



KRAKEN

**BROKERAGE AND MARKET PLATFORM
FOR PERSONAL DATA**

*D5.7 KRAKEN marketplace testing and
validation first report*

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D5.7 KRAKEN marketplace testing and validation first report

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List of Acronyms

Acronym	Description
FBK	Fondazione Bruno Kessler
GDPR	General Data Protection Regulation
HE	Heuristic Evaluation
MeSH	Medical Subject Headings
NPS	Net Promoter Score
SD	Standard Deviation
SUS	System Usability Scale
SSI	Self-Sovereign Identity
TUGraz	Technical University of Graz
UCD	User-Centered Design
UIs	User Interfaces
UX	User eXperience
WP	Work Package

Executive Summary

This document is the first deliverable of T5.5 of WP5, aimed to provide initial results from the evaluation of the KRAKEN platform and, specifically, of the marketplace features prototyped and released in August 2021 for deployment in the Health and Education pilots.

Initial evaluations based on mockups of the marketplace user interface were conducted until May 2021, to inform the user-centered design of the prototype front-end and improve its usability.

The following multi-dimensional evaluation of the KRAKEN prototype involved users selected from the relevant user groups identified in *D5.1 Initial pilot marketplaces user stories* and consisted in both usability assessment of the prototype features after individual usage and in a more extensive evaluation of the prototype in terms of user preferences and expectations collected during dedicated workshops with target participants involved in the Health and Education pilots.

This report presents the main results of the evaluation activities conducted in 2021 to inform the user-centered design of the KRAKEN platform by including user feedback and recommendations in the design cycle and supporting future technical and strategic decision-making by the KRAKEN consortium regarding the design and implementation of the second prototype, to be released and deployed in the two pilots in 2022.

Findings from this KRAKEN evaluation phase are also relevant to inform future KRAKEN exploitation activities to facilitate a wider adoption of the KRAKEN solution by users in the next years.

1 Introduction

1.1 Purpose of the document

This document aims to describe the user-centered methodological approach used to evaluate the first KRAKEN prototype in year 2021, by combining the deployment of both expert-based evaluation methods (e.g., Heuristic Evaluation) and user-based evaluation.

It presents the main findings and recommendations collected from the usability experts and the users involved in the KRAKEN prototype assessments, providing a multi-dimensional view of the prototype qualities and its initial impact on the target user groups. These findings can provide a valid support to the next design and implementation activities of KRAKEN, as well as inform future strategic decisions on the prototype future development and exploitation in the two pilot domains and beyond.

1.2 Structure of the document

After the introduction to the deliverable's contents, in section 2 the methodology and main findings derived from the initial Heuristic Evaluation of the KRAKEN marketplace mockups are reported. Section 3 describes the methodology deployed to assess the usability of the KRAKEN marketplace prototype released in August 2021 and to collect user feedback on main preferences and expectations that may affect future adoption of the KRAKEN solution. It also presents the main results from this evaluation activity relevant to inform the next design, implementation and validation phases to be conducted in 2022. Finally, section 4 concludes the report by summarizing the main insights from this evaluation phase that will feed the KRAKEN activities next year.

2 Expert-based review of initial marketplace mockups

2.1 Heuristic Evaluation method

Among the expert-based evaluation techniques mostly deployed during the early phases of systems design and prototyping, Heuristic Evaluation (HE) is a main one [1]. HE can be defined as a process where design experts use rules of thumb (i.e., heuristics) to measure the usability of user interfaces (UIs) in independent walkthroughs and report main issues found. Typically, in HE evaluators use established heuristics from the original Nielsen and Molich's work [1][2] and reveal insights that can help design teams enhance product usability from early development phases.

From March to May 2021 design activities in WP5 started to release initial user interface mockups of the KRAKEN marketplace, displaying and simulating possible user-system interactions with the main functionalities of the marketplace. Although the main goal of these initial mockups was to guide the developers' work in the implementation of the first KRAKEN prototype, they were also deemed suitable for a usability inspection by experts to early detect possible areas of improvement of the marketplace UIs and feed the design/implementation of the KRAKEN prototype for a subsequent testing with users in October 2021.

Five usability experts from the *Digital Health Lab* of partner FBK, with expertise in Human-Computer Interaction and User-centered design (UCD) of mobile and web platforms were involved in conducting the HE.

The evaluation procedure followed the following steps:

1. Experts were provided with a link to an InVision (<https://www.invisionapp.com/>) simulation of the KRAKEN marketplace UIs designed, showing interaction with the main functionalities offered by the marketplace and they were asked to use the simulation to perform tasks on the marketplace, in order to assess the mockups usability and privacy preserving qualities.
2. Experts were asked to perform the evaluation by first reading the personas developed in T5.1 (reported in D5.1 Initial Pilot Marketplaces User stories), in order to consider the main characteristics and profiles of the relevant target user groups of the KRAKEN platform.
3. Experts were provided with a digital form reporting the heuristics to be used, including the 10 Nielsen's usability heuristics [2] in [Table 1](#), and 6 additional privacy related heuristics relevant to the KRAKEN platform objectives, reported in [Table 2](#), from a set of privacy heuristics recently validated and deployed in [3]. The aim of the heuristics identified was to enable a first inspection of the UIs mockups usability and privacy enforcing quality.
4. An initial briefing with evaluators was conducted to cover the selection of tasks to be performed with the mockups' simulation, suggesting a 5 levels scale of severity codes (0=no usability problem, 5=Usability catastrophe) to flag issues.
5. Experts were asked to use the prototype freely in a following session to identify main issues in performing individual tasks with it.
6. In the following week they also filled in the HE form provided, by recording all issues encountered.
7. A final debriefing session attended by all 5 evaluators was conducted to collate results from the individual reports and suggest fixes and recommendation to be provided to the KRAKEN marketplace designers by May 2021.

Heuristic	Description
#1: Visibility of system status	The design should always keep users informed about what is going on, through appropriate feedback within a reasonable amount of time.
#2: Match between system and the real world	The design should speak the users' language. Use words, phrases, and concepts familiar to the user, rather than internal jargon. Follow real-world conventions, making information appear in a natural and logical order.
#3: User control and freedom	Users often perform actions by mistake. They need a clearly marked "emergency exit" to leave the unwanted action without having to go through an extended process.
#4: Consistency and standards	Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform and industry conventions.
#5: Error prevention	Good error messages are important, but the best designs carefully prevent problems from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.
#6: Recognition rather than recall	Minimize the user's memory load by making elements, actions, and options visible. The user should not have to remember information from one part of the interface to another. Information required to use the design (e.g., field labels or menu items) should be visible or easily retrievable when needed.
#7: Flexibility and efficiency of use	Shortcuts — hidden from novice users — may speed up the interaction for the expert user such that the design can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.
#8: Aesthetic and minimalist design	Interfaces should not contain information which is irrelevant or rarely needed. Every extra unit of information in an interface competes with the relevant units of information and diminishes their relative visibility.
#9: Help users recognize, diagnose, and recover from errors	Error messages should be expressed in plain language (no error codes), precisely indicate the problem, and constructively suggest a solution.
#10: Help and documentation	It's best if the system doesn't need any additional explanation. However, it may be necessary to provide documentation to help users understand how to complete their tasks.

