

Supplementary Information

CoKnowEMe: an Edge Evaluation Scheme for QoS of IoMT Microservices in 6G scenario

Grazia Veronica Aiosa^{1,*}, Barbara Attanasio¹, Aurelio La Corte¹ and Marialisa Scata¹

¹ Dipartimento di Ingegneria Elettrica, Elettronica e Informatica, Università di Catania, 95125, Catania (Italy)

* corresponding author (veronicaaiosa7@hotmail.it)

⁺these authors contributed equally to this work

Supplementary Table S1. Acceptability Factors. The table shows the external factors influencing the acceptability of a service. These factors can be classified in personal, demographic and socio-economic, each of them characterized by several sub elements listed in the Table.

ACCEPTABILITY FACTORS		
PERSONAL	DEMOGRAPHIC	SOCIO-ECONOMIC
Fun [SR1] Enjoyment [SR1] Apprehensiveness [SR1]	Age [45], [SR1], [SR2] Gender [45], [SR1], [SR2] Culture end ethnicity [45], [SR2] Occupation [45], [SR1], [SR2] Education [45], [SR1] Family [45]	Price [SR2] Income [45], [SR1] Social influence (compliance, identification and internalization) [SR3] Social prestige [SR1] Social pressure [SR1]

Supplementary Table S2. Usability Factors. The table displays the external factors influencing the usability of a service which are user, task and use context.

USABILITY FACTORS			
	USER	TASK	USE CONTEXT
DEFINITION (ISO 9241-11:2018 [61])	Person who interacts with a system, product or service.	Set of activities undertaken in order to achieve a specific goal.	Combination of users, goals and tasks, resources, and environment.

Supplementary Table S3. Acceptability. The Table shows the acceptability attributes and sub-attributes, which specify it and allow for a more complete evaluation of the service. The table highlights also the relationships between the attributes and sub-attributes.

		ACCEPTABILITY ATTRIBUTES					
		Ease of use	Perceived Usefulness	Compatibility / Interoperability	Reliability	Accuracy	Security
SUB-ATTRIBUTES	Availability				X		X
	Recoverability				X		
	Fault tolerance				X		
	Robustness				X		
	Integrity						X
	Confidentiality						X
	Non-repudiation						X
	Authenticity						X

Supplementary Table S4. Usability. The table shows the relationship existing between attributes and sub-attributes, which are used to evaluate and characterize the service itself. Each attribute can have some associated sub-attributes that specify it and allow for a more complete evaluation.

		USABILITY ATTRIBUTES					
		Effectiveness	Efficiency	Satisfaction	Learnability	Safety	Understandability
SUB-ATTRIBUTES	Operability		X	X			
	Attractiveness			X			
	Memorability	X			X		
	Flexibility	X		X			
	Cognitive Load		X	X	X		
	Error		X	X			
	Simplicity				X		X
	Accuracy	X				X	
	Privacy					X	
	Authentication					X	
	Accountability					X	

Supplementary Table S5. Acceptability evaluation models. The table sheds light on the most popular models and the attributes considered to evaluate the acceptability of the service.

ACCEPTABILITY EVALUATION			
N.	EVALUATION MODEL	COMPONENTS	REFERENCES
1	TAM - Technology Acceptance Model	Perceived Usefulness, Perceived Ease of use	[28], [SR4], [44], [29], [45], [SR3], [SR1]
2	ECM-IT – Expectation Confirmation Model in the context of IT	Perceived Usefulness, Satisfaction	[28]
3	EECM-IT – Extended ECM-IT	Perceived Usefulness, Perceived Ease of use, Satisfaction	[28]
4	UTAUT – Unified Theory of Acceptance and Use of Technology	Performance Expectancy, Effort Expectancy, Social Influence, Facilitation, Mediation Factors (Age, Gender, Experience, Voluntariness)	[29], [45]
5	STAM – Senior Technology Acceptance and Adoption Model	User Context, Perceived Utility, Intent of use, Experimenting and Exploration, Easy of learning and Use, Useful Utility, Actual Use, Acceptance or Rejection	[29]
6	MOTPAM – Mobile Technology Acceptance Models	Perceived Usefulness, Perceived Ease of use, Social Influence, Facilitating Condition, Mediation Factors (Demographic, Socio-economic, Personal)	[29]
7	RUTAM - Rural Technology Acceptance Model	External Factors, Individual Factors, Perceived Usefulness, Perceived Ease of use	[45]

Supplementary Table S6. Usability evaluation models. The table shows the most popular models to evaluate the usability and specify the attributes considered for the evaluation by the different models.

