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Summary

Usability metrics for the KRIS5 land register management software

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Table of Contents

Definitions	4
1 Introduction	5
2 Usability metrics system	6
2.1 Objective of the usability metrics system	6
2.2 Usability attributes	6
3 Application of usability metrics	8
3.1 Usability levels	8
3.2 When and how to measure?	9
3.3 Usability metrics list	9
3.3.1 Effectiveness	10
Metric 1. The percentage of changing form default values.....	10
Metric 2. The percentage of incomplete search results.....	10
Metric 3. The percentage of switching between tabs.....	11
Metric 4. The percentage of moving forward-backward when navigating.....	11
Metric 5. The percentage of scrolling drop-down menus	12
Metric 6. The percentage of using filters for table sorting	12
Metric 7. The number of interactions in a specific act evaluated against a benchmark..	13
3.3.2 Learnability.....	13
Metric 8. The percentage of using speech bubbles.....	13
Metric 9. The percentage of new users' learning speed	14
3.3.3 Efficiency	14
Metric 10. Average processing time from registering to status "Finished"	14
Metric 11. Average processing time from status "In review" to status "In processing"	
minus waiting time.....	15
Metric 12. Average processing time from status "In processing" to status "Finished"	
minus waiting time.....	15
Metric 13. Average processing time minus waiting time	15
Metric 14. Time spend in session forms per object	15
3.3.4 Error prevention.....	16
Metric 15. The percentage of user sessions with validation errors.....	16
Metric 16. The percentage of contacting user support	17
3.4 Additional metrics.....	18
Additional metric 1. Active time spent in the system.....	18

4 Summary 19

Definitions

Filtering	Narrowing data based on a specific criteria (such as proceeding type).
Interaction	Action by the user that has a consequence in the system (such as clicking on a button).
Usability	Describes the usage of a system, its ease of use, satisfaction and effectiveness for the user.
Measured element	Part of the user interface that the metric is based upon and measures (such as a button, form field, dropdown etc).
Navigation journey	The users movement within the system.
Object	Consists of multiple measured elements (such as the navigation menu).
Sorting	Ordering or grouping data based on a criteria (for example, alphabetically)
Statistical significance	Shows what is the probability that the given result will occur in a population.
Sample	Part of the user population that allows to make conclusion about the whole population.

1 Introduction

Usability metrics for the KRIS5 land register management software were developed over the period of July through October 2018 under the project “User experience and user needs of the land register management software and development of its user interface prototype”.

The metrics system was designed following the good practice of usability metrics, the user satisfaction study and the prototype developed during the project. The metrics take into consideration the particular nature of the KRIS5 management software as well as that of the users’ daily tasks.

The following chapters provide an overview of the metrics system designed for KRIS5 and outline applied usability attributes. Then, the evaluation of usability levels and the specifics of applying each metric is discussed.

2 Usability metrics system

2.1 Objective of the usability metrics system

The usability metrics system is designed to gather ongoing feedback on the behaviour patterns of users of the management software and use this data to identify problematic areas that can hinder efficiency and performance in daily work. What is more, keeping track of the metrics facilitates continuous usability of the information system, which, in turn, helps to go about the planning and sequencing of further development and design tasks in a more constructive manner.

It follows that the metrics system will be mainly applied by information system developers, user interface designers and system managers.

2.2 Usability attributes

A metrics system developed specifically for the KRIS5 management software relies on four usability attributes – effectiveness, learnability, efficiency and error prevention. Each attribute is in turn divided into specific metrics (*Figure 1*). Each usability attribute adapted to the needs of KRIS5 has its distinct goal, which helps to identify the attribute's strengths and weaknesses.

The objective of the metrics system designed for KRIS5 according to each attribute.