Table 1: Nielsen's Usability Heuristics used in the KRAKEN evaluation

Heuristic	Description
#1: System contains robust authentication measures	The system provides the ability for users to authenticate themselves through a robust, secure mechanism
#2: System contains a role-based authentication mechanism for data providers to access their data product	The system access strategy from a provider perspective involves role-based authentication (i.e. smart card) to be granted access to a data product based on a seller's privacy preferences
#3: System provides a means for data providers to specify consent directives in terms of access, use and disclosure of their data.	The system should be able to provide data providers with a consent management option to specify their preferences or directives in terms of privacy management (access, use & disclosure of data)
#4: The systems consent management protocol contains an "opt-in" and "opt-out" feature	The data sharing/marketplace platform must request the users "opts-in" or "opts-out" in order to utilize or terminate access to the system
#5: The platform/marketplace provides a user-controlled amendable privacy policy prevention	The system should have the ability to contain users' related privacy policies and metrics
#6: The system provides an easy-to-use communication tool to contact privacy officer	The system should contain a visible and accessible communication tool to contact a privacy officer or person, in the event of a suspected privacy breach or inquest. This communication tool should be accessible within each interface in the system

Table 2: Privacy Heuristics used in the KRAKEN evaluation

2.1.1 Main results and recommendations

The main output of the HE conducted on the KRAKEN marketplace mockups consisted in a set of 15 main blocks of flagged usability and privacy related issues identified by experts, as reported in [Table 3](#) below.

The recommendations provided by experts were meant to facilitate the acquisition of familiarity with the marketplace by target users, considering typical expectations of usability when interacting with modern web platforms and marketplaces. In particular, some recommendations addressed the online procedure provided by the KRAKEN marketplace to create/modify a user profile, to create and publish a data product, to specify a data product access modalities from a data provider's view. Other recommendations addressed the usability requirements from a data consumer's perspective, like the possibility of easily browsing through the data products available, selecting among the relevant market sectors available (e.g., Health, Education) and performing the purchasing tasks available in the most intuitive and less cognitive demanding way.

Regarding the privacy related issues, recommendations from experts mainly indicated the integration of information in the marketplace referring to contact persons in charge of solving possible privacy issues and the possibility of modifying data product access modalities and the user profile over time, as it might be required by a long-term usage of the platform once publicly released.

#Screen/feature	Issue detected	Recommendations for improvement	Severity rating	Heuristic violated
Data product information	<i>Sold by</i>	Use terms not referring to ownership of data, such as <i>published by (data holder instead of data owner)</i>	2	2, 4
Home	Help, tutorial not available	Provide a simple video tutorial to show what you can do in the marketplace Or a simple scheme of the benefits of exchanging data through KRAKEN marketplace	2	10
	<i>Market sector, Education, Health and Wellness</i> are written with same font	Make it clear we have 2 sectors by now, group data products per sector	3	8
Home/All pages	Who to contact for support or privacy issues is missing	Provide specific contacts for technical support and privacy issues	2	9, P6
Publish data page	Long process, <i>buyer</i> categories	Split in steps (maybe 3 main blocks, similar to the user profile creation steps), highlight in red any missing information, replace <i>buyer</i> with <i>consumers</i>	2	5, 2
Published data	Enable modification of a data product	Provide a way of modifying choices in data product page, in case of user's mistake (now you can edit data published)	3	5

#Screen/feature	Issue detected	Recommendations for improvement	Severity rating	Heuristic violated
Profile page	Not clear if the form and information to fill in is for an individual user or person on behalf of institution	Organize information requested, avoid asking details that might change over time (e.g., email of DPO)	2	P2
	Deleting account not possible	Consider whether to include possibility to close/delete account	2	
User profile creation	Option to be contacted by other users (read more not available)	Specify what this option refers to	3	5
	Are you sharing data or looking for data...?	Better to split in two different questions leading to 2 types of user profile		
User profile (consumer case)	No user consumer profile	Add the case of a data consumer's perspective in the marketplace	2	2
Window of data products	Link to wrong product (Prototype issue)	Make sure each type of data product is linked to the correct product	1	4
	Order of product presentation	Recently added products first; Recommended for you for frequent users	2	6, 7
Data products	No indication of data product quality	Add a rating system (stars), for data products that have been rated by previous consumers	2	2

#Screen/feature	Issue detected	Recommendations for improvement	Severity rating	Heuristic violated
Example Data product "Citizens lifestyle dataset"	Inconsistency in stating that data are anonymized and there are personal data	Resolve inconsistency	2	2
Publish data tab	Not clear why you can access it from the main menu tab	Make it clear that a user must sign up first and then can publish data	2	4
Publish data	Lack of fidelisation mechanism	Reward publishing of data products/analytics, in case of publishing free of charge (e.g., karma points that can be used to access products/services offered by the platform)	0	N/A
Data product access requests	Add option of 'Terminate' to the ones available (accept/decline)	This could enable user control to terminate access to data from a certain point of time onwards	1	P3
Education pilot Credentialview_wallet	Avoid displaying code in the Notification msg	Provide clear feedback to the user on success or failure of the action performed	3	8

Table 3: Final HE report of the KRAKEN marketplace mockups

2.1.2 Improvements based on main recommendations

In June 2021, following the results of the HE of the KRAKEN marketplace mockups, designers of the UIs reviewed their initial mockups and integrated the marketplace frontend to improve its usability and privacy preserving qualities.

The results of the HE study were combined with internal feedback from the development team, and additions and changes were made to the marketplace based on both HE results and development team feedback. Some main additions regarded the data analytics product workflow, affecting the Publish data and the Publish analytics functionalities. The data and data analytics product publishing page was reorganized to have the form contents in three blocks, thus making the process more understandable. A personal profile menu was added to the upper right corner indicating if the user has signed up and signed in, and featuring among others an administrative page for the user's own data products, and an administrative page for purchased data access.