USABILITY EVALUATION			
N.	EVALUATION MODEL	ATTRIBUTES	REFERENCES
1	ISO 9241-11:2018 [61]	Effectiveness, Efficiency, Satisfaction	[47], [24], [56], [26],[57]
2	NIELSEN	Efficiency, Errors, Satisfaction, Learnability, Memorability	[26], [56], [57]
3	QUIM - Quality in Use Integrated Map	Factors (Effectiveness, Efficiency, Satisfaction, Productivity, Safety, Internationability, Accessibility), Criteria (Attractiveness, Consistency, Minimal Action, Minimal Memory Load, Completeness), Metrics, Data	[56], [SR5]
4	PACMAD model - People at the center of Mobile application development	Effectiveness, Efficiency, Satisfaction, Learnability, Memorability, Errors and Cognitive Load	[47], [56], [26], [57]
5	GQM - Goal Question Metric	First level (effectiveness, efficiency, satisfaction), Second level (simplicity, accuracy, time spent, features, safety, attractiveness), Third level (questions and metrics)	[47]
6	MAUEM – Mobile Application Usability Evaluation Metrics	Efficiency, Effectiveness, Learnability, Memorability, Errors, Satisfaction, Cognitive Workload, Interruptibility, Simplicity	[27]
7	Mortem Hertzum	Universal Usability, Situational Usability, Perceived Usability, Hedonic Usability, Organizational Usability, Cultural Usability	[49]

Supplementary Table S7. Usability evaluation questionnaires. The table indicates some of the most common usability evaluation questionnaires, specifying also which attributes it is able to evaluate and how many questions it contains. The missing entries (X) indicates that, so far and to the best of our knowledge, there is not enough information in the literature to be able to specify the appropriate field.

USABILITY EVALUATION				
N.	EVALUATION QUESTIONNAIRES	ATTRIBUTES	NUMBER OF QUESTIONS	REFERENCES
1	SUS – System Usability Scale	Efficiency, Learnability, Satisfaction	10	[58], [56]
2	SUMI – Software Usability Measurement Inventory	Efficiency, Learnability, Satisfaction, Helpfulness	50	[58]
3	CSUQ – Computer System Usability Questionnaire	Efficiency, Learnability, Satisfaction, Training, Effectiveness	7	[58], [27]
4	QUIS – Questionnaire User Interaction Satisfaction	Satisfaction	27	[58]
5	UMUX – Usability Metric for User Experience	Efficiency, Effectiveness, Satisfaction	10	[58]
6	ASQ – After Scenario Questionnaire	Helpfulness, Satisfaction, Operability, Human Engineering	7	[58]
7	SEQ – Single Easy Question	Effectiveness, Satisfaction	7	[58], [44]
8	SMEQ – Subjective Mental Effort Question	Satisfaction	1 (with 9 verb forms)	[58]
9	WAMMI- Website Analysis and Measurement Inventory	Reliability, Efficiency, Understandability, Helpfulness, Learnability, Attractiveness, Usability Compliance	20	[58]
10	SUPR-Q – Standardized User Experience Percentile Rank Questionnaire	Attractiveness, Satisfaction	13	[58]
11	UEQ – User Experience Questionnaire	Acceptance, Satisfaction	26	[59]
12	NASA-TLX – NASA Task Load Index	Cognitive Load	X	[26]

Supplementary Table S8. User Experience evaluation tool. The table describes different user experience evaluation tools, indicating, for each of them, the kind of study, the observed period for the evaluation, the number of users who can evaluate the service at the same time and the type of data provided [60].