- **Effectiveness** – describes the extent to which users are able to achieve their goals.
 - It follows from the particular nature of the work of KRIS5 users – namely that no proceeding or proceeding stage is left unfinished – that effectiveness metrics focus on the usability of elements supporting the work process (for example, forms, drop-down menus, navigation structure).
- **Learnability** – describes the ease-of-use for first-time users of the system. How well does the system facilitate its increasingly efficient use over time?
 - Any management software should be easy to use for all users and an ideal system is one in which users don't encounter any issues or don't need any help. Exploring the system's learnability demonstrates to what extent the above is true, how easy or complicated the system is for new users and how long it takes to achieve a certain level of competence.
- **Efficiency** – describes the time users need to accomplish their tasks.
 - Similarly, to the attribute of effectiveness, the time it takes to accomplish tasks depends on a number of factors; for example, processing a large application takes several days versus a few dozen small-scale applications are processed in one day.

Therefore, in measuring the performance of the system the focus is not directly on the time required to accomplish a task but rather on the average processing time. Efficiency metrics are divided between various stages according to proceeding statuses and for most metrics, waiting time is subtracted from the total time spent.

- Error prevention** – describes the number of errors users make. How well does the system prevent users from making errors and wrong decisions? How quickly do users recover from errors?
 - The user interface should prevent confusing situations and forward sufficient information to users. The attribute of error prevention helps to identify which situations are confusing for users (for example, a mandatory form is not filled out).

