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Testing Communicability in Public e-Services – Process and Outcomes

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Abstract. In this paper, a case of testing public e-Service communicability is analysed in terms of process as well as outcomes. Key elements in test processes are defined, together with the meaning of communicability identified in terms of information-oriented metrics. The purpose of our paper is to develop knowledge about how e-Service providers should improve their ability to communicate and support users in finding, understanding and using e-Services. The reconstructed test process design is based of an analysis of gaze replays in citizen test sessions by means of eyetracking technology. Empirical findings on communicability metrics are further grounded in theory. Our main contribution to the research community and the field of practice, are a test process and a communicability framework to support the assessing of e-Service information. The use of wireframes for the e-Service five layers, together with a multifunctional template for data collection, analysis and presentation are introduced.

Keywords. Communicability, Information-oriented metrics, Test process, e-Service layers

Introduction

The basis of the elaboration on design and outcomes in this paper is a study involving the reconstruction of a user test process with citizens in a municipality. Our aim is to increase knowledge of how to improve the communication of public e-Services, i.e. to provide information content in the e-Service solution to support users' finding, understanding and using the e-Service. Many governmental agendas have been focused on providing many e-Services, customization and making the website attractive. When front-end services are aligned with the back-end business processes, and systems with internal as well as external actors, changes occur in the overall service [1]. However, the instant access to services has to be balanced against more complex websites to navigate in the e-Service use, which might be the results of customization and multiple channels. To be a professional e-Service provider, the task is not only to develop new e-Services, but also to keep the existing services on the websites and to provide an *information content* for communicating e-Services in order to support the users' ability to find, understand and use the service provided [2]. Evaluation based on communicability; i.e. to reflect on purpose, roles involved, business context, action modes and intentional message exchange [2] includes usability issues; i.e. to reflect on the e-Service ability to support user performance, in the way that is expected by the

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user, without hindrance, hesitation or questions [3] and a system that is efficient, easy to learn and remember, secure to use and difficult to do wrong [4]. In usability testing, the end user evaluates the usefulness of a particular IT solution, most often on systems, with which the user interacts. The focus is on ascertaining if the system meets specific usability criteria [3] to identify problems, which arise when using the systems [4]. Communicability includes usability as well as interactability, actability, visibility and simultaneity issues [c.f. 2, 10]. Our focus is on the ability to inform the user of the e-Service and instruct in the e-Service use, i.e. to inform e-Service users. *The purpose of this paper is to develop a test process with outcomes aimed at supporting e-Service providers' ability to communicate e-Services*.

In the following, we reflect on what matters in finding, understanding and using services in the Swedish municipality case by analysing user reactions and performance in e-Service use. Our research is based on a repeated case study with two user tests (one conducted in 2012 and another in 2013). By considering the test process and its outcomes, insights and lessons learned were inductively achieved. The acquired knowledge was then related to previous research to base our findings on a theory and empirical grounding. In our case, the normative statements on what matters when communicating e-Services based on a reflective analysis of conducted user tests must be tested against previous theory in a validation process. With this deductive approach, we will be able to narrow down our findings to some metrics for communicability in public e-Service solutions. Thus, our case study will generate useful contribution to the local practice (Karlstad municipality), the general practice (organisations with e-Services) as well as scholars in the field of e-Service development and test. As our findings will be interrelated, the study will in particular contribute to the professional practice of communicating and testing e-Services. We will provide practical guidance, as suggested by, for example, Heeks and Bailur [5] as well as Goldkuhl [6].

In the following, communicability in public e-Services is first discussed. In the next section, the research design and our empirical case are described and then the test process as well as outcomes is elaborated on. Our inductive reflections and lessons learned are discussed and related to theory. In the concluding section of the paper, we summarise the contributions.

1. Communicability in Public e-Services

e-Service development requires multiple competence including business process improvements [1], website communication and design [10], open innovation possibilities [7], collaboration with citizens [8] and service design enhancing public value and trust [9]. Communicability has a characteristic intersection and is important in each one of the interactive design areas [10]. The authors [10:227] define the concept as *"A qualitative communication between the user and the interactive system… to which an interactive system successfully conveys its functionality to the user"*. However, there are more software metrics presented by Pressman [11], which might be relevant to relate to communicability, besides the function-aimed. Additional views are quality-aimed metrics (user need, expectations and response on how to satisfy the need) and person-aimed (the users point of view of effectiveness). To understand the quality of e-Services and thus the meaning of communicability, different knowledge areas are important, e.g. organisation, IT and service [2] as well as a social, political and a legal base [20]. In our study we focus on the information-

oriented metrics in a public e-Service setting. Xu et al. [13] have examined system quality, information quality and service quality in an integrated model for a commercial e-Service setting. The result of their study shows that high information and system quality (limited to the information-receiving stage of information regarding e-Service provider, product and/or advice) directly or indirectly improved the e-Service context. Thus, information tends to be an important element in the service delivery.