N.	EVALUATION TOOL	STUDY TYPE	STUDIED PERIOD OF EXPERIENCE	INFO PROVIDER	DATA
1	Affect Grid	Field studies, Lab studies, Online studies, Questionnaire	Before usage, An episode	One user at a time	Quantitative
2	AttrakDiff	Field studies, Lab studies, Online studies, Questionnaire	An episode, Long-term UX	One user at a time	Quantitative
3	AXE (Anticipated eXperience Evaluation)	Field studies, Lab studies	Before usage	One user at a time	Qualitative
4	Co-discovery	Lab studies	An episode	Pairs of users	Qualitative
5	Contextual Laddering	Field studies, Lab studies	Before usage, An episode, Long-term UX	One user at a time	Qualitative, Quantitative
6	Controlled observation	Lab studies	Snapshots, An episode	One user at a time	Qualitative, Quantitative
7	Differential Emotions Scale (DES)	Field studies, Lab studies, Questionnaire	Snapshots, An episode	One user at a time	Quantitative
8	EMO2	Field studies, Lab studies	An episode	One user at a time	Quantitative

9	Emofaces	Field studies, Lab studies, Online studies	An episode	One user at a time, Pairs of users	Quantitative
10	Emotion Cards	Field studies, Lab studies, Online studies	Before usage, Snapshots, An episode, Long-term UX	One user at a time	Qualitative, Quantitative
11	Experience Sampling Method (ESM)	Field studies	Snapshots, Long-term UX	One user at a time	Qualitative, Quantitative
12	Facial EMG	Lab studies	Snapshots	One user at a time	Qualitative, Quantitative
13	Geneva Appraisal Questionnaire	Field studies, Lab studies, Online studies, Questionnaire	Snapshots, An episode	One user at a time	Quantitative
14	Geneva Emotion Wheel	Field studies, Lab studies, Online studies, Questionnaire	Snapshots, An episode	One user at a time	Quantitative
15	Hedonic Utility scale (HED/UT)	Field studies, Lab studies, Online studies, Questionnaire	Snapshots, An episode	One user at a time	Quantitative
16	I.D. Tool	Field studies, Lab studies	Before usage, An episode, Long-term UX	One user at a time	Qualitative
17	Intrinsic motivation inventory (IMI)	Field studies, Lab studies, Online studies, Questionnaire	Snapshots, An episode	One user at a time	Quantitative
18	iScale	Lab studies, Online studies	Long-term UX	One user at a time	Qualitative, Quantitative
19	Long term diary study	Field studies, Online studies	Long-term UX	One user at a time	Qualitative
20	Mental effort	Field studies, Lab studies, Online studies, Questionnaire	Snapshots, An episode	One user at a time	Quantitative
21	Mindmap	Lab studies	Before usage, Snapshots, An episode	One user at a time	Qualitative, Quantitative
22	PAD	Field studies, Lab studies, Online studies	Snapshots, An episode	One user at a time	Quantitative
23	PrEmo	Field studies, Lab studies, Online studies	Before usage, Snapshots	One user at a time	Qualitative, Quantitative
24	Private camera conversation	Lab studies	An episode, Long-term UX	One user at a time, Pairs of users	Qualitative
25	Product Attachment Scale	Field studies, Online studies	Long-term UX	One user at a time	Quantitative
26	Reaction checklists	Lab studies, Online studies	An episode	One user at a time	Quantitative
27	Self-Assessment Manikin (SAM)	Field studies, Lab studies, Online studies, Questionnaire	Snapshots, An episode	One user at a time	Quantitative
28	Semi-structured experience interview	Field studies, Online studies	Before usage, Snapshots, An episode, Long-term UX	One user at a time, Pairs of users	Qualitative
29	Sensual Evaluation Instrument	Lab studies	Snapshots	One user at a time	Qualitative, Quantitative
30	Sentence Completion	Lab studies, Online studies	Long-term UX	One user at a time	Qualitative, Quantitative
31	This-or-that	Field studies, Lab studies	Snapshots, An episode	One user at a time	Qualitative, Quantitative