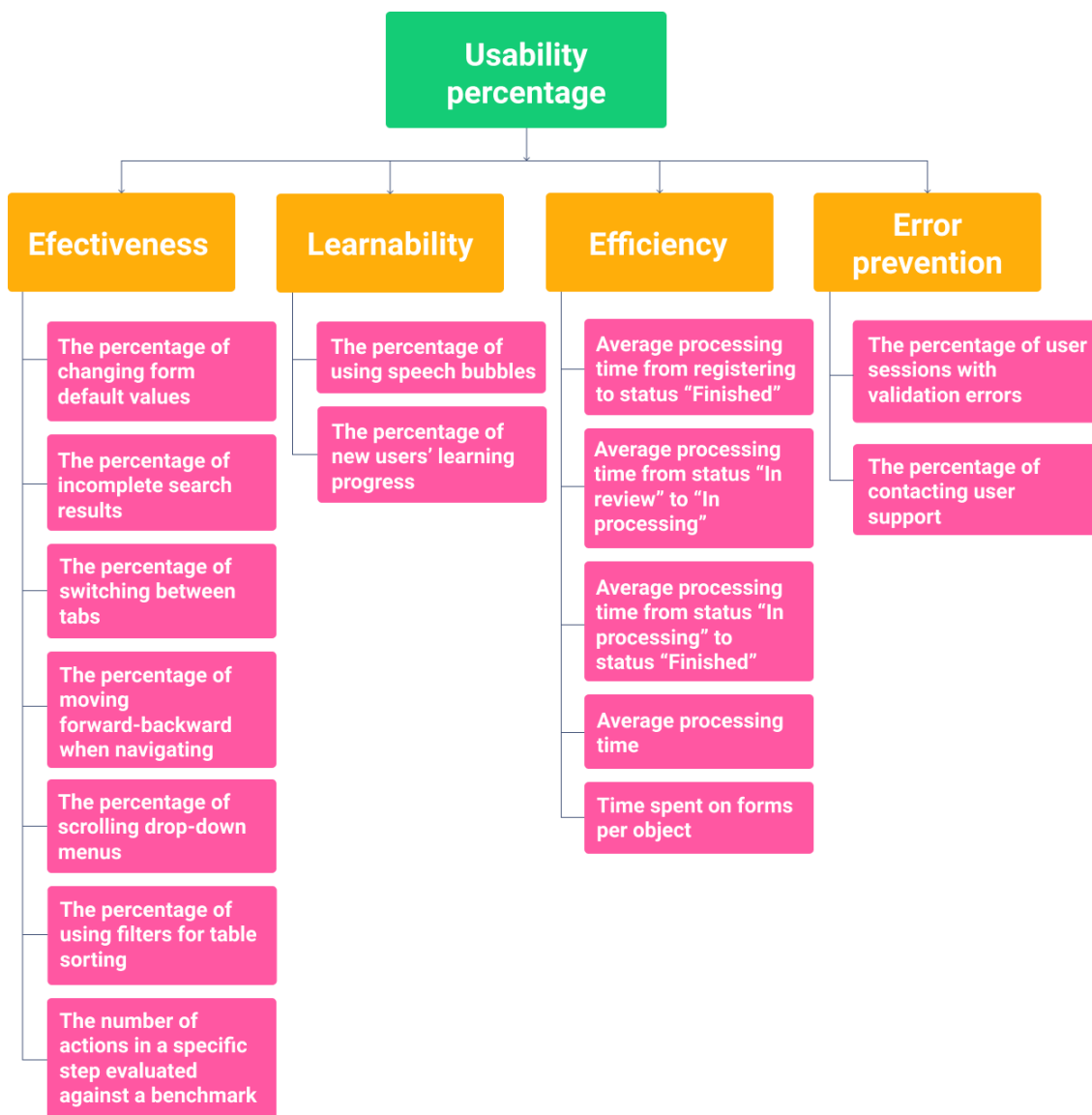


Figure 1 Usability metrics system for KRIS5

3 Application of usability metrics

3.1 Usability levels

The usability percentage is calculated for total usability, for each attribute and for each attribute metric. Usability metrics calculations are divided between three levels and each following level depends on the preceding one, which means that to calculate the total percentage, calculations for lower levels have to be performed first.

The following describes the calculations for each usability level.

- **Level 3.** Each metric has certain elements or instances for which a specific percentage is calculated. In Figure 1 metrics are in pink and the formulas for calculating each metric are given in [Chapter 3.3](#).

- General structure of the formula:

$$\text{Metric value \%} = \frac{\text{Number of occurred instances}}{\text{Total number of user sessions}} * 100$$

- **Level 2.** For each attribute, an average percentage is calculated on the basis of its metrics.

- General structure of the formula:

$$\text{Usability \% per attribute} = \frac{\text{Metric 1 average \%} + \text{Metric 2 average \%} + \text{Metric 3 average \%} + \text{Metric 4 average \%} + \text{Metric 5 average \%} + \text{Metric n+1 average \%}}{\text{Number of metrics}}$$

- **Level 1.** The total usability percentage is calculated on the basis of the average value for all four attributes while the proportion of each attribute in the total percentage is 25%.

- Formula:

$$\text{Usability \%} = \frac{\text{Average effectiveness \%} + \text{Average efficiency \%} + \text{Average learnability \%} + \text{Average error prevention \%}}{4}$$

The total usability percentage describes the usability of the information system as follows:

1. 0–29%: poor usability of the information system

2. 30–69%: average usability of the information system
3. 70–100%: excellent usability of the information system

3.2 When and how to measure?

The metrics should be tracked as one set over the same period of time. This means that each individual metric is tracked along with all other metrics, for example, on a monthly basis. The time of tracking metrics also depends on the development cycle. If the system is frequently updated, metrics should be tracked for a minimum of one month immediately before and after making an update. This makes it possible to find out how the update affects users. If possible, comparing vacation periods with normal work periods should be avoided (especially periods of long holidays, such as Christmas).

Certain metrics need to be applied only in exceptional cases. How and when to apply metrics intended for exceptional cases is outlined in [Chapter 3.3](#) in a table for the given metric.

Metrics make it possible to draw more far-reaching conclusions if there are more than 30 occurred instances tracked (look at “General structure of the formula” in [Chapter 3.1](#)). This is the average size of a sample, which enables the conclusion to be drawn that an issue is statistically significant. When drawing conclusions on the basis of smaller samples, it is not possible to be sure that the issue affects other users as well. Sufficient sample size is vital to be able to identify issues. For example, when applying the formula (*number of changes made to form default values / total number of user sessions*) * 100, the default value of a form should be changed on at least 30 occasions to be able to draw a conclusion. However, it should be kept in mind that system-wise it is great when there are no issues and a metric doesn’t keep generating a result that indicates an issue.

