

# Review of UX evaluation: 10 Usability Heuristics and applicable direction for service evaluation

## Contents

### Abstract

#### 1. Introduction

#### 2. Related works

2.1. Nielsen's 10 Heuristic evaluation

2.2. Time spans of UX

2.3 Conceptual Framework for Service evaluation

#### 3. Method

#### 4. Research and Discussion

4.1. Evaluation Scope

4.2. User Experiences in Service release process

4.3. Value Objectives in Service release process

4.4. Applying 10 Heuristics in Service release process

#### 5. Conclusion

#### 6. Reference

## Abstract:

In the change of industries that digital services are impacting on the global economy, users are experiencing and creating real-time interactions with service producers in the process of usage (Miettinen et al., 2014). Subsequently, User Experience (UX) emerged as an essential design quality to evaluate for interactive products and services to improve both a firm's performance and customers' experiences (Bargas et al., 2011). Although the term UX is widely used, there is still a lack of study of how existing evaluation methods transformed and applied into a dynamic service dominant era (Mattila and Waljas, 2010). In this paper heuristic evaluation is selected which is one of the UX inspection techniques as it includes crucial usability points related to user interfaces (Nielsen and Molich, 1990). Service evaluation frameworks and value objectives from the related research will be discussed to match with Nielsen's ten heuristics to be present comprehensive evaluation methodology.

**Keywords: User Experience, Usability, Heuristic evaluation, Service evaluation, Value**

## 1. Introduction

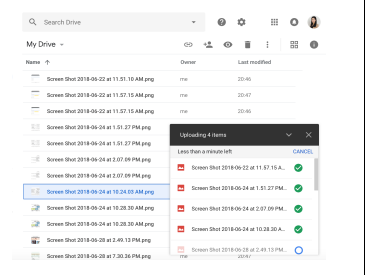
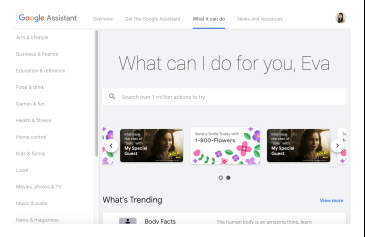
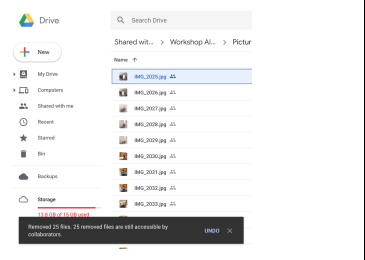
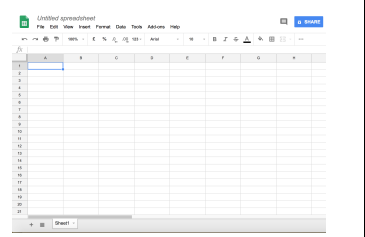
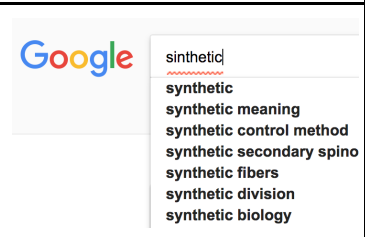
In the latest service paradigm, the scope of UX design is involved along the many service journey and emphasizing experiences from a single product to various touchpoints and channels including applications, devices, and face to face encounters (Law et al., 2018). Consequently, the value points of UX and usability have changed with evolved usage, also evaluation methodologies have been developed. There are several usability evaluation techniques for evaluating the changes; however, an initial set of Nielsen's 10 Heuristics evaluation is adopted to proceed with this study. It is one of the most actively used techniques which are considered the most general principles for interaction design as it is easy, quick and inexpensive to implement (Nielsen and Molich, 1990).

In sum, developing and improving the quality of the user interfaces is necessary in order to develop new services and products with positive experiences. Considering changes of services and the aspects that make it difficult to evaluate them, it is required to have extensive heuristics to implement adaptable assessments in this compelling circumstance of the service economy (Costa et al., 2016). This paper presents different evaluation methods, and it describes how Heuristic evaluation enable assessment of user values in different time spans with the different perspective of actors (Foglieni and Holmlid, 2017). Consequently, the aim of this study is identifying a fundamental principle of service interface evaluation and demonstrating a comprehensive evaluation model based on 10 Heuristics. The contents will follow section 2 reviews of service evaluation models by reviewing published studies. Additionally, it presents adopted evaluation frameworks in this paper. Section 3 explains several steps for implementing this study. Section 4 presents a process to integrate heuristic evaluation into a service releasing process and value objectives. Section 5 analyzes and validate the result of the study.