Rodriguez et al.'s [14] survey on municipality websites stresses the government as the provider of services, information, transparency and interactive communication. In our view of e-Service solutions all those elements work together in the website as a channel transforming the business interaction in a digitalised mode. Further, the user is viewed as a co-producer in the service delivery, as the service per se becomes real in action with the customer (e.g., citizens) [15]. Despite different views on e-Services (e.g., user as a subject compared with a co-producer), scope (websites compared with the web channel) and focus (e-Governance quality compared with e-Service quality), some of the 152 aspects sorted in 23 categories with statements to fulfil seven metrics (components) used in Rodriguez et al. [14] are found to be relevant in our case and focus on informing the user. Additionally, Iskender and Özkan [20] findings are included in Table 1 summarizing our brief literature review on what matters when communicating e-Services, i.e. to inform the user.

Table 1. Communicability in the e-Service context

To find the e-Service	e-Service purpose/goals/role with a match to expectations [2]
	Service catalogue with e-Service offerings [2], administrative transactions [14]
	e-Service business process and its prerequisites [2]
	Multiple channels for service delivery [2]
	Main menu including not more than 12 options in the same category [14]
	Menu images must include text, menu options are representatives [14]
	Link lists are organized by categories and indicated with the screen hand pointer appearing when indicated with the screen arrow [14]
	The web site includes search/advanced search option, help area, site's use polls, local government's actions and decisions polls, contact us/email form, site map, e-newsletter, suggestions/complaints (e-Service), chat room, forums, FAQ, print out options [14]
	Time of accessing the intended information - if users are not able to access information on a website in one to two minutes, then the user thinks it is not worth trying [10]
	Personalization, relevance and security [20]
To understand the e-Service	Actors and roles in the social relation [2]
	Business context [2]
	Legal issues, the form/site shows the local government's regulations [14]
	Valuable actions with a match to intention [2]
	The forms clearly differentiate the mandatory form field, the form data are validated with clear messages, offers on line transactions, close questions as frequently as possible, include elements directly related with the expected options [14]
	Sufficient information, affordance, guidance and consistency [2], ease of understanding and completeness [20]
	Meaning of abbreviations, organized by categories, technical words are

	explained [14] An icon to see more information [14]
To use the e-Service	Action repertoire [2] Results with significant value in use [2], trust in performance [9]

Variations of elements in communicability regarding usability, e.g. perception, navigation, use of icons/symbols and language style for channel choices depends on both context and culture [12]. In this paper the discussions on preferable placement of e-Services; search patterns and the citizens' ability to navigate are excluded.

2. Research Design

2.1. Data collection

The Swedish municipality case consists of user tests performed by citizens partaking in a university course. Test sessions (totalling 71 different users) were conducted on e-Services (totalling 11 different services) in a standard portal provided by one supplier [16]. A majority of the e-Services included in the standard portal test environment were aimed at elderly users, or users with specific life experiences such as having children or house ownership. Therefore, the selection of e-Services was based on the services that can be reasonably understood by our sample (i.e. young students ages 19-23) and by taking use scenarios into account. The scenarios were created and tested by students in another university course for the purpose of finding suitable e-Services with a young target group, and thus e-Services relevant to our users. An example of one scenario (translated from Swedish):

"Your child has finally got a place at a nursery school so now you want to pay your fee as smoothly as possible to the municipality, preferably through a standing automatically order. You decide to investigate this possibility via the municipal website."

Our scenarios were formulated without keywords that could give away the name of the intended e-Service. Giving the user a scenario-based task to perform will alter the way he or she looks at the website, but as Pernice and Nielsen argue [17:148]: *"The main reason to base usability tests on tasks is that this best mirrors the way people actually use the Web: there's a reason you visit a website."* Thus, the scenarios used in our test contained a reason for our users to use a particular e-Service; the user interpreted the matter based on the scenario, thus made the selection of a potential e-Service.