The following additions and changes were made to the Marketplace UI based on results from the HE study:

- Data product publishing page grouped in a new way to three blocks to make the process more clear
- Wordings were changed to avoid referring to ownership of data (e.g. 'data owner'), also many other small changes to wordings
- Inconsistency in wordings that concerned anonymised and personal data at the same time was resolved. Anonymisation questions and metadata about anonymisation removed from data analytics products.
- An option was added to manage data product subscriptions and terminate any individual subscription.

The following additions and changes were made based on other (internal) feedback:

- Data publication process includes now the possibility to publish your own data as a data subject
- A time limit was added to the data product creation process regarding how long the data can be consumed (three options given: unspecified period of time, until a certain date, for a fixed period of time).
- Some missing UI functionalities were added such as the creation of column titles for the data analytics product files based on the MeSH terminology, and an input field to provide the marketplace with the location of the cloud storage.
- Disclaimer titles and text contents revised completely, and a copyright notice was added.

The following changes were regarded necessary based on either HE results or internal feedback, but at some later stage of the Marketplace development roadmap:

- Video tutorial and other instructions and help content for the users. Also marketing content with different value propositions for those that don't have a user profile yet.
- Possibility to contact someone for support or because of privacy issues
- Possibility to delete the user account (however, regarding possible obligations posed by the GDPR).
- Need to specify in which situations and how users can be contacted by other users
- Filtering of data product search results (e.g. latest first, alphabetical order)
- Indication of data product quality, with ratings from previous users
- The options in "*What countries the data can be shared with*" are too broad and there is a need to add granularity in country selection for the data subjects so that they can give their informed consent.
- Adding more granularity to the choices regarding the purpose of the use of data, possibly with an open text field where the user can set their own purposes.

3 Multi-dimensional evaluation of the KRAKEN platform

3.1 Methodology and procedural protocol

Participants Inclusion criteria

To conduct the multi-dimensional evaluation of the KRAKEN marketplace first release, in Autumn 2021 15 participants belonging to the user groups of *data providers* and *data consumers* identified in 'D5.1 Initial Pilot Marketplaces User stories' were invited to take part to the evaluation for both the Health and Education pilots.

Recruitment strategy

Eligible candidates identified by FBK and the KRAKEN consortium, in collaboration with the pilots' leaders from Lynkeus and TUGraz, were contacted and invited (by email) to participate to the evaluation activities. They were asked to read the information sheet and sign the consent form (see [Annex A](#)), provided by FBK, before their enrolment in the evaluation.

A calendar of timeframes for the evaluation activities was agreed at consortium level and proposed to participant at the time of their recruitment.

Rewarding mechanism

Participants were rewarded for their time dedicated to the evaluation by means of an Amazon gift card of 50 Euros.

Preliminary individual assessment of the KRAKEN release

In late October 2021 participants were invited to access the KRAKEN first release prototype individually and to conduct a *walkthrough* of the solution to assess its usability. They were invited to watch a set of introductory videos showing how to access the KRAKEN marketplace by using the SSI mobile app, how to use the marketplace mobile app (Health pilot) and the marketplace web app (Health and Education pilots). Then participants were asked to perform a set of basic tasks representing the key functionalities supported by the prototype and to fill in a digital version of the SUS (System Usability Scale) questionnaire [4] to assess its usability ([Annex B](#)).

Examples of tasks to be performed by participants involved in the Health pilot are: registering to the KRAKEN marketplace by means of the KRAKEN SSI mobile app, browsing the available products in the Health sector, requesting access to a data product, offering access to a data product, setting the relevant privacy options to access the data product.

Examples of tasks to be performed by participants involved in the Education pilot are: login to the Edu connector, connect the Wallet App to the Edu Connector, export a credential (Grade or Diploma) into the mobile wallet, display the credential in the wallet. On the marketplace: register to the KRAKEN marketplace, access/browse the KRAKEN marketplace, update the user profile.

Multi-dimensional evaluation workshops

In the first week of November 2021 participants were invited to join an evaluation workshop of the duration of 1.5 hour, to further report their comments, preferences and expectations regarding the KRAKEN solution. A total of 4 workshops were carried out, three for the Health pilot evaluation (attended overall by 12 participants) and one for the Education pilot evaluation (3 participants), each moderated by FBK staff and recorded to enable a more detailed analysis of participants' responses. The moderator initially provided a brief introduction to the workshop objectives. Then, participants were asked to answer a series of questions regarding their expectations, preferences, ethics concerns

and intention to use a data sharing platform, such as KRAKEN, to perform these tasks. In [Table 4](#) below is the list of questions posed to participants attending the Health marketplace evaluation.

In [Table 5](#) the questions posed to participants to the Education pilot are reported.

Factor investigated	Questions
Set 1: Health Data Management	1.1 Would you trust a platform like KRAKEN to share personal data? 1.2 Would you be interested to use KRAKEN for providing/consuming data products like the ones you have seen provided by the KRAKEN prototype? Why or why not?
Set 2: Privacy preserving data sharing systems	2.1 Are you interested to use the privacy preserving analytics of KRAKEN? 2.2 Would you be willing to use a web system that will secure your data, even if you will have to authenticate through a mobile app?
Set 3: Sharing health data	3.1 Would you be willing to share your data product with other entities through the KRAKEN platform if it's pseudoanonymized, anonymized (e.g. universities pharmaceutical companies, private organizations, research institutions)? Why and why not? 3.2 What factors do you consider important when deciding to share your information with another entity?
Set 4: Compensation for Sharing Data and Data valorization	4.1 What type of compensation would you be looking for in exchange for your data products? 4.2 Do you feel comfortable in defining a price for your data product? 4.3 Would you need any support from for example an available tool in the platform to define or check if your price is sensible/correct?
Set 5: Acceptance, ethics	5.1 What is your impression of the level of data protection and privacy of the KRAKEN platform? 5.2 Can you think of any data protection or privacy risks that you could encounter using the KRAKEN platform? 5.3 Is the provided information relating to your data protection and privacy rights and freedoms sufficiently clear and understandable?

Table 4: Factors and questions posed to participants attending the Health pilot evaluation

Participants' characteristics

In total, 12 individuals (6 men and 6 women) participated in the Health pilot evaluation, 8 (66.7%) were aged 35 to 54, 2 (16.7%) were aged 18 to 34, 2 (16.7%) were aged 55 to 64. Three participants were researchers, 2 of them with expertise in Big Data projects for healthcare, 1 on blockchain technologies for health, 2 participants were legal experts working in projects related to personal data sharing, 2 participants were managers in private companies offering digital health solutions, 5 participants were project managers of public health solutions.