## 2. Related works

### 2.1. Nielsen's 10 Heuristic evaluation

Gómez has defined, "Heuristic evaluation, an inspection method identifying any problems associated with the design of user interfaces over a real system or prototype, which is based on checklists which are mostly desktop-centered" (Gómez, Caballero and Sevillano, 2014, p1). Heuristics has significant advantages including low budget execution, original motivation to people, early utilization in the development process, and no requirement of planning (Nielsen and Molich, 1990). Figure 1 is analyzing Google services with Nielsen's 10 Heuristics and explaining how heuristic can be applied to assess interfaces. Figure 1 explains the heuristics briefly and user interfaces that generate user actions. Google services are used to present each heuristics objective for helping readers' understanding, and how well they comprehend a wide variety of web service characteristics. Google Drive, Google Assistant, Google Sheets, Google Search and Google Maps are chosen regarding offering a seamless user experience between PC and mobile interfaces.

Heuristics	Detail	Service	Image
1. Visibility of system status (H1)	The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.	Google Drive is showing the status of a file upload.	
2. Match between system and the real world (H2)	The system should speak the users' language, with words, phrases, and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.	Google Assistant site showing message with User's name.	
3. User control and freedom (H3)	Users often choose system functions by mistake and will need a marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.	Google Drive is showing a flash message with 'Undo' action.	
4. Consistency and standards (H4)	Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow the platform conventions.	Google Sheet adopted UI and shortcuts from Microsoft Excel.	
5. Error prevention (H5)	Even better than right error messages is a careful design which prevents a problem 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.	Google Search showing a right spelling word and the list of related term	

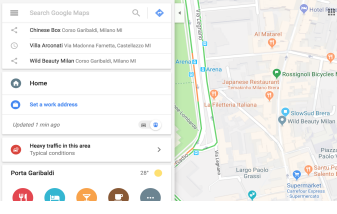
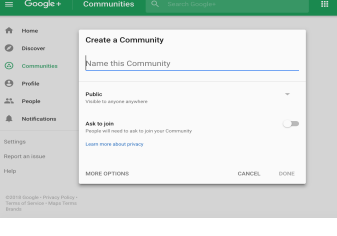
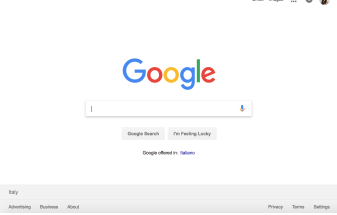
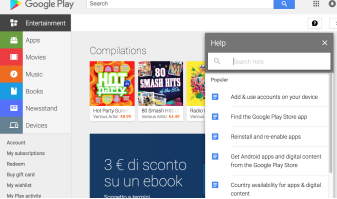
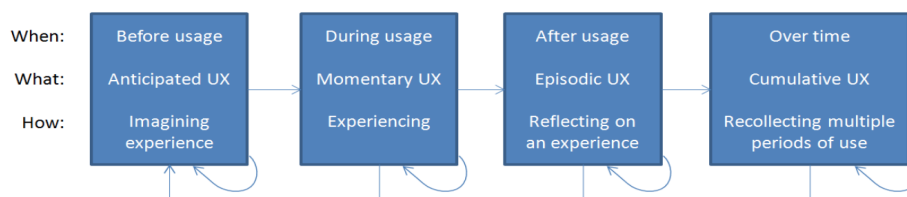
<p>6. Recognition rather than recall (H6)</p>	<p>Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for the use of the system should be visible or easily retrievable whenever appropriate</p>	<p>Google Maps are showing previous search record by suggesting places based on location.</p>	
<p>7. Flexibility and efficiency of use (H7)</p>	<p>Accelerators - unseen by the novice user - may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.</p>	<p>Google Plus is hiding complex features under 'More Options' button.</p>	
<p>8. Aesthetic and minimalist design (H8)</p>	<p>Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.</p>	<p>Google search page is showing a minimal design of search page.</p>	
<p>9. Help users recognize, diagnose, and recover from errors (H9)</p>	<p>Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.</p>	<p>Google Create Account page is checking error and giving a specific guideline to fix it.</p>	
<p>10. Help and documentation (H10)</p>	<p>Even though it is better if the system works without documentation, it may be necessary to provide help and documentation. Any such information should be accessible to search, focused on the user's task, list concrete steps to be carried out, and not be too large.</p>	<p>Google Play is showing default question-related Android device users.</p>	