During the test (17 Dec. 2012) the user was asked *to find*[2] one of the selected e-Service from *the e-Service start-page* (the test environment), *use* it and *determine case status and expected turnaround time* (case handling time). A second task (18 Dec. 2012) was *to navigate* from *the municipality home page*[3] *to find* the requested e-Service, to be able to *describe its purpose* and *expected turnaround time*. During the second test (16-17 Dec. 2013, 7 Jan. 2014) the user was directed to a scenario, to

[2] Using the search function was not allowed due to technical limitations of the e-Service test environment.
[3] A new website launched in October 2012, www.karlstad.se

interpret the task and to *find*[4] an e-Service to handle the errand from *the e-Service start-page* (the test environment) and *use* it.

Seeing exactly what the user sees, acts, and says helps in understanding why users have problems finding e-Services, and performing and completing their task. In this study, we used the Tobii technology 1750 eye tracker [19] as a data collection tool to capture and record eye movements as well as the real time dialogue between the user, observers and test administrator. The focus was on the comments, actions/non actions of citizens regarding overall aspects of the service provider's ability to communicate e-Services, i.e. to explore and further develop the meaning of communicability.

During the test sessions the users were encouraged to "think aloud", meaning that the users verbalized their thoughts, actions, confusions and frustrations [3]. There are some disadvantages of this technique: the user can interpret it as unnatural and obtrusive [3]; or it may can affect the interaction and scan paths of the user [17]. Nonetheless, the users' comments were found highly valuable during our analysis.

The eye tracking data from our test sessions can be visualised in various ways. The gaze replay is a recording of the screen overlaid with the user's eye movements. It is similar to gaze plots, which are still images that show the point where users fixate their eyes and in what order (see Figure 1). However, the latter visualisation does not account for dynamic elements and therefore this and other visualisations were not used in our analysis.

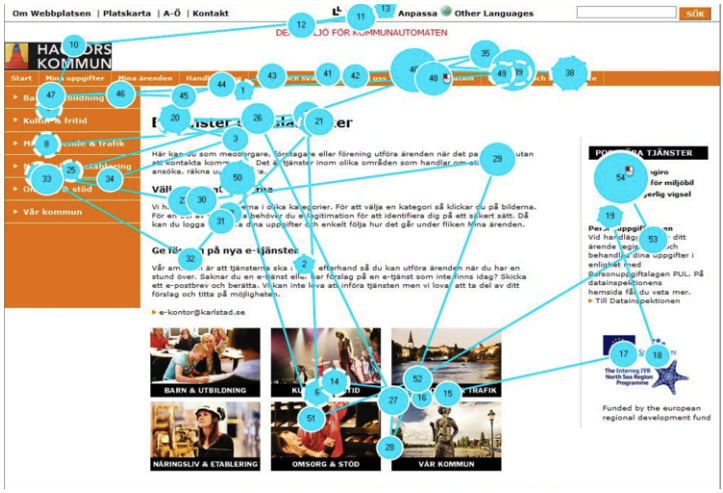

Figure 1. A Gaze plot - showing one user searching for the e-Service "Apply for Direct Debit"

2.2. Analysis

One drawback of using the eye tracking technique is that studies result in large amount of data to handle. Extracting results and interpreting the eye tracking data are labour intensive as well as difficult [17] [18]. Furthermore, a quick scan of the reported

[4] If the user used the search function, it was noted and the search queries/terms were collected.

studies of the supplier Tobii Technology [19] website, shows no explicit method for efficient elicitation of test results from gaze replay. However, we used the eyetracking technique because it does provide valuable data to analyse, such as how efficiently a user searches for an element and indications of a user's difficulty to extract information from an element and importance of the element [18]. Eye-movement analysis is valuable as it affords seeing what the users do, react on and act upon, not only what they say they have done (which is not always consistent). This technique allows us to see gradations in actions taken (and not taken).

For the best analytical results, Pernice and Nielsen [17] recommend a gaze replay analysis with approximately six users to be able to draw correct conclusions on usability.[5] Regarding communicability, no conclusions can be drawn whether and what users understand by what they have seen or not seen. However, comments from users and insights into viewed gazes and search patterns, failed actions, action modes (status in errands) and problems arising in the finding, understanding and using of the e-Service can be observed. No diagnoses have been made of problem causes; instead user expressions and ability to perform, and hindrance, hesitation, questions and mistakes in handling are observed. To be able to draw conclusions of communicability we should have asked a wide range of users in different target groups. However, we found a pattern of practical meaning for our young users based on the gaze replays.