Three individuals (1 men, 2 women) were involved in the Education pilot evaluation, they were students at the Technical University of Graz with computer science background, all aged 18 to 34.

Factor investigated	Questions
Set 1: Education Data Management	1.1 Would you trust a platform like KRAKEN to share personal data? 1.2 Would you be interested to use KRAKEN for providing/consuming data products like the ones you have seen provided by the KRAKEN prototype? Why or why not? 1.3 What is your motivation to share (or sell) your education data?
Set 2: Privacy preserving data sharing systems	2.1 Are you interested to use the privacy preserving analytics of KRAKEN? 2.2 Would you be willing to use a web system that will secure your data, even if you will have to authenticate through a mobile app?
Set 3: Sharing education data	3.1 What types of data do you feel comfortable sharing/selling? What types of data should the edu pilot support in addition to the ones we support? 3.2 Which kinds of entities would you be willing to share it with? 3.3 Will you feel comfortable letting other entities (organizations, universities) see your data using the KRAKEN platform? Do you think it will be secure?
Set 4: Compensation for Sharing Data and Data valorization	4.1 Would you seek compensation in exchange for securely sharing your data products?
Set 5: Acceptance, ethics	5.1 Will your acceptance for the KRAKEN data sharing services differ if it was provided by a company like Google? A recruiting company? Or an IT company like IBM? 5.2 Do you see any ethics concerns in using a data sharing platform like KRAKEN?

Table 5: Factors and questions posed to participants attending the Education pilot evaluation

Data analysis

In November 2021 the data collected during the evaluation workshops were analysed by applying the micro interlocutor analysis method [5][6] to the videorecorded sessions, whose main results are reported in section 3.2. The micro interlocutor analysis is a method used to analyse focus group data in health-related research [6][7]. It not only reveals each participant's attitude, stance, and arguments, but also provides researchers with a quantitative overview of participant grouping [5]. Following Onwuegbuzie et al [5], we first analysed all the transcriptions of the workshop discussions, to get an overall understanding of the transcriptions. Next, we coded participants' responses to each discussion question to the dedicated Health or Education workshops. We paid attention to their words throughout the group discussion and coded their responses by interpreting all the words they contributed. By taking this step, we produced descriptive statistics for all the questions, as summarized in section [3.3.1](#) and [3.3.2](#) below. In this way, it is possible to see how each participant responded to each question, but also to get an overview of the responses of the group as a whole, based on which we generated the insights explained in the results section. Finally, we analysed the responses to each question and coded the categories of explanations that participants provided for their responses, which helped us understand more deeply why the participants responded in certain ways. We used these categories of topics used in participants' answers to structure our reporting on the open-ended questions, available in the results section.

3.2 Results of the usability assessment

Results from the participants individual assessment of the KRAKEN first prototype release, based on the SUS questionnaire, showed an average score (0-100 scale) of 51.87 (Standard Deviation, SD 23.67) for the Health pilot and an average score of 55 (SD 10.89) for the Education pilot. These scores (see [Annex B](#)) correspond to the grade D, percentile range 15-34, they can be defined with the adjective OK/Fair, they reach a marginal level of acceptance and belong to the detractor level, meaning that users are more likely not to recommend this system to other users with this level of usability [8][9]. To notice that SUS scores below 68 (Good level) indicate problems with the system design that should be identified and resolved before a final release of the solution.

Participants to the Health pilot reported a series of problems with installing the SSI app and completing the registration process, which was deemed not so intuitive to perform. One participant recommended to facilitate the registration process on the marketplace by informing the user on what needs to be changed in the registration fields, in case some details are missing or incorrect. He also asked for having a bidding functionality to adjust the price of a data product automatically based on the demand. Most participants also were concerned by the need of having Android 8.0 operating system or above in order to be able to install the SSI app on their mobile, which would exclude users with different operating systems from accessing the KRAKEN solution.

Participants to the Education pilot also reported problems with the registration process, for example at the stage of 'accepting invitation', which was perceived as rather ambiguous. A participant recommended to add the possibility of deleting credentials or connections, another participant asked for the possibility of having a suggested name for the credentials. Participants complained about the slow functioning of the marketplace.

Overall, these results indicate the need of improving the usability of the KRAKEN first release over the next months in order to reach at least a score range of 68 (Good) with the final release and a full acceptability of the KRAKEN solution to turn users into possible promoters of the system.

3.3 Results of the workshops evaluation

[Table 6](#) and [Table 7](#) display how each participant in the workshops responded to each question, including the indication of agreement, indication of dissent, ambivalent response, no response, and response given with an elaboration. In section [3.3.1](#) and [3.3.2](#), we explain our results for each question included in the Health and Education pilot evaluations, providing a descriptive statistical overview of the types of responses (including nonresponses) and qualitative categorizations of participants' elaborations.

Question	Participant No.											
	1	2	3	4	5	6	7	8	9	10	11	12
1.1	AR ^f	SE	SE	A	AR	SE	AR	AR	SE	A	A	SD
1.2	A ^a	A	SE	A	A	AR	AR	A	AR	AR	AR	A
2.1	SE ^b	SE	SE	NR	SE	SE	SE	SE	A	A	A	SE
2.2	AR	AR	SD	SD	SD	SE	A	A	SD	A	A	D
3.1	AR	A	SE	A	AR	AR	AR	A	A	AR	A	AR
3.2	AR ^f	A	A	A	A	A	A	A	SE	SE	AR	SE
4.1	A	A	A	A	A	SE	SE	SE	SE	SE	AR	NR
4.2	SD ^e	SD	SE	SD	SD	D	D	D	SD	D	D	SD
4.3	SE	A	A	A	SE	SE	A	A	SE	A	A	SE
5.1	D	D	D	A	D	AR	A	D	AR	NR	NR	NR
5.2	A	A	A	A	SE	SE	SE	A	A	A	NR	NR
5.3	D ^d	D	D	SD	NR	SD	A	NR	SD	NR	D	D

^aA: indicated agreement.

^bSE: Provided significant example suggesting agreement.

^cNR: Did not indicate agreement or dissent (i.e., nonresponse or did not know).

^dD: Indicated dissent.

^eSD: Provided significant example suggesting dissent.

^fAR: Ambivalent response.