Figure 1. 10 Heuristics and examples, Nielsen, J, 1995

## 2.2. Time spans of UX

For the research phase, time spans of UX are adopted: anticipated UX, momentary UX, episodic UX, and cumulative UX by User Experience White Paper (Roto, V. et al., 2011).

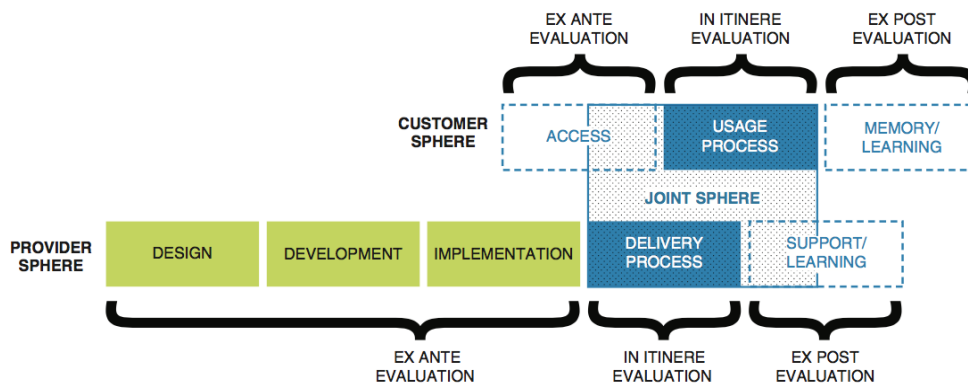


“Figure 2. Time spans of user experience, the terms to describe the kind of user experience related to the spans, and the internal process taking place in the different time spans”, Roto, V. et al., 2011, p.8

In section 4 of this paper, the perspective from this time spans applied to interpret experience when users encounter with a service (Roto, V. et al., 2011, p.8). Anticipated UX refers to the experience as the users imagine it before use, and it enables to assess a qualitative manner by presenting a product concept in an interview setting or using visual stimuli to gather users' feelings and attitudes towards the concept (Roto, V. et al., 2011). During usage, the stream of felt experience is called Momentary UX, and following these users will reflect on their experience which called Episodic UX (Roto, V. et al., 2011). The last one is Cumulative UX which will be recollected after multiple periods of use over time (Roto, V. et al., 2011). Bargas and Hornbæk (2011) defined UX field researchers chose to assess UX with the most frequent patterns which are the combination of during and after usage measurements (Bargas and Hornbæk, 2011). Again temporal approach is important since "focusing on the moment can give information on a person's emotional responses to the details of the user interface" (Roto, V. et al., 2011,p9).

### 2.3. Conceptual Frameworks for Service Evaluation

This study derived several elements from Foglieni and Holmlid (2017) which should be considered when evaluating services to compare service evaluation and heuristic technique. The research suggested the temporal aspects of value creation processes are analyzed to understand when services can be evaluated (Foglieni and Holmlid, 2017). "Times and Perspective of Evaluation in Relation with Value Creation Spheres" (Foglieni and Holmlid, 2017, p.80) explains the value creation with three spheres of actors: a provider sphere, a joint sphere, and a customer sphere (Foglieni and Holmlid, 2017).



"Figure 2. Times and Perspective of Evaluation in Relation with Value Creation Spheres", Foglieni and Holmlid, 2017,p.80

Also, this study adopted the terminology of value objectives from "Figure 5. Possible Value Objectives of Service Evaluation" (Foglieni and Holmlid, 2017, p.85) which explains value objectives for the evaluations of the different timings and the different perspectives. Different focuses of evaluation of each actor, tangible service elements, processes, and outcomes should be defined to clarify possible objects of evaluation.