32	TRUE Realtime Experience	Tracking User	Lab studies	An episode	One user at a time	Qualitative, Quantitative
33	UX Curve		Lab studies	Long-term UX	One user at a time	Qualitative, Quantitative
34	UX laddering		Field studies, Lab studies	Before usage, Snapshots, An episode, Long-term UX	One user at a time	Qualitative, Quantitative
35	Valence method		Lab studies	Snapshots, An episode	One user at a time	Qualitative, Quantitative

Supplementary Table S9. Acceptability attributes and sub-attributes. The table describes in detail the set of attributes and sub-attributes related to evaluation of acceptability. In particular, for each of them the table contains the following fields: the evaluation approach (whether objective or subjective), the definition, the used metric, the unit of measurement, the measurement method and the information provided by attributes and sub-attributes. The missing entries (X) indicates that, so far and to the best of our knowledge, there is not enough information in the literature to be able to specify the appropriate field.

ACCEPTABILITY						
APPROACH	DEFINITION	METRIC	UNIT OF MEASURE	METHOD OF MEASUREMENT	INFORMATION	REFERENCES
ATTRIBUTES						
EASE OF USE						
Subjective	The perceived level of the user's effort related to usage of the application.	Predefined statements with Likert-scale ranking.	X	Survey	Ease of use indicates the degree of difficulty or effort that the user experiences while using a particular system, but it can also indicate the degree to which a software product facilitates the control and use of the system itself.	[47], [SR4], [35]
PERCEIVED USEFULNESS						
Subjective	The degree to which a person believes that using a particular technology would enhance his or her job performance.	Predefined statements with Likert scale ranking.	X	Survey	Indicates the ability of a system to be used advantageously by the user to satisfy present or future needs.	[28], [SR4]
COMPATIBILITY / INTEROPERABILITY						
Objective	Degree to which two or more systems, products or components can exchange information and use the information that has been exchanged.	Ratio between the number of efficient interactions on the number of total interactions.	Percentage of Compatibility	Controlled Observation	Interoperability or compatibility indicates the ability of two or more systems to work together, without them having to be modified, exchanging information and understanding the	[55], [35], ISO/IEC 25010:2011 [SR10]

					information exchanged.	
RELIABILITY						
Objective	Degree to which a system, product or component performs specified functions under specified conditions for a specified period of time.	Weighted sum of sub-factors (Recoverability, Availability, Fault Tolerance, Robustness).	Percentage of Reliability	Weighted-Sum	Indicates the ability of a service to fulfill specific functions, even certain conditions and in a certain time interval.	[55], [35], ISO/IEC 25010:2011 [SR10]
SECURITY						
Objective	Degree to which a product or system protects information and data so that persons or other products or systems have the degree of data access appropriate to their types and levels of authorization.	Weighted sum of subfactors (Confidentiality, Integrity, Availability, Non-Repudiation).	Percentage of Security	Weighted-Sum	The Security indicates the set of actions and tools adopted by the system in response to an ongoing threat organized in order to cause damage; thus protecting information and data from unauthorized persons or systems.	[35], [SR6], ISO/IEC 25010:2011 [SR10]
ACCURACY						
Objective	The degree to which the software product provides the right or specified results with the needed degree of precision.	Ratio between the service that is expected and that which is observed.	Percentage of Accuracy	Controlled Observation	Indicates the correctness, precision and rigor with which the results are provided.	[55], [35]
SUB-ATTRIBUTES						
AVAILABILITY						
Objective	Degree to which a system, product or component is operational and accessible when required for use.	Service accessibility Uptime percentage of a service during a time interval Number of availability threats blocked/Number of total threats	Seconds Percentage of uptime Percentage of Availability	Controlled Observation	Indicates the ability of a service to be operational and accessible when it is required for use.	[55], [35], [SR6], ISO/IEC 25010:2011 [SR10]
RECOVERABILITY						
Objective	Degree to which, in the event of an interruption or a failure, a product or system can recover the data directly affected and re-establish the desired state of the system.	CFR (coverage of failure recovery)	Solved Faults/Total Faults	Controlled Observation	Indicates the ability of a system to recover data and restore the desired state in the event of an outage or failure.	[55], [35], ISO/IEC 25010:2011 [SR10]
FAULT TOLERANCE						
Objective	Degree to which a system, product or component operates as intended despite	MTBF (mean time between failures) MTTF(mean time to failure)	Seconds	Controlled Observation	Indicates the ability of the service to remain reachable and functioning	[55], [35], ISO/IEC 25010:20