3.3 Usability metrics list

Below follows a list of all metrics across their respective attributes. Each metric is described in terms of its objective indicating its specific role in the usability of the system and the kind of problems it helps to identify, the element it is used to measure (plus examples from the prototype), its formula and the interpretation of its result.

The column “Interpretation of result” shows whether the recorded value indicates a positive or a negative result. The values are to be interpreted as follows.

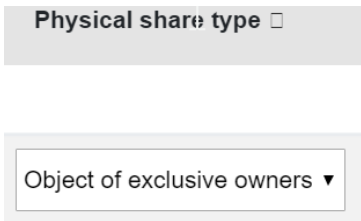
- The result *Maximum is negative* means that getting a result of 100% when using a formula indicates a serious usability issue. Because this is a negative metric, for calculating the at-

tribute's average value it must be converted into a positive metric by applying the formula *(100 – the % value of a negative metric)*.

- The result *Maximum is positive* means that getting a result of 100% when using a formula indicates excellent usability.

3.3.1 Effectiveness

Metric 1. The percentage of changing form default values

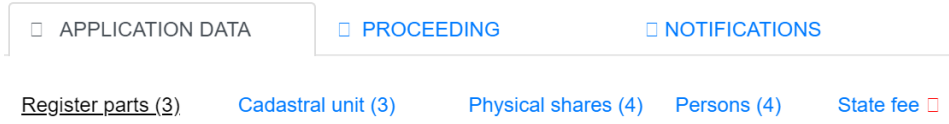
Objective	Identify forms the default values of which are constantly changed. Frequently changing a default value indicates that the assigned value is not appropriate in terms of user needs and that another, more popular default value should be assigned to the form. The most popular value can be identified on the basis of options available for the specific form.
Measured element	All forms and drop-down menus containing default values.
Example of measured element	Physical share type dropdown menu in the Physical shares tab, Object of exclusive owners is selected by default: 
Formula	<i>(number of changes made to form default values / total number of user sessions) * 100</i>
Interpretation of result	Maximum is negative

Metric 2. The percentage of incomplete search results

Objective	Identify problematic search forms that are used to make a query but don't yield a satisfying result. If the user performs multiple searches within a small time limit, it indicates that the first result was not adequate enough to satisfy the users need.
Measured element	All search forms in the system.
Example of measured element	Search forms in the Search view:

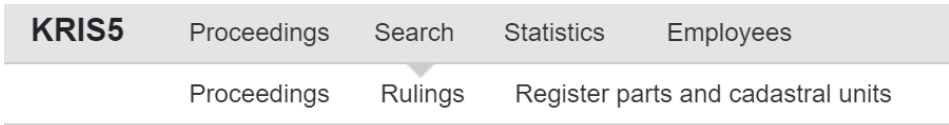
	<p>Search by keyword</p> <p>Enter number, name or code <input type="text"/></p> <p>Hide advanced search ^</p> <p> <input type="text" value="Proceeding number"/> <input type="text" value="Person data"/> <input type="text" value="Type of right"/> </p> <p> <input type="text" value="Proceeding number"/> <input type="text" value="Name/ID/code"/> <input type="text" value="Choose"/> </p>
Formula	$(\text{number of multiple searches} / \text{total number of searches}) * 100$
Interpretation of result	Maximum is negative