PERSPECTIVE	Provider sphere	PERSPECTIVE	Joint sphere	PERSPECTIVE	Customer sphere
TIME		TIME		TIME	
EX ANTE During service design, development and implementation	Profitability feasibility	EX ANTE Before service delivery/Usage process	Visibility accessibility	EX ANTE Before service usage process	Desirability credibility brand equity
IN ITINERE During service delivery process	Effectiveness assurance empathy responsiveness	IN ITINERE During service delivery/Usage process	Utility interactivity engagement	IN ITINERE During service usage process	Customer satisfaction customer effort social significance
EX POST After service delivery process	Efficiency productivity	EX POST After service delivery/Usage process	Reliability	EX POST After service usage process	Loyalty recommendation

"Figure 5. Possible Value Objectives of Service Evaluation", Foglieni and Holmlid, 2017, p.85

In section 3 and 4 will argue how heuristic evaluation is utilized in entire service time spans based on related researches.

### 3. Method

This paper follows a process below to understand the advantages of Heuristic evaluation and demonstrate fundamental principles of service interface evaluation: First, defining existing evaluation methods and scope of the evaluation. Second, presenting adopted and recreated service release process with the perspective of different actors and different time conditions. Third, mapping value objectives into an encompassing process. Lastly, it will be a compilation of Heuristics models (Nielsen) based on the existing reference but repositioned on service time spans.

This study adopted appropriate evaluation frameworks from multidisciplinary publication and research data in UX, service design and HCI fields. Specially taxonomy and terms from Foglieni and Holmlid's (2017) figures and definitions: "Times and Perspective of Evaluation in Relation with Value Creation Spheres" (Foglieni and Holmlid, 2017, p.80) and 'Possible Objects of Service Evaluation' and 'Possible Value Objectives of Service Evaluation' (Foglieni and Holmlid, 2017, p.85). The approaching point is defining the intersection of heuristics evaluation from current researches and guiding to a generalizable evaluation model for improving user experiences. It also means methodology that applicable to widely different domains and which can be useful in inadequately studied areas (Alonso-Ríos et al., 2018).

### 4. Research and Discussion

#### 4.1. Evaluation scope

There are three premises to define evaluation scope in this paper. First, usability evaluation scope will be explained from the point of view that users interact with different type of digital interfaces which is main touchpoints of the today's services. Commonly it designates digital interfaces from pc environments which is studied widely to touchscreen devices including smartphones and tablets. Second is about an understanding that UX has some extent developed from usability evaluation from HCI domain. Accordingly, put usability as a basis that is a particular evaluation method in this service economy since UX is a result of interactions with systems, products or services (Bargas and Hornbæk, 2011).

#### 4.2. User experiences in Service release process

Based on 'Value Creation Process' (Foglieni and Holmlid, 2017, p.80) and "Time spans of User Experiences" (Roto, V. et al., 2011), service release process is defined in this section (Figure 2). It presents actions based on two different phases as a perspective of provider and customer side: before release and after release for providers, during release and after release for customers. In this analysis, the focus is on 'Release' action which is the moment of creation that interactions between the providers and the customers. More specifically 'Release' has been chosen to reflect the unique character of the digital service process including beta deployment or pre-launching.

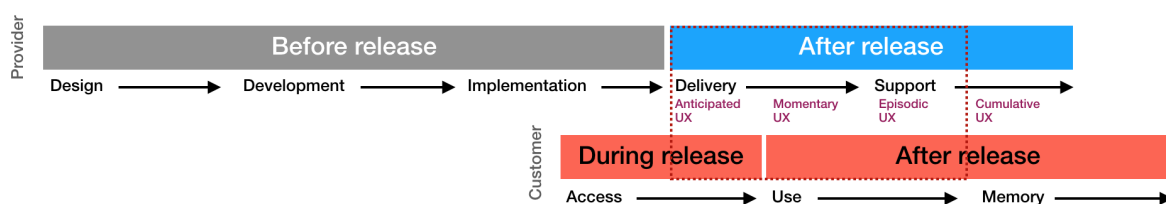


Figure 2. Service release process

Before release, central actions are conducted by a provider by designing and developing service. When the provider plans a new service and implements it, they going through numerous tests session internally including customers' perspective. It is because, in the service industry, the user experience is a crucial value objective (Law, E. et al., 2018). Once the provider implements the service, customers able to access it under the provider's will. This process indicates during release phase from the customer side since the service is not an officially released in a market. For example, companies conduct user tests with specific target users to simulate real usage situations before releasing to general customers. After release process customers start to use the service while the provider is delivering the service, and then they will generate service memories as a result of cumulated experiences. Once customers meet the service, the