	the presence of hardware or software faults.	MTTR (mean time to repair) CFT (coverage of fault tolerance)	Solved Faults/Total Faults		even in the event of anomalies or failures.	11 [SR10]
ROBUSTNESS						
Objective	The degree to which an executable work product continues to function properly under abnormal conditions or circumstances.	Probability of service being affected by the failure.	Probability of failure	Controlled observation	Indicates the ability of a system to continue to perform its work even in the event of failures or malfunctions.	[55], [35]
INTEGRITY						
Objective	The degree to which a system, product or component prevents unauthorized access to, or modification of, computer programs or data.	Number of integrity threats blocked / Number of total threats	Percentage of Integrity	Controlled observation	Indicates the ability of a system to prevent unauthorized users from accessing or modifying applications or data.	[55], [35], [SR6], ISO/IEC 25010:2011 [SR10]
CONFIDENTIALITY						
Objective	Degree to which a product or system ensures that data are accessible only to those authorized to have access.	Number of confidentiality threats blocked / Number of total threats	Percentage of Confidentiality	Controlled observation	Indicates the ability of a system to ensure that data is accessible only to those who are authorized to access it.	[55], [35], [SR6], ISO/IEC 25010:2011 [SR10]
NON-REPUDIATION						
Objective	The degree to which actions or events can be proven to have taken place, so that the events or actions cannot be repudiated later.	Number of non-repudiation threats blocked / Number of total threats	Percentage of Non-Repudiation	Controlled observation	It indicates the ability to provide evidence of the origin and integrity of data without that someone can deny their validity.	[35], [SR6], ISO/IEC 25010:2011 [SR10]
AUTHENTICITY						
Objective	The degree to which the identity of a subject or resource can be proved to be the one claimed.	X	X	Controlled observation	Indicates the ability to verify the identity of a subject or resource by demonstrating that it is what it claims to be.	[55], [35], ISO/IEC 25010:2011 [SR10]

Supplementary Table S10. Usability attributes and sub-attributes. The table describes in detail the set of attributes and sub-attributes used for the evaluation of usability. In particular, for each of them, the table indicates: the type evaluation approach (whether objective or subjective), the definition, the metric used, the unit of measurement, the measurement method, the information retrieved from each attribute and sub-attribute and the questionnaires suitable for evaluation. The missing entries (X) indicate that, so far and to the best of our knowledge, there is not enough information in the literature to be able to specify the appropriate field.

USABILITY							
APPROACH	DEFINITION	METRIC	UNIT OF MEASUREMENT	METHOD OF MEASUREMENT	INFORMATION	EVALUATION QUESTIONNAIRES	REFERENCES
ATTRIBUTES							

EFFECTIVENESS							
Objective/ Subjective	Accuracy and completeness with which users achieve specified goals.	Task success rate	Number of successfully completed tasks / Total number of tasks	Survey	Indicates a user's ability to achieve specific goals accurately and completely.	CSUQ, UMUX, SEQ	[47], [58], [59], [27], [SR7], ISO 9241-11:2018 [61], ISO/IEC 25010:2011 [SR10]
		The number of steps required to complete a task.	Number of steps required/task	Controlled observation			
		Number of errors	Number of errors / tasks				
EFFICIENCY							
Objective/ Subjective	Resources expended in relation to the accuracy and completeness with which users achieve goals.	Duration spent on each screen	Seconds / milliseconds	Survey	Indicates the ability of a user to complete their activities in the shortest possible time, also taking into account the resources (time, human commitment, costs and material resources) spent.	SUS, SUMI, CSUQ, UMUX, WAMMI	[47], [24], [58], [59], [27], [SR7], [35], ISO/IEC 25010:2011 [SR10]
		Task time		Controlled observation			
		Productive Time					
		User's error rate	Number of user's errors/tasks				
SATISFACTION							
Subjective	Degree to which user needs are satisfied when a product or system is used in a specified context of use.	Subjective rating scale of users towards services after using them.	Percentage of satisfaction	Survey	Indicates the subjective responses (in terms of target, communication, environment) of users, both positive and negative, about their feelings when using the service.	SUMI, SUS, CSUQ, QUIS, UMUX, ASQ, SEQ, SMEQ, SUPR-Q, UEQ	[47], [24], [58], [59], [27], [56], [SR7], ISO/IEC 25010:2011 [SR10]
		Predefined statements with Likert-scale ranking.					
UNDERSTANDABILITY							
Subjective	The degree to which the software product enables users to recognize whether the software is appropriate for their needs.	Subjective rating scale of users towards services after using them	X	Survey	Indicates the ability of the system to allow the user to understand the functionalities of the service and how to use them successfully to perform particular tasks.	WAMMI	[58], [35]
		Predefined statements with Likert-scale ranking.					
LEARNABILITY							
Objective/ Subjective	Degree to which a product or system can be used by specified users to achieve	First Time:		Survey	Indicates the ability of the system to allow the user to learn the content of the service comprehensively	SUMI, SUS, CSUQ, WAMMI	[47], [58], [27], [SR7], ISO/IEC 25010:2011 [SR10]