Metric 3. The percentage of switching between tabs

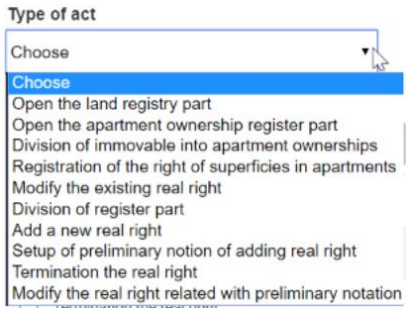
Objective	Identify unnecessary switching between tabs per object. Excessive switching between tabs indicates that information is not readily available or that it should be available on one page.
Measured element	Views containing tabs: <ul style="list-style-type: none"> Application data Proceeding
Example of measured element	<p>The menu for detailed application data:</p>  <p>Users move several times between the "Proceeding" tab and the "Application data" tab.</p>
Formula	$(\text{clicking on a tab on which less than 10 seconds is spent} / \text{total number of user sessions per object}) * 100$
Interpretation of result	Maximum is negative

Metric 4. The percentage of moving forward-backward when navigating

Objective	Identify erroneous movements along the navigation journey. Constant use of "Back" and "Forward" buttons indicates that users end up on pages they didn't need to visit. The metric helps to identify issues in the system navigation structure (menus).
Measured element	Navigation menu.

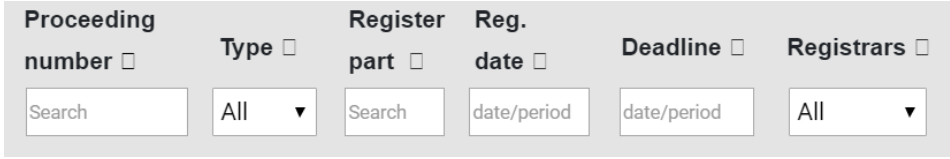
<p>Example of measured element</p>	<p>Navigation menu where Search is selected:</p>  <p>Users move back and forth between the menu items.</p>
<p>Formula</p>	<p><i>(number of user sessions during which a tab is opened within one object more than once / total number of user sessions per object) * 100</i></p>
<p>Interpretation of result</p>	<p>Maximum is negative</p>

Metric 5. The percentage of scrolling drop-down menus

<p>Objective</p>	<p>Identify problems in the structure of drop-down menus. Because KRIS5 features a generous amount of drop-down menus and many of them list large volumes of information, it is vital to know how drop-down menu items should be arranged in sequence. Whether necessary information can be found quickly, or users are forced to do a lot of scrolling to find what they need.</p>
<p>Measured element</p>	<p>All drop-down menus in the system.</p>
<p>Example of measured element</p>	<p>Choosing the act type from a drop-down menu:</p> 
<p>Formula</p>	<p><i>(number of users' sessions featuring scrolling / total number of user sessions) * 100</i></p>
<p>Interpretation of result</p>	<p>Maximum is negative</p>

Metric 6. The percentage of using filters for table sorting

<p>Objective</p>	<p>Measure how many times users need to apply filters to table content to be able to achieve the desired result. The metric demonstrates whether content presented earlier in a table is appropriate in terms</p>
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	of user needs and whether it is easy to filter.
Measured element	Table headers, including sorting and filters.
Example of measured element	Table header from My proceedings: 
Formula	<i>(number of user sessions during which sorting was used more than once in a row / total number of user sessions) * 100</i>
Interpretation of result	Maximum is negative

Metric 7. The number of interactions in a specific act evaluated against a benchmark

Objective	Identify situations in which the system requires too many interactions. For example, ideally the maximum number of clicks it takes to complete a task is three, but in the system it takes five clicks.
Measured element	Pre-defined acts or views.
Formula	<i>(pre-defined number of interactions / number of actual interactions) * 100</i>
Interpretation of result	Maximum is negative

3.3.2 Learnability

Metric 8. The percentage of using speech bubbles

Objective	Measure to what extent users need assistance from speech bubbles. Too much clicking on speech bubbles indicates that users are constantly confused and, in such case, it should be considered whether it is possible to re-design problematic components.
Measured element	Speech bubbles.
Example of measured element	Speech bubble within the Register parts tab:

<p>Formula</p>	<p><i>(number of times speech bubbles are used / total number of user sessions) * 100</i></p>
<p>Interpretation of result</p>	<p>Maximum is negative</p>

Metric 9. The percentage of new users' learning speed

<p>Objective</p>	<p>Measure how easy it is for new users to pick up the system. This metric represents an individual usability percentage for new users: the total average value for all attributes is calculated for the first two weeks and the result is compared to the same total average value for the next two weeks. The metric helps to measure how long it takes a new user to achieve his/her average user level (the faster the better). Achieving the average level can be defined by comparing it to a pre-defined normality or to the average level of other users.</p>
<p>Measured element</p>	<p>Total usability of the system per individual user</p>
<p>Formula</p>	<p>All average values are calculated per specific user only.</p> <p><i>(average effectiveness + average efficiency + average learnability (excl. usability metric for new users) + average prevention of errors) / 4</i></p>
<p>When to track</p>	<p>During the first two weeks of using the system and during each following period of two weeks until a user achieves the average level.</p>
<p>Interpretation of result</p>	<p>Maximum is positive</p>

3.3.3 Efficiency

Metric 10. Average processing time from registering to status "Finished"

<p>Objective</p>	<p>Measure how long it takes on average to process one proceeding.</p>
<p>Measured element</p>	<p>Processing time from registering to status "Finished".</p>
<p>Formula</p>	<p><i>(time of finishing (status "Finished") - time of starting (registering an application))</i></p>

Metric 11. Average processing time from status “In review” to status “In processing” minus waiting time

Objective	Measure how long it takes for a land register secretary on average to process one proceeding.
Measured element	Processing time from status “In review” to status “In processing”.
Formula	$(time\ of\ finishing\ (status\ "In\ processing") - time\ of\ starting\ (status\ "In\ review")) - waiting\ time$

Metric 12. Average processing time from status “In processing” to status “Finished” minus waiting time

Objective	Measure how long it takes for an assistant judge on average to process one proceeding.
Measured element	Processing time from status “In processing” to status “Finished”.
Formula	$(time\ of\ finishing\ (status\ "Finished") - time\ of\ starting\ (status\ "In\ processing")) - waiting\ time$

Metric 13. Average processing time minus waiting time

Objective	Measure how long it actually takes to process one proceeding, that is, without accounting for waiting time.
Measured element	Average processing time
Formula	$(time\ of\ finishing\ (status\ "Finished") - time\ of\ starting\ (registering\ an\ application)) - waiting\ time$

Metric 14. Time spend in session forms per object

Objective	Measure how much time users spend in session forms. This metric shows how much time users spend in forms when processing them. Also, it points out which forms require more time from users and this helps to analyse whether the structure of those forms is overly complicated.
Measured element	All forms per view.
Example of measured element	For example, in the act “Open the apartment ownership register part”, where users spend time filling out forms in two acts:

	<p>1 Choose source document</p> <div style="border: 1px solid #ccc; padding: 5px;"> <p>Source documents</p> <table border="1"> <thead> <tr> <th>Spource doc</th> <th>Document</th> <th>Type of document</th> <th>Date of the document</th> <th>Compiler</th> <th>Addition date</th> <th>Notes</th> </tr> </thead> <tbody> <tr> <td><input type="checkbox"/></td> <td>Container.bdoc</td> <td></td> <td>21.07.18</td> <td>Pohl Peeter</td> <td>21.07.18</td> <td></td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td>Application.pdf</td> <td>Application</td> <td>21.07.18</td> <td>Pohl Peeter</td> <td>21.07.18</td> <td></td> </tr> <tr> <td><input type="checkbox"/></td> <td>Propertylawcontract.pdf</td> <td>Choose</td> <td>21.07.18</td> <td>Pohl Peeter</td> <td>21.07.18</td> <td></td> </tr> <tr> <td><input type="checkbox"/></td> <td>Empowerment.pdf</td> <td>Choose</td> <td>21.07.18</td> <td>Pohl Peeter</td> <td>21.07.18</td> <td></td> </tr> </tbody> </table> <p style="text-align: center; border: 1px dashed #ccc; padding: 5px; margin: 10px 0;"> Drag documents here - or - <input type="button" value="Search from computer"/> </p> </div> <p>2 Open and fill openable physical shares data</p> <div style="border: 1px solid #ccc; padding: 5px;"> <p>Register parts</p> <table border="1"> <thead> <tr> <th>Register part number</th> <th>Physical share number</th> <th>Physical share type</th> <th>Legal share</th> <th>Marked on the plan</th> <th>Owner</th> <th>Property type</th> <th>Content</th> </tr> </thead> <tbody> <tr> <td>1436003</td> <td>1</td> <td>Object of exclus</td> <td></td> <td></td> <td><input type="button" value="Determine"/></td> <td><input type="button" value="Add"/></td> <td></td> </tr> <tr> <td colspan="7" style="text-align: center;"><input type="button" value="Determine to all"/></td> <td></td> </tr> <tr> <td>1436004</td> <td>2</td> <td>Object of exclus</td> <td></td> <td></td> <td><input type="button" value="Determine"/></td> <td><input type="button" value="Add"/></td> <td></td> </tr> <tr> <td>1436005</td> <td>3</td> <td>Object of exclus</td> <td></td> <td></td> <td><input type="button" value="Determine"/></td> <td><input type="button" value="Add"/></td> <td></td> </tr> <tr> <td>1436006</td> <td>4</td> <td>Object of exclus</td> <td></td> <td></td> <td><input type="button" value="Determine"/></td> <td><input type="button" value="Add"/></td> <td></td> </tr> </tbody> </table> <p>Add physical share(s): <input type="text" value="Enter physical shares number"/> <input type="button" value="Add"/></p> </div>	Spource doc	Document	Type of document	Date of the document	Compiler	Addition date	Notes	<input type="checkbox"/>	Container.bdoc		21.07.18	Pohl Peeter	21.07.18		<input checked="" type="checkbox"/>	Application.pdf	Application	21.07.18	Pohl Peeter	21.07.18		<input type="checkbox"/>	Propertylawcontract.pdf	Choose	21.07.18	Pohl Peeter	21.07.18		<input type="checkbox"/>	Empowerment.pdf	Choose	21.07.18	Pohl Peeter	21.07.18		Register part number	Physical share number	Physical share type	Legal share	Marked on the plan	Owner	Property type	Content	1436003	1	Object of exclus			<input type="button" value="Determine"/>	<input type="button" value="Add"/>		<input type="button" value="Determine to all"/>								1436004	2	Object of exclus			<input type="button" value="Determine"/>	<input type="button" value="Add"/>		1436005	3	Object of exclus			<input type="button" value="Determine"/>	<input type="button" value="Add"/>		1436006	4	Object of exclus			<input type="button" value="Determine"/>	<input type="button" value="Add"/>	
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3.3.4 Error prevention

Metric 15. The percentage of user sessions with validation errors

Objective	Measure the number of user sessions during which error messages are generated due to erroneous data input or unfilled mandatory fields. An excessive amount of error messages indicates that the user interface does not give enough feedback on which fields are mandatory or users struggle with understanding forms.
Measured element	All views in which error messages are displayed to users.
Example of measured element	Validation errors that occur in the system:

	<p style="background-color: #f8d7da; padding: 5px;">NB! Required fields are missing! Please fill in the red areas.</p> <div style="border: 1px solid #ccc; padding: 10px;"> <p>^ Openable physical shares (5)</p> <table border="1"> <thead> <tr> <th>Register part nr</th> <th>Physical share nr</th> <th>Physical share type</th> <th>Legal share</th> <th>Marked on the plan</th> <th>Owner</th> </tr> </thead> <tbody> <tr> <td>1436001 🔗</td> <td><input type="text" value="1"/></td> <td>Obejct of exclusive... ▾</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Fund Ehitus AS</td> </tr> <tr> <td>1436002 🔗</td> <td style="border: 2px solid red; padding: 2px;"><input type="text"/></td> <td>Obejct of exclusive... ▾</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Fund Ehitus AS</td> </tr> <tr> <td>1436003 🔗</td> <td><input type="text" value="3"/></td> <td>Obejct of exclusive... ▾</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Fund Ehitus AS</td> </tr> <tr> <td>1436004 🔗</td> <td><input type="text" value="4"/></td> <td>Obejct of exclusive... ▾</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Fund Ehitus AS</td> </tr> <tr> <td>1436005 🔗</td> <td><input type="text" value="5"/></td> <td>Obejct of exclusive... ▾</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="text" value="AS:"/> ⓘ Owner is missing.</td> </tr> </tbody> </table> </div>	Register part nr	Physical share nr	Physical share type	Legal share	Marked on the plan	Owner	1436001 🔗	<input type="text" value="1"/>	Obejct of exclusive... ▾	<input type="checkbox"/>	<input type="checkbox"/>	Fund Ehitus AS	1436002 🔗	<input type="text"/>	Obejct of exclusive... ▾	<input type="checkbox"/>	<input type="checkbox"/>	Fund Ehitus AS	1436003 🔗	<input type="text" value="3"/>	Obejct of exclusive... ▾	<input type="checkbox"/>	<input type="checkbox"/>	Fund Ehitus AS	1436004 🔗	<input type="text" value="4"/>	Obejct of exclusive... ▾	<input type="checkbox"/>	<input type="checkbox"/>	Fund Ehitus AS	1436005 🔗	<input type="text" value="5"/>	Obejct of exclusive... ▾	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="AS:"/> ⓘ Owner is missing.
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1436005 🔗	<input type="text" value="5"/>	Obejct of exclusive... ▾	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="AS:"/> ⓘ Owner is missing.																																
Formula	$(user\ sessions\ with\ validation\ errors / total\ number\ of\ user\ sessions) * 100$																																				
Interpretation of result	Maximum is negative																																				

Metric 16. The percentage of contacting user support

Objective	Measure the amount of problems users are not able to resolve themselves. Contacting user support may indicate that users have trouble understanding a specific section of the system and are thus unable to complete their task.
Measured element	IT support widget
Example of measured element	<p>IT support widget:</p>

Formula	<i>(number of times user support is contacted / total number of user sessions) * 100</i>
Interpretation of result	Maximum is negative

3.4 Additional metrics

It is possible to measure statistical data about the software outside of the usability metrics system. An additional metric is introduced below, which is measured outside of the usability percentage because the calculation would not show the rise or fall of the usability percentage but still provides statistically useful information.

Additional metric 1. Active time spent in the system

The additional metric shows how much time is spent actively using the system throughout the working on a proceeding. To implement the metric, it is necessary to establish active time spent in the system per every user and every proceeding type.

Formula for the metric:

- *(time spent on a proceeding / active time spent in the system per proceeding) * 100%*

In order to identify the average active time spent on a proceeding per proceeding type, it is necessary to first calculate the active time of every user by every proceeding type and then calculate the average based on that.

4 Summary

A metrics system of four usability attributes was designed under the project “User experience and user needs of the land register management software and development of its user interface prototype”. All in all, the system includes 16 metrics that help measure the usability of the information system as well as indicate areas that are problematic for management software users. One additional metric was added, which helps to statistically identify the average active time spent in the system for every user and proceeding type.

Each metric takes up a specific percentage in the total usability of the system and facilitates the identification of specific issues in the software and user interface. The regular application of these metrics provides a continuous overview of system usability as well as contributes to ongoing development and design processes for the purpose of improving the management software.