Table 6: Participants' responses in the Health pilot evaluation

Question	Participant No.		
	1	2	3
1.1	SE ^b	A	AR
1.2	SE	SE	D
1.3	AR ^f	A	AR
2.1	A ^a	AR	NR
2.2	A	AR	A
3.1	SE	A	A
3.2	SE	SE	SE
3.3	SE	SE	SE
4.1	AR	AR	AR
5.1	D	SD	D
5.2	AR	SE	SE

^aA: indicated agreement.

^bSE: Provided significant example suggesting agreement.

^cNR: Did not indicate agreement or dissent (i.e., nonresponse or did not know).

^dD: Indicated dissent.

^eSD: Provided significant example suggesting dissent.

^fAR: Ambivalent response.

Table 7: Participants' responses in the Education pilot evaluation

3.3.1 Health pilot findings

Health data management

Question 1.1: Trust in using KRAKEN for sharing personal data

Participants were asked “Would you trust a platform like KRAKEN to share personal data?” In response, 7 participants expressed interest and trust in the platform, 5 had some concerns related to security and privacy of sharing data, due to a lack of understanding of the privacy preserving technology supporting it. Those who were interested expressed trust in the blockchain technology behind the platform and in the KRAKEN consortium, as it is a public funded project supported by the European Commission.

Those who expressed concerns mentioned a lack of transparency in the way personal data are protected and treated by KRAKEN, they asked for more clear information on the entities supporting the project, as well as more clear and accessible explanations on the mechanisms ensuring privacy and security of data.

Question 1.2: Interest in providing or consuming data through KRAKEN

We asked participants “Would you be interested to use KRAKEN for providing/consuming data products like the ones you have seen provided by the KRAKEN prototype? Why or why not?”. Four participants said they were very interested in consuming data through KRAKEN, 3 had a stronger interest for providing data through the platform, 5 said they were potentially interested to use KRAKEN for sharing data if the platform was able to ensure security, privacy and quality of data sharing. Most participants thought KRAKEN should guarantee that the personal data shared are reliable, accurate as well as ensure that usage of the data shared is compliant with the goals and privacy settings stated by the data provider when offering access to a data product.

Privacy preserving data sharing systems

Question 2.1: Interest in using the privacy preserving analytics of KRAKEN

This question asked participants “Are you interested to use the privacy preserving analytics of KRAKEN?”. In response, 11 participants expressed interest to access this type of service offered by the platform, while 1 participant did not provide any answer. In general, the privacy preserving analytics were considered as a service providing an added value to users of the platform, especially for those interested to access statistics for research purposes. One participant mentioned the importance of having access to customizable analytics, fitting the needs of each particular study. Another participant stressed the need for the platform to be kept updated with the latest crypto techniques and to provide state-of-the-art anonymization mechanisms for data sharing.

Question 2.2: Willingness to authenticate to the marketplace via the SSI mobile app

We asked participants “Would you be willing to use a web system that will secure your data, even if you will have to authenticate through a mobile app?” Five participants replied that the double authentication modality is nowadays quite familiar to users, so they did not see any obstacle in using this method also to access the KRAKEN marketplace. Three participants expressed a preference for using already existing certified systems to authenticate (e.g., SPID), to lower the effort required by the user to download and install the mobile app. Four participants reported their frustration with installing and using the KRAKEN SSI mobile app, due to compatibility and usability problems experienced with the prototype release tested during the evaluation, therefore they recommended to improve its usability to avoid future users from abandoning the platform after the first interaction.

Sharing health data

Question 3.1: Types of data to share

Participants were asked “Would you be willing to share your data product with other entities through the KRAKEN platform if it’s pseudo anonymized, anonymized (e.g. universities pharmaceutical companies, private organizations, research institutions)? Why and why not?”

Six participants expressed willingness to share anonymized data products, 6 participants replied that they would be willing to share data only for research purposes, not for commercial purposes, since they were motivated mainly by ethics reasons for sharing personal data. Three participants explicitly mentioned they would share data with public entities (universities, research foundations) for research goals, but not with private entities, such as pharmaceutical companies.

Question 3.2: Entities to share education data with

Participants were also asked “Which kinds of entities would you be willing to share it with?”

In response, 7 participants mentioned they would share their data with an entity if they clearly knew the purpose of the data usage, 2 participants said they would share data in case they can keep control over their data and can even revoke access to data, 2 participants mentioned ethics reasons (e.g., contributing to improving healthcare treatments), 1 participant said he would be motivated by receiving some form of acknowledgement or credit for sharing his data.

Compensation for sharing data and data valorization

Question 4.1: Type of compensation for sharing data products

We asked participants “What type of compensation would you be looking for in exchange for your data products?” Five participants replied that a monetary compensation would be appreciated for sharing their data products, since this would be the easiest way of managing a compensation for this type of products. Five participants expressed a preference for having a non-monetary form of compensation, mentioning more knowledge on their health condition, free access to services (counselling, premium contents on relevant health topics), gift cards or other credits. One participant thought that deciding for a type of compensation is a complex issue, since the platform should also compensate intermediary entities that may ensure the quality and standardization of the data products offered through the platform. One participant said she had no clear position on the type of compensation that should be provided.

Question 4.2: Defining a price for a data product

Participants were asked “Do you feel comfortable in defining a price for your data product?” In response, 11 participants expressed difficulties in defining a price for a data product, while just 1 participant said that he would be fine with defining a price for research purposes, by referring to other available datasets of health data that can be bought online. Two participants mentioned the need for having a general regulation helping to define prices for health data in a more standardized way.

Question 4.3: Support from a tool in the platform to check price

We asked participants “Would you need any support from for example an available tool in the platform to define or check if your price is sensible/correct?” To this question, 12 participants expressed appreciation for having a tool or reference system in the platform supporting in defining a fair and sensible price for their data products. One participant proposed to develop a bidding system for data products, to promote quality of the data shared and incentives to share better data products. In

general, there was large agreement among participants in the need of providing such a tool to help define prices and to valorise data products over time.

Acceptance, ethics

Question 5.1: Impression over data protection and privacy of KRAKEN

Participants were asked “What is your impression of the level of data protection and privacy of the KRAKEN platform?” Five participants replied that it was not clear from their interaction with the prototype how KRAKEN was ensuring data protection and privacy of data products. Two participants said they knew how blockchain technologies contribute to data protection and privacy, so they would trust KRAKEN just by knowing it is based on this type of technology. Two participants admitted that users typically read very superficially the conditions of use of a new system and then click accept, but in the case of KRAKEN it would be useful to be reminded about fundamental aspects of privacy and ethics at the specific moment when the user takes decisions about creating and publishing a data product. Three participants did not have a clear impression on how KRAKEN was dealing with privacy and data protection issues and asked to have more information on that.