	specified goals of learning to use the product or system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use.				and to acquire knowledge and skills comfortably.			
		Number of attempts to solve a task	Attempts / tasks					
		Number of errors performed by an user						
		Number of assists during performing a task	Number of aids / tasks					
		Time spent on training	Seconds / milliseconds					
		Time task	Seconds / milliseconds	Controlled observation				
		Over Time:						
		Repeating similar pairs of tasks in each session.	Number of similar repetitions/ tasks					
		Duration to reach a pre-specified proficiency.	Seconds/ milliseconds					
		Learning Curve	Number of Wrong accessed page/task					

SAFETY

Objective	Aspects of the system related to protecting the user from dangerous conditions and undesirable situations.	Weighted sum of sub-factors (Accuracy, Privacy, Authentication , Responsibility).	Percentage of Safety	Weighted-Sum	Indicates both the totality of the measures and tools adopted by the system in order to prevent or reduce accidental events that could cause damage to people or things, and the ability of users to protect themselves by not disclosing information and personal data.	X	[SR8], [36]
-----------	--	--	----------------------	--------------	--	---	-------------

SUB-ATTRIBUTES

OPERABILITY

Objective/ Subjective	Degree to which a product or system has attributes that make it easy to operate and control.	X	X	X	Indicates the ability of the services to allow the user to use and control its functions.	ASQ	[58], ISO/IEC 25010:2011 [SR10]
-----------------------	--	---	---	---	---	-----	---------------------------------

ATTRACTIVENESS

Subjective	The degree to which the software product is attractive to the user.	Predefined statements with Likert-scale ranking.	X	Survey	Indicates the charm of a user interface for users involved in services.	SUPR-Q, WAMMI	[58], [35]	
MEMORABILITY								
Objective/ Subjective	The degree of ease with which a user can remember how to use an application effectively.	Effect of response time		Survey	Indicates the level of ease with which a user can recall how to use the application after interrupting it for some time.	X	[47], [SR8], [27], [SR7]	
		Duration of pauses	Seconds / milliseconds	Controlled observation				
		Predefined statements with Likert-scale ranking.	X	Visual tracking				
		On the second use:						
		Task time	Seconds / milliseconds					
		Number of navigational steps	Number of accessed pages/experiment					
		Number of error	Number of errors/experiment					
		Number of touch	Number of touches/page/experiment					
FLEXIBILITY								
Subjective	Degree to which a product or system can be used with effectiveness, efficiency, freedom from risk and satisfaction in contexts beyond those initially specified in the requirements.	Predefined statements with Likert-scale ranking.	X	Survey	Indicates the possibility of adapting the software product to the personal preferences of users.	X	[SR8], [36], ISO/IEC 25010:2011 [SR10]	
COGNITIVE LOAD								
Objective/ Subjective	Refers to the amount of mental activity imposed on a user's working memory during application usage.	Fixations, gaze points and heat maps	X	Survey	Indicates the amount of mental energy needed by the user to use the service.	NASA-TLX	[47], [23], [SR7], [57]	
		Text summarization	X	Controlled observation				
		Predefined statements with Likert-scale ranking.	X	Visual tracking				
		Request of help	Number of help access / experiment					

