on "ENERYDA"	P K M
17	Click on "<-" to go back to the main menu	P K
18	Click on "Room design"	P K M
19	Click on 1st frame	P K M
20	Choose the desired design	P K M
21	Click on 2nd frame	P K M

Nr.	Subtasks	Operators for each subtask
22	Choose the desired design	P K M
23	Click on "<-" to go back to the main menu	P K
24	Click on "Færdiggør"	P K M

To calculate the total time it takes to complete the task at hand we insert the values from the tables above into the formula:

$$t_{execute} \;=\; 21P + 20K + 13M \;=\; 1.1s \cdot 21 + 0.28s \cdot 20 + 1.35s \cdot 13 \;=\; 46.25s$$

References

Bargas-Avila, J. A., & Hornbæk, K. (2011). Old wine in new bottles or novel challenges: A critical analysis of empirical studies of user experience. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 2689–2698.

Greenberg, S., & Buxton, B. (2008). Usability evaluation considered harmful (some of the time). *Proceedings of ACM CHI, 111-120.*

Hornbæk, K. (2022a). *Brugergrænseflader.* University of Copenhagen.

Hornbæk, K. (2022b). *Evaluation.* Københavns Universitet.

Hornbæk, K., Kristensson, P. O., & Oulasvirta, A. (2022). *An introduction to human-computer interaction.* Oxford University Press.

Johnson, J. (2021). *Designing with the mind in mind: Simple guide to understanding user interface design rules.* Morgan Kaufmann Publishers Inc.

MacKenzie, I. S. (2013). *Human-computer interaction: An empirical research perspective.* Elsevier Science & Technology.

Nielsen, J. (1993). *Usability engineering.* Elsevier Science & Technology.

Nielsen, J. (1994). Enhancing the explanatory power of usability heuristics. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.*

Shneiderman, B., Plaisant, C., Cohen, M. S., Jacobs, S., & Elmqvist, N. (2016). *Designing the user interface - strategies for effective human-computer interaction, 6th edition.* Pearson.

Wharton, C., Rieman, J., Lewis, C., & Polson, P. (1994). *The cognitive walkthrough method: A practitioner's guide.* John Wiley; sons.