user interface becomes the central touch point, and its role is substantial. Due to the interaction between services and customers, user experiences are mostly generated from the provider's release phase which coincides with customers' after release phase, and in this figure, one more layer of phase is added regarding UX which has the same degree with a joint sphere (Grönroos and Voima, 2012). The usage process has divided into four layers depends on time spans to present encompassing process (Roto, V. et al., 2011). While the customers predict experiences, Anticipate UX is generated. After the service is delivered, Momentary UX and Episodic UX are generated while users are experiencing and reflecting on their experiences of service. Finally, after multiple periods of use, Cumulated UX is generated.

### 4.3. Value objectives in Service release process

To evaluate a service, value objectives (Foglieni and Holmlid, 2017, p.80) mapping is conducted in each phase situated on different perspectives. Figure 3 framed value objectives aligned with the specific timing of the process from Figure 2.

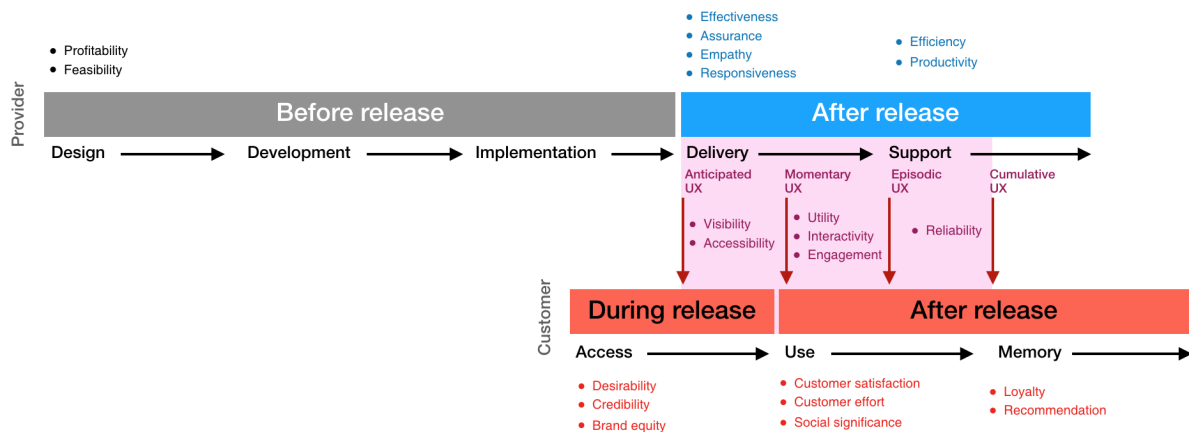


Figure 3. Value objectives in Service release process

From the provider's perspective, the evaluation could be started by focusing on a path to the service release. After release, the value evaluation starts to engage customer perspective by exchanging service features (Foglieni and Holmlid, 2017). While the delivery process, how effectively and surely deliver the service could be a primary value objective. At the same time, empathy with personalized attention and responsiveness with prompt help will be a value to be explicitly assessed in problem cases (Zeithaml et al., 2002). Once a service is settled, the capacity to deliver "outputs with a minimum consumption of inputs" (Foglieni and Holmlid, 2017, p.86) will be important standards.

When users can access the service, they can start to anticipate and evaluate an entire service experience. During the release, the phase includes ambiguousness to define value objectives since users do not experience the real version service. Thus direct interactions are excluded in this phase, and only psychological values such as desirability, credibility, and brand equity can be evaluated (Foglieni and Holmlid, 2017). While usage process, customer value such as customer satisfaction, customer effort, the social significance will be able to evaluate. Values in the usage process are influential in generating loyalty and recommendation values which influencing customer engagement for a long-term (Foglieni and Holmlid, 2017).

At the point that the provider and the customer meets, different values sets should be considered since the value is generated from the interaction of both sides. Before the usage process, anticipated UX can be generated between the provider's delivering activities and customer's accessing activities. In general visibility and accessibility is helping customers to imagine the experience of the service (Roto, V. et al., 2011). Momentary UX is about the timing when the customer is first encountering a new service, and it is related both visually also functionality (Roto, V. et al., 2011). Continuously customers reflecting on experiences while using the service and in this period, utility, interactivity, and engagement will be required to be evaluated by considering a specific change of feeling during interaction (momentary UX) and assessment of a specific usage episode (episodic UX). After having used it for a while (cumulated UX), reliability could be a value to be evaluated under a system collectively (Roto, V. et al., 2011).