Question 5.2: Data protection or privacy risks in using KRAKEN

We asked participants “Can you think of any data protection or privacy risks that you could encounter using the KRAKEN platform?” In response, 8 participants agreed that there is no software system or platform that can be considered completely secure, but they thought that the role of KRAKEN is to minimize the risk as far as possible, since the type of data shared are particularly sensitive. Among the risks identified by participants were: misuse of data, data leakage, hackers’ attacks, risk of deleting data by mistake, unclear specification about who to contact in case of problems (e.g., local vs European authorities). One participant said it would be important to provide more information on data protection and privacy when registering an account in the marketplace, another participant mentioned that quantum computing may represent a future threat for blockchain-based platforms such as KRAKEN. Two participants had nothing to add to this question.

Question 5.3: Understanding information on data protection and privacy

Finally, participants were asked “Is the provided information relating to your data protection and privacy rights and freedoms sufficiently clear and understandable?” Three participants replied that they appreciated the fact that KRAKEN considered this issue and the quality of information provided is sufficient for the current status of the prototype released. Six participants asked for having more clear information on this topic and proposed to use icons to present information on privacy and GDPR compliance, to provide more information on privacy by design measured adopted, more contextual information on privacy and data protection when performing key actions in the platform for publishing data products. Three participants had no clear answer to this question or had a neutral position regarding this issue.

3.3.2 Education pilot findings

Education Data Management

Question 1.1: Trust in using KRAKEN for sharing personal data

Participants were asked “Would you trust a platform like KRAKEN to share personal data?” In response, two participants said they would trust KRAKEN since they appreciated the concept behind the KRAKEN solution, but they would trust it more if the user interaction with the prototype would be improved. One participant stressed the fact that the problems he met in using the prototype decreased his trust

in the system, but generally he is more in favour of using open access, source code transparent systems.

Question 1.2: Interest in providing or consuming data through KRAKEN

We asked participants “Would you be interested to use KRAKEN for providing/consuming data products like the ones you have seen provided by the KRAKEN prototype? Why or why not?”. Two participants said they would be interested to share educational data through the platform, one mentioned that the KRAKEN concept and use case is much needed, since companies and employers might be interested to access more easily and reliably these data through the marketplace. One participant specified she did not want to provide access to her education data through a marketplace.

Question 1.3: Motivation to share education data

This question asked: “What is your motivation to share (or sell) your education data?” Two participants said they would feel motivated to share their education data when applying for a job, to avoid sending scanned copies of printed documents and ease things. One participant explained she would prefer to share data about a study (e.g., a thesis work) but only if anonymised, while she would not feel motivated to share other types of data.

Privacy preserving data sharing systems

Question 2.1: Interest in using the privacy preserving analytics of KRAKEN

This question asked participants “Are you interested to use the privacy preserving analytics of KRAKEN?”. In response, two participants replied they would require knowing or read more about this functionality to have an opinion on that. One participant said he might be interested in using such a service, once supported by the platform.

Question 2.2: Willingness to authenticate to the marketplace via the SSI mobile app

We asked participants “Would you be willing to use a web system that will secure your data, even if you will have to authenticate through a mobile app?” All three participants agreed that they would be willing to use such an authentication modality, since it is quite common and secure nowadays. However, they all stressed the need of improving the usability of the SSI app and its synchronization with the marketplace to avoid confusing the user in her first interaction with the KRAKEN solution.

Sharing education data

Question 3.1: Motivation for sharing data products

Participants were asked “What types of data do you feel comfortable sharing/selling? What types of data should the Education pilot support in addition to the ones we support?” All three participants expressed interest for sharing education data, such as CVs and diploma. They were willing to share also other personal data, such as passports, citizenship certificates, but they had more concerns in sharing for example health data.

Question 3.2: Entities to share data with

Participants were also asked “Which kinds of entities would you be willing to share data with?” In response, 2 participants said they would prefer to share data with universities, employers, government agencies, since this would facilitate bureaucratic processes in a secure and privacy preserving mode. One participant said he would be willing to share data with these entities if the KRAKEN platform

provides guarantee that the user keeps control of his data and the platform properly manages any possible system failure.

Question 3.3: Provide access to data by other entities

We asked participants “Will you feel comfortable letting other entities (organizations, universities) see your data using the KRAKEN platform? Do you think it will be secure?” Here all 3 participants stressed they would provide access to their education data to universities and state entities, rather than private companies that may want to access data with a money-making purpose. One participant said KRAKEN would allow to share data in a more secure way if compared with transfer of documents in hard copies, and it would support a better control of personal data by providers.

Compensation for sharing data and data valorization

Question 4.1: Compensation for sharing data products

We asked participants “Would you seek compensation in exchange for securely sharing your data products?” All three participants said they were not interested in sharing their education data for a monetary compensation. One participant had concerns with companies like LinkedIn selling data entered by users in that platform. Another participant expressed interest for receiving a different form of compensation, for example free access to educational licenses of software.

Acceptance, ethics

Question 5.1: Acceptance of KRAKEN if provided by a private entity

Participants were asked “Will your acceptance for the KRAKEN data sharing services differ if it was provided by a company like Google? A recruiting company? Or an IT company like IBM?” All 3 participants replied they would not share their data with Google or IBM since they store data in the U.S. outside of Europe, and in the case of recruiting companies, they would prefer to decide each time with whom to share or not share their data.

Question 5.2: Ethics concerns in using KRAKEN

We asked participants “Do you see any ethics concerns in using a data sharing platform like KRAKEN?” In response, one participant said it is important that KRAKEN supports data sharing in a secure way, by ensuring that data is not sold or used differently from what stated by the data provider. One participant was concerned about possible changes in regulation and discontinuity of the platform once the KRAKEN project is over. One participant mentioned he would prefer to start using KRAKEN by providing noncritical data and then, after some months of usage, if everything works fine, he might be willing to share more sensitive personal data (e.g., health data) through it.

4 Conclusion

This document has provided results from the evaluation of the KRAKEN platform, first prototype release, by representatives of the target user groups involved in the Health and Education pilots.

The user-centered design of the KRAKEN solution was initially informed by a heuristic evaluation of its front-ends mockups, conducted by 4 usability experts to improve the design. In Autumn 2021 the KRAKEN first release was evaluated by 15 users from the relevant user groups identified in *D5.1 Initial pilot marketplaces user stories* who assessed both the usability of the marketplace features after individual usage and provided further feedback and recommendations on the system during dedicated workshops regarding the Health and Education pilots.