In 2012 log notes with empirical data from the visualisations and recorded user voices were collected and structured by each researcher based on our two background references, a human-computer-interaction lens and a social interaction lens in information systems development. In a second run we merged our observations into an analysis protocol. The protocol was then used when we structured our findings into the characteristics of communicability. One challenge in 2013 was to design a more effective handling of the extensive data results from observing the gaze replays. We therefore developed a web-based template to help us to structure log notes and at the same time analyse the material faster by means of the tool Survey & Report used by the university. We had to reconstruct our analysis from 2012 (which step and in what order according to the gaze replay) to develop a useful observation template as a basis for the survey. Another challenge was to know what to call levels and elements in the e-Service in our analysis; comments on the website, the e-Services start page, the focal e-Service start page and steps in performance, placement on the user interface etc. In this study we therefore used the wireframe approach which is a commonly used framework when outlining the structure of the content on a website, without focusing on details of the design [4]. See example in Figure 2 of a wireframe used to be able to map our comments on where user problem occurred, information was missing, user areas neglected etc. The areas in the frame representing the municipality website link (1), the municipality logo (2), the search area (3), the global navigation bar (4), the left menu/main categories (5), the contextual content (6), test environment specific information (6b), drop-down menus: e-Service categories (7), e-Service name (7.1), information sign/icon (7.2), link to e-Service (7.3), link to form (7.4), the right menu/shortcuts (8), information in text (9), footer (10).

[5] Five users are required for qualitative think-out-loud results.

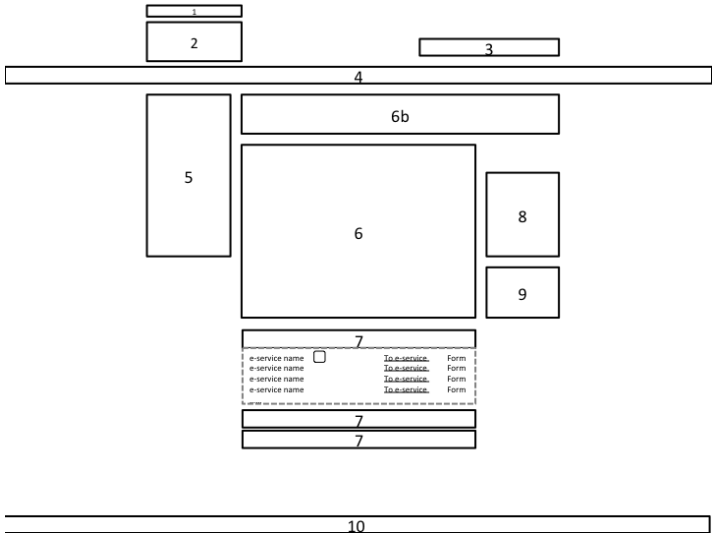

Figure 2. The structure on the focal area e-Service page

When working with wireframes in the analysis, we discovered a new challenge in handling multiple layers in an e-Service, which resulted in five wireframes. The observation template was improved and redefined four times to reach a maturity that would work for data collection, analysis and presentation of results. The major revision of the template was a result of the expanded use of wireframes.

Later in our template development, successful completion criteria (SCC) enable measuring how and if a user has successfully completed the task [3]. In our case we asked the municipality as to provide some SCC to test how their expectations were met. However, they had not yet formed an opinion on this, so instead we asked our users about their thoughts and expectations, based on the scenario. In our analysis we have only noted deviations in user experience: hence, only the behavior of users in compliance with expected use is included. Screenshots have been acting as "the expected" and define our wireframes. Our web-based template has speeded up the analysis from 90 minutes to 24 minutes per user test, because we have learnt from the previous analysis and a more mature communicability concept has been developed. The multifunctional template (to collect, analyse and report) is a result that will benefit further gaze replay analysis in education and research as well as practitioners working with gaze replays. In order to validate the use of the template without pre knowledge of communicability, a student working on his Bachelor thesis, has been testing it on 12 recorded gaze replays from the same user tests on two random selected e-Services. However, a further elaboration on the multifunctional template is beyond the scope of this paper.

3. e-Service User Tests

Our test sessions showed that it was difficult for some users to get adequate information to understand the e-Service purpose, how the service works and what to be expected in the service delivery. Moreover, the users were expecting 'status' in direct

relation to the performed service and were not always reading, thus not taking action when instructed to take note of something. According to our analysis of search patterns some users found the e-Service a natural, quick and easily accomplished case while others experienced the same e-Service as messy and difficult, with frustration and a feeling of jumping from page to page, each distinguished by a different appearance, language and form. For a more comprehensive report, confer Christiansson [2] and Christiansson and Wik [21].