		Time spent on help	Seconds / milliseconds				
		Response time	Seconds / milliseconds				
ERROR							
Objective	Refers to the amount and type of errors which occur during task performance by a user.	Amount and type of errors occurred	Number of errors	Survey	Indicates a situation in which the user is in difficulty and is potentially unable to use the system to achieve the desired goal.	X	[47], [27], [56]
		Number of errors	Number of errors/experiment	Controlled observation			
SIMPLICITY							
Objective/ Subjective	Degree to which a system or component has a design and implementation that is straightforward and easy to understand.	Number of performed gestures to reach a destination object.	X	Survey	Indicates the ease of understanding or ease of use of the service.	X	[47], [27], [SR7], ISO/IEC/IEEE 24765 [SR12]
		Duration of searching a button to perform a specific function	Seconds	Controlled observation			
		Predefined statements with Likert-scale ranking	X	Interview			
		Number of errors	Number of errors/experiment				
		Number of touches to finish task	Number of touches/page/experiment				
		Number of navigated pages task	Number of accessed pages/experiment				
PRIVACY							
Subjective	The ability of individuals to maintain control of their personal information.	X	X	X	Indicates the right to have some control over the collection and use of one's personal information.	X	[44]
AUTHENTICATION							
Objective	Formalized process of verification that, if successful, results in an authenticated identity for an entity.	Number of Authentication Threats Blocked / Number of Total Threats	Percentage of Authentication	Controlled observation	Indicates the process of verifying the user's identity by the service provider.	X	ISO/IEC 24760-1:2019 [SR11], [SR6]
ACCURACY							

Objective	The degree to which the software product provides the right or specified results with the needed degree of precision.	Ratio between the service that is expected and that which is observed.	Percentage of Accuracy	Controlled observation	Indicates the correctness, precision and rigor with which the results are provided.	X	[55], [35]
ACCOUNTABILITY							
Objective	The degree to which the actions of an entity can be traced uniquely to the entity.	X	X	X	Indicates the ability to trace the actions of the service.	X	[55], [35], ISO/IEC 25010:2011 [SR10]

Supplementary Table S11. User Experience attributes. The table describes some of the possible attributes that characterize the user experience evaluation indicating both the definition and the information provided. Differently from the case of Usability and Acceptability, the approach, the measurement method and the metric are the same for all attributes due to the extremely subjective nature of this concept.

USER EXPERIENCE		
APPROACH:	Subjective	
METHOD OF MEASUREMENT:	Survey/Interview	
METRIC:	Predefined statements with Likert-scale ranking	
	Subjective rating scale of users towards services after using them	
DEFINITION	INFORMATION	REFERENCES
ATTRIBUTE: USABILITY		
Degree to which a product or system can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.	Indicates the ability of a software product or system to be understood, learned, used, as well as its ability to attract users.	ISO/IEC 25010:2011 [SR10], [SR14]
ATTRIBUTE: USEFULNESS		
The degree to which a person believes that using a particular technology would enhance his or her job performance.	Indicates the ability of a system to be used advantageously by the user to satisfy present or future needs.	[SR4], [SR14]
ATTRIBUTE: CREDIBILITY		
The degree to which data has attributes that are regarded as true and believable by users in a specific context of use. Credibility includes the concept of authenticity (the truthfulness of origins, attributions, commitments).	Credibility is about both the information (correlation, relevance, correct syntax) and the design or functionality available.	ISO/IEC 25012:2008 [SR13], [SR14]
ATTRIBUTE: ACCESSIBILITY		
Degree to which a product or system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.	Indicates the ability of the service to be perceived, understood and used by people with disabilities.	ISO/IEC 25010:2011 [SR10], [SR14]
ATTRIBUTE: FINDABILITY		
The degree to which a particular object is easy to discover or locate.	Indicates the ability for users to easily locate the resource or service they are looking for.	[SR9], [SR14]
ATTRIBUTE: DESIRABILITY		
Attraction that an asset exercises due to the fact that it is considered suitable to satisfy a given need.	Indicates a product or service that the user would like to own.	[SR14]
ATTRIBUTE: VALUABLE		
Everything that is particularly appreciated and considered, both because it has valuable characteristics, and because it	Indicates both something that has a certain value, both economic and sentimental, and something that is essential for the user.	[SR14]

is necessary or even indispensable in certain circumstances and for certain purposes.		
---	--	--