#### 4.4. Applying 10 Heuristics in Service release process

In this section, the updated service release process is proposed which covers heuristic evaluation methods with value objectives. As a first step, probable value objects related to heuristic checkpoints are matched in Figure 4. (P) means provider perspective, (J) means joint perspective, and (C) means customer perspective.

10 Heuristics	Value objectives	10 Heuristics	Value objectives
1.Visibility of system status (H1)	<ul style="list-style-type: none"> <li>Effectiveness (P)</li> <li>Assurance (P)</li> <li>Responsiveness (P)</li> <li>Visibility (J)</li> </ul>	6.Recognition rather than recall (H6)	<ul style="list-style-type: none"> <li>Efficiency (P)</li> <li>Productivity (P)</li> <li>Visibility (J)</li> <li>Reliability (J)</li> <li>Customer effort (C)</li> </ul>
2.Match between system and the real world (H2)	<ul style="list-style-type: none"> <li>Empathy (P)</li> <li>Responsiveness (P)</li> <li>Interactivity (J)</li> <li>Engagement (J)</li> </ul>	7.Flexibility and efficiency of use (H7)	<ul style="list-style-type: none"> <li>Effectiveness (P)</li> <li>Efficiency (P)</li> <li>Accessibility (J)</li> <li>Utility (J)</li> <li>Engagement (J)</li> </ul>
3.User control and freedom (H3)	<ul style="list-style-type: none"> <li>Utility (J)</li> <li>Interactivity (J)</li> <li>Customer Satisfaction (C)</li> <li>Accessibility (J)</li> <li>Customer effort (C)</li> </ul>	8.Aesthetic and minimalist design (H8)	<ul style="list-style-type: none"> <li>Visibility (J)</li> <li>Desirability (C)</li> <li>Credibility (C)</li> <li>Brand equity (C)</li> <li>Social significance (C)</li> <li>Loyalty (C)</li> <li>Recommendation (C)</li> </ul>
4.Consistency and standards (H4)	<ul style="list-style-type: none"> <li>Effectiveness (P)</li> <li>Assurance (P)</li> <li>Efficiency (P)</li> <li>Productivity (P)</li> <li>Customer effort (C)</li> </ul>	9. Help users recognize, diagnose, and recover from errors (H9)	<ul style="list-style-type: none"> <li>Efficiency (P)</li> <li>Responsiveness (P)</li> <li>Utility (J)</li> </ul>
5.Error prevention (H5)	<ul style="list-style-type: none"> <li>Efficiency (P)</li> <li>Productivity (P)</li> <li>Customer effort (C)</li> </ul>	10.Help and documentation (H10)	<ul style="list-style-type: none"> <li>Efficiency (P)</li> <li>Empathy (P)</li> <li>Reliability (J)</li> </ul>

Figure 4. Heuristics matched with probable value objects

H1 can evaluate effectiveness, visibility, assurance, and responsiveness how visual elements can keep users informed about what is going on, through appropriate feedback within a reasonable time (Nielsen, 1995). H2 is focusing on presenting an interface through customer's perspective, and its inspection can improve empathy and engagement values (Nielsen, 1995). H3 is especially enabling to assess customer satisfaction and customer effort by providing a path to escape the unwanted state of the interface(Nielsen, 1995). H4 and H5 review how the service ensuring customers should not be lost in the service (Nielsen, 1995). Both could check how the service is carefully designed to prevent a problem and it is directly related reducing customer effort (Nielsen, 1995). H6 is about how to minimize the user's memory load by making objects, actions, and options visible. Mainly it will be convenient to evaluate customer effort (Nielsen, 1995). H7 enables to assess how the service can accelerate amateur user's activities easily and quickly (Nielsen, 1995). Accessibility and utility will guide users to engagement (Nielsen, 1995). H8 contributes to evaluating during the release phase by checking desirability, credibility, and brand equity (Nielsen, 1995). H9 can evaluate efficiency since it helps the provider's repetitive works to respond to inquiries from users. It is fundamental to help users solve problems while using the service (Nielsen, 1995). H10 can improve reliability by ensuring how much the service is prepared to help customers in every situation (Nielsen, 1995). Also, it is related to efficiency as H9 reducing recurrent operations. Empathy can be evaluated how a document presents in a user-friendly way (Nielsen, 1995).