Overall, the results regarding usability of the prototype release, measured on the SUS questionnaire, show an average score (0-100 scale) of 51.87 (SD 23.67) for the Health pilot and an average score of 55 (SD 10.89) for the Education pilot. These scores correspond to the grade D, percentile range 15-34, they can be defined with the adjective OK/Fair and reach a marginal level of acceptance. This result may be acceptable for an early release of the platform components, but the usability and UX with the KRAKEN solution should be improved to reach at least a score of 68 (Good) by the second evaluation round of the platform, planned in the third project year.

Results from the Health and Education workshops shed further light on participants expectations, preferences, and main concerns regarding adoption of the KRAKEN solution. In general, participants expressed appreciation for the KRAKEN concept and use cases, they provided interesting suggestions and recommendations for a future refinement of the platform components, as well as for facilitating user engagement and trust in the final solution.

These findings are going to inform the future technical and strategic decision-making by the KRAKEN consortium regarding the design and implementation of the second prototype, to be released and deployed in the Health and Education pilots in 2022.

Findings from this KRAKEN evaluation phase are also relevant to inform future KRAKEN exploitation activities, to facilitate a wider adoption of the KRAKEN solution by early adopters and other stakeholders in the next years.

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Annexes

Annex A

Information sheet and consent form presented to users involved in the first evaluation round

KRAKEN INFORMED CONSENT FORM

The user of the KRAKEN Platform first prototype:

I, hereby freely and voluntarily give my CONSENT to participate in the evaluation study of the KRAKEN Project to the benefit of the KRAKEN Consortium.

I understand and agree that my personal data will be processed during the recording of the activities pursuant to the KRAKEN Platform evaluation. These personal data (name, gender, age group, email address, occupation, video recording of answers and comments regarding the KRAKEN evaluation) will be processed for and on behalf of the KRAKEN consortium members as detailed in the information sheet, for purposes of testing of the technologies included in the Health and Education Pilot Cases, as developed during and for the KRAKEN research project. My personal data will be processed in a confidential manner, taking into account applicable data protection laws, and in compliance with the General Data Protection Regulation (GDPR).

Please read carefully the accompanying information sheet, which further details the personal data processing activities and the rights you have as a data subject.

Giving my consent, I confirm that:

1. I HAVE CAREFULLY READ and UNDERSTOOD THE INFORMATION SHEET

2. All questions that I posed have been answered to my satisfaction,

3. I AM FULLY AWARE THAT:

- It is my right to withdraw my consent for my participation and associated personal data processing from the evaluation study at any time without consequences,
- Any information about myself will be treated as confidential by research Consortium members, the European Commission and its expert project reviewers.
- My personal data will only be processed by the KRAKEN consortium and will only be used for purposes of research related to the development of the KRAKEN technology, demonstration, validation and training in use of the research tools developed, as detailed in the information sheet and in compliance with GDPR.
- Extracts from the pilot testing proceedings will be demonstrated before the European Commission Project Officer and the appointed Reviewers for the purpose of validating the KRAKEN project.
- In any publication resulting from the KRAKEN evaluation study, my personal details will not be revealed and it will not be possible to retrieve any data which might disclose my identity.

4. HAVING READ, UNDERSTOOD AND ACCEPTED ALL OF THE ABOVE,

I hereby agree, for legal and ethical purposes, to the participation in the KRAKEN evaluation study and to the use of my personal data that results there out.

Tap/click I agree / I do not agree

I agree

I do not agree

Signature

KRAKEN INFORMATION SHEET – DATA COLLECTION FOR THE PILOT EVALUATION WITHIN THE FRAMEWORK OF THE KRAKEN PROJECT

You are being invited to take part in a research study in the framework of the KRAKEN project. Before you decide whether to participate it is important that you understand why the research is being done and what it will involve. Please take the time to read the following information carefully. If there is anything that is not clear, or if you would like more information, please get in touch with the research team (contact details at the end of this information sheet).

Purpose of the research

This research is carried out under the HORIZON 2020 project KRAKEN (Brokerage and market platform for personal data), funded by the European Commission under grant agreement No 871473.

The project develops a trusted and secure personal data platform with state-of-the-art privacy aware analytics methods, guaranteeing on metadata privacy, including query privacy. It aims to return the control of personal data back to users (data providers) throughout the entire data lifecycle. It will standardize different IT solutions thanks to featuring the (privacy-preserving) integration of independently obtained data sources from subjects consenting to different analyses. The project combines, interoperates, and extends the best results from two existing mature computing platforms developed within two H2020 actions: CREDENTIAL and MyHealthMyData.

You can learn more about the project at <https://www.krakenh2020.eu/>

Procedure description

The KRAKEN Platform testing will take place online from October 18th 2021 until November 12nd 2021 and it will consist of two main sessions: one individual use of the platform for usability checking and rating, one group session moderated by the consortium partner FBK (Fondazione Bruno Kessler) where testers participating in the evaluation will be asked to answer some questions regarding key expectations and preferences for the future use and improvement of the KRAKEN Platform.

More precisely, you will be asked to attend the following testing phases:

- Phase 1: you will be asked to individually access and use the KRAKEN platform, to perform key tasks enabled by the functionalities included in its first prototype release. You will be provided by FBK with the list of tasks to be performed and afterwards asked to fill in a questionnaire (System Usability Scale) to rate the level of usability of the prototype used.
- Phase 2: you will be invited to join an online session (on MS Teams conference system, duration 1.5 hours) with other participants who attended phase 1, moderated by FBK, where you will be asked a series of questions regarding your expectations and preferences for the future use and improvement of the KRAKEN platform. The session will be recorded for a subsequent quantitative and qualitative analyses of the participants responses that will be elaborated and reported anonymously for research purposes.

Your participation to Phase 1 and 2 of this evaluation will be rewarded with an Amazon gift card of 50 Euros.

KRAKEN partners

1. Atos Spain s.a.
2. InfoCert S.p.A.
3. AIT Austrian Institute of Technology GmbH
4. Graz University of Technology
5. XLAB razvoj programske opreme in svetovanje d.o.o.
6. Katholieke Universiteit Leuven
7. Fondazione Bruno Kessler (FBK)

8. Lynkeus srl
9. TX Technology Exploration Oy
10. Stiftung Secure Information and Communication Technologies

Consent, privacy and data handling

You are asked to consent that your personal data will be used for the pilot testing of the KRAKEN platform, as described above. Your consent will be collected by the project partner FBK which is in charge of collecting and analysing the testing data for project reporting.