In this Supplementary file we have cited some references of the manuscript with the same number of the Section Reference. Moreover, we have cited additional references, not included in the manuscript, here, reported as SR and listed in the following Supplementary Reference section.

Supplementary Reference List

- SR1.** H. S. Kwon and L. Chidambaram, “A test of the technology acceptance model: The case of cellular telephone adoption,” in Proceedings of the 33rd Annual Hawaii International Conference on System Sciences. IEEE, 2000, pp. 7–pp.
- SR2.** H.-C. Kim, “Acceptability engineering: the study of user acceptance of innovative technologies,” Journal of applied research and technology, vol. 13, no. 2, pp. 230–237, 2015.
- SR3.** Y. Malhotra and D. F. Galletta, “Extending the technology acceptance model to account for social influence: Theoretical bases and empirical validation,” in Proceedings of the 32nd Annual Hawaii International Conference on Systems Sciences. 1999. HICSS-32. Abstracts and CD-ROM of Full Papers. IEEE, 1999, pp. 14–pp.
- SR4.** M. A. Babar, D. Winkler, and S. Biffi, “Evaluating the usefulness and ease of use of a group-ware tool for the software architecture evaluation process,” in First International Symposium on Empirical Software Engineering and Measurement (ESEM 2007). IEEE, 2007, pp. 430–439.
- SR5.** A. Seffah, N. Kececi, and M. Donyae, “Quim: a framework for quantifying usability metrics in software quality models,” in Proceedings Second Asia-Pacific Conference on Quality Software. IEEE, 2001, pp. 311–318.
- SR6.** E. Serrelis and N. Alexandris, “An empirical model for quantifying security based on services,” in 2007 International Multi-Conference on Computing in the Global Information Technology (ICCGI’07). IEEE, 2007, pp. 30–30.
- SR7.** E. Kaur and P. D. Haghghi, “A context-aware usability model for mobile health applications,” in Proceedings of the 14th International Conference on Advances in Mobile Computing and Multi Media, 2016, pp. 181–189.
- SR8.** H. Petrie and N. Bevan, “The evaluation of accessibility, usability, and user experience.” The universal access handbook, vol. 1, pp. 1–16, 2009.
- SR9.** Z. Gao, Y. Gao, and J. Yu, “What makes it findable? an exploration on user search behaviour and the findability of technical documentation,” in 2020 IEEE International Professional Communication Conference (ProComm). IEEE, 2020, pp. 154–160.
- SR10.** I. J. S. Software and systems engineering. (2011) ISO/IEC 25010:2011(en) systems and software engineering — systems and software quality requirements and evaluation (square) — system and software quality models. [Online]. Available: <https://www.iso.org/standard/35733.html>
- SR11.** c. ISO/IEC JTC 1/SC 27 Information security and privacy protection. (2019) Iso/iec24760-1:2019(en) it security and privacy — a framework for identity management — part 1: Terminology and concepts. [Online]. Available: <https://www.iso.org/standard/77582.html>
- SR12.** I.J.S. Software and systems engineering. (2017) Iso/iec/ieec24765: 2017(en) systems and software engineering — vocabulary. [Online]. Available: <https://www.iso.org/standard/71952.html>
- SR13.** (2008) Iso/iec 25012:2008(en) software engineering — software product quality requirements and evaluation (square) — data quality model. [Online]. Available: <https://iso25000.com/index.php/en/iso-25000-standards/iso-25012>
- SR14.** P. Morville and P. Sullenger, “Ambient findability: libraries, serials, and the internet of things,” The serials librarian, vol. 58, no. 1-4, pp. 33–38, 2010.