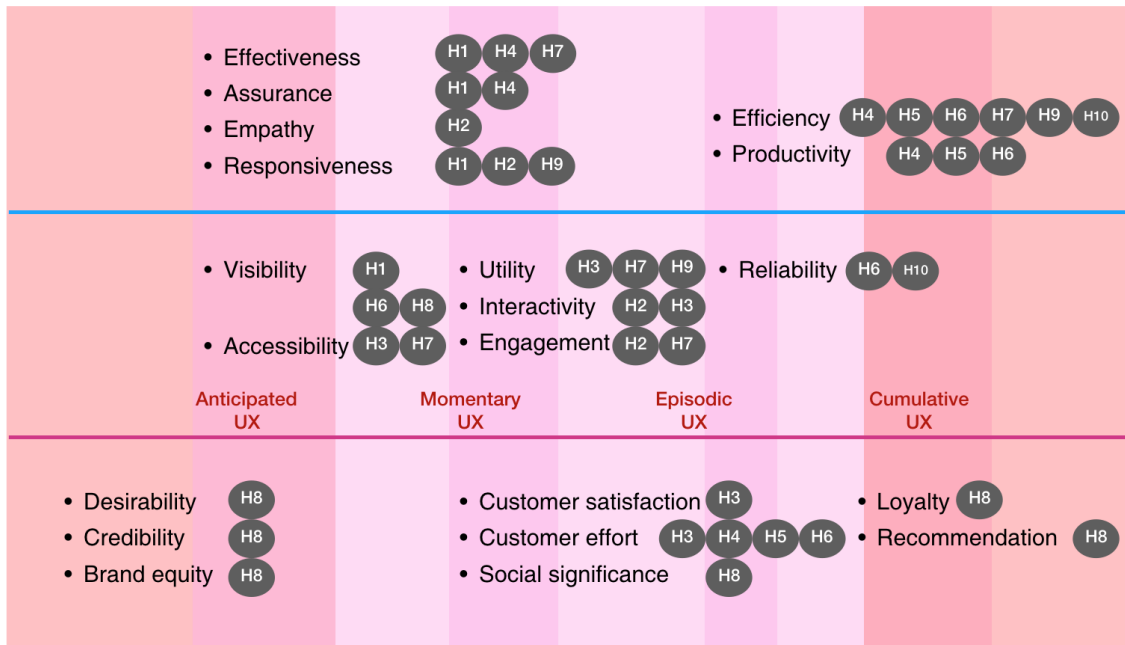


Figure 5. Value objectives map

Based on Figure 4, heuristics have placed on the value objects map which based on the service release process model, and finally, Figure 5 shows how heuristics can evaluate in different time spans for different actors. Most heuristics could be utilized in momentary UX and Episodic UX phase which is focusing on a joint sphere. What newly found is the usefulness from the provider perspective. H1, H2, and H4 are significant values can be evaluated from the provider's perspective. Those are making the positive experience during a delivery process. Specially H2 and H7 should be emphasized to keep motivating the provider to maintain the service as a definite touch point, and eventually, it will lead general users to loyal users who engaged fully with the service (Foglieni and Holmlid, 2017). Also, the analysis discovered the efficiency objective could be wholly evaluated with heuristics.

## 5. Conclusion

This paper has explained the service evaluation framework with the approach of UX and usability perspective. Due to the heuristic evaluation method originate from a usability test, its innateness is concentrated to examine a phase after releasing a service. However, it is available for improving multiple time spans. Additionally, the value objectives effect on each entity's action thus evaluation results will be reflected the various perspectives. Eventually, this study shows that first, usability is a fundamental subject to be evaluated for enhancing user experience in the service domain. Second, ten heuristic evaluation method is reasonably practical and easy to apply in temporal service release process to different actors. Even though inadequacies are existed in the service UX evaluation methods and tools, defining convergence of methodologies from different origins could be a useful exploration to develop applicable service evaluation methods in the change of future service economy.

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