While the carrying out of the pilot test, the following categories personal data will be collected and used:

- Name and surname
- Gender
- Email address
- Age group
- Occupation
- Video recording of answers/comments regarding the KRAKEN evaluation

Data, collected in this testing phase, will only be accessible to FBK and partners involved in the Educational and Healthcare pilots.

Results from the evaluation will be presented before the European Commission Policy Officer and appointed Reviewers for the purpose of reviewing and validating the KRAKEN project.

Anonymised research results will be published in journal articles, conference presentations and via other modes of scientific exchange and dissemination.

Potential risk and discomfort

If, at any time, you should become tired or feel other forms of discomfort, you can simply quit the participation in the KRAKEN evaluation study.

The period for which the data will be stored

The data will be stored until the end of the KRAKEN project, i.e. until December 2022, and then permanently deleted. In some cases, e.g. because it is needed for the research purpose or because of a legal obligation, then the personal data might be retained for a maximum of one year after the termination of the project, unless otherwise indicated or requested by a supervisory authority or for auditing purposes.

Voluntary participation and right to withdraw from the research

Your choice to take part in the research is entirely voluntary. You are completely free to choose not to participate, or to withdraw your participation at any moment without any consequence.

Rights of the participant

You have all the rights stated in Chapter III of the GDPR (articles 13-22), and in particular:

- a. You have the right to request from the controller **access to** and **rectification** or **erasure** of personal data or to **restrict processing** concerning yourself or to **object** to processing.
- b. You have the right to **withdraw your consent**, the right to **refuse to participate** and to **withdraw** your participation, samples or data at any time —**without any consequences**.
- c. You have the right to **lodge a complaint** with a supervisory authority.

For this purpose, you can contact:

- For the Education Pilot Case: Stefan More (TUG) [stefan.more@iaik.tugraz.at]
- For the Healthcare Pilot Case: Davide Zaccagnini (LYN) [d.zaccagnini@lynkeus.com]
- For the evaluation study: Silvia Gabrielli (FBK), [sgabrielli@fbk.eu]; Anna Benedetti, DPO (FBK), [privacy@fbk.eu]

Contacts

For any further doubt or clarification request, do not hesitate to contact the KRAKEN Project Coordinator, Juan Carlos Perez Baun (ATOS) at [juan.perezbaun@atos.net].

Annex B

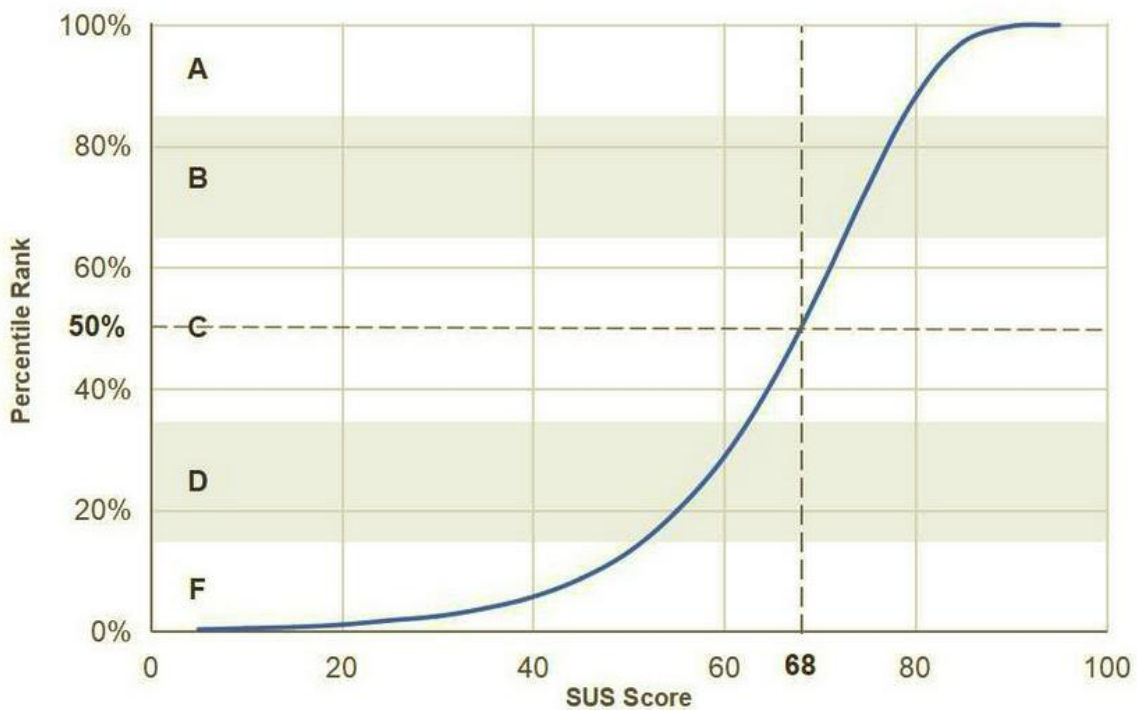
The System Usability Scale

The SUS is a 10 item questionnaire with 5 response options.

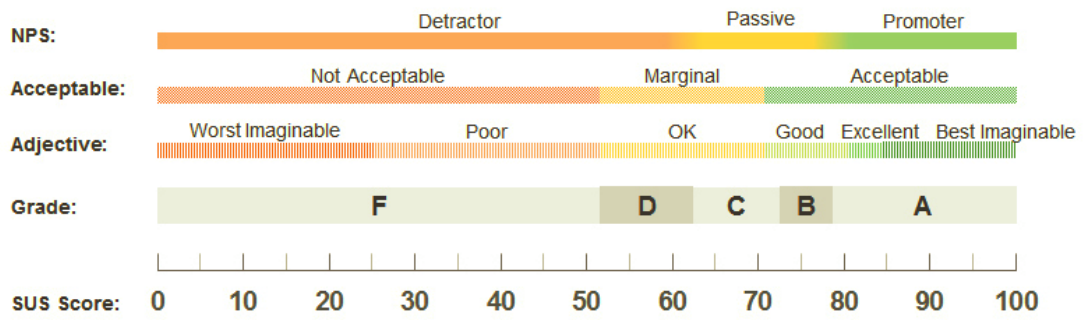
1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

The SUS uses the following response format:

Strongly Disagree 1	2	3	4	Strongly Agree 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



SUS on a curve with percentile ranks and grades



Grades, adjectives, acceptability and NPS categories associated to SUS scores



Atos

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BRUNO KESSLER

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OF TECHNOLOGY



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