Lessons learned from our user tests and the reconstructed and further improved test process are summarised as follows:

- Actions in the user test should start with identifying the pre-conditions for test; the trigger is at best a test request from the stakeholder with SCC and their expectations.
- Selection of specified e-Services to be tested should be conducted based on the user target group, in our case young citizens.
- In preparation of the test sessions, an observation template based on 'communicability' should give directions and support in the data collection during the conducted test sessions to generate useful log notes. Roles in the test sessions should be assigned (e.g. a test administrator, a test moderator and observers).
- Resources in the test process, as identified in our case, were the e-Service portal in the supplier test environment and the municipality home page as the point of departure.
- To conduct the test session an eye tracker might be required together with a recorder and a web cam, or similar tests could be conducted with other techniques without the possibility to elicit information on what elements in the website and e-Service the user saw or did not see.
- Introduce a scenario and let the users elaborate on their thoughts and expectations on the concept of 'e-Service', actions required, results and handling time (to be able to compare with test results).
- In order to increase the quality of analysis, include a web-based template with the approach to note deviations (according to wireframes) in user's ability to find, understand and use the e-Service.
- Pre-marked areas of interest (AOI) in wireframes were useful to analyse the information provided in the e-Service, i.e. (in our case) if the users keep their eyes on a fixed point or limited area and the transitions between AOIs (looks) or several fixed points in one limited area (reading) or if they act on the information (clicking/writing).
- Wireframes are needed at all levels of the website and the use of e-Service. In our case wireframes showing five levels were used in the data collection, analysis and visualisation of results: the municipality home page, the e-Services start page, the e-Service focal area page, the focal e-Service page and the appointed e-Service.

4. Conclusions: Process and Outcomes

The purpose of this paper is to develop a test process with outcomes aimed to support e-Service providers' ability to communicate e-Services. The test process design recommended for similar and repeated tests on communicability in public e-Services is presented in Figure 3.

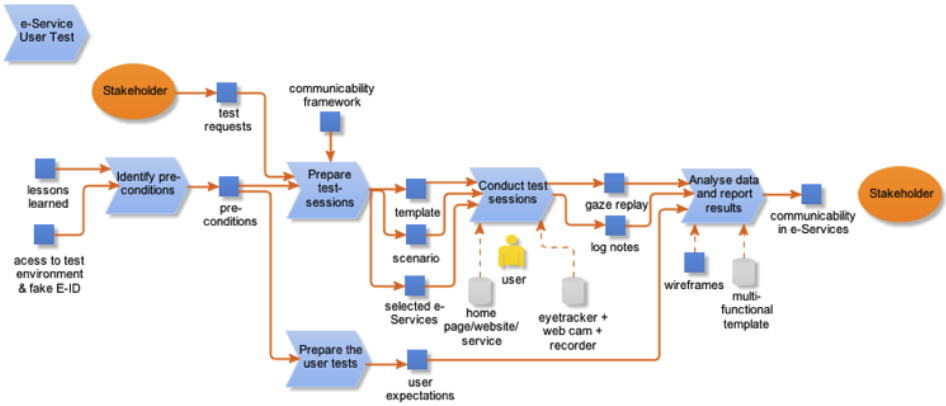

Figure 3. A test process for user tests on public e-Services

Information-oriented metrics, validated in our condensed literature review and lessons learned from conducted user tests, are presented in the communicability framework, see Table 2. The framework can be used in observations and analysis to support assessing e-Service information content in relation to the e-Service information layers in the web channel. Complementary techniques, besides eye tracking and gaze replays, to use in data collections and analysis are illustrated with following abbreviations, (R): Recorded voice - the user talk out loud, (I): Interview and (SC): Screen shot analysis.

Table 2. Elements and information-oriented metrics in the communicability framework

Elements	Information-oriented metrics in e-Service context
Purpose	Explicit intention and value? (SC) (R) Explicit target group? (SC)
Context	Best placement according to business context/case handling/problem to solve? (SC) (R)
Interaction	Explicit roles in the service performance? (SC) (R) Understandable intentions of message exchange? (R)
Actor	Explicit service provider? (SC) Explicit user and role (customer/citizens/co-producer)? (SC)
Action	Relevant actions provided? (R) Support of how service is working? (R) Explicit prerequisites and legal conditions for using/completing the service? (R) (SC) Support of service performance – in a confidence manner? (R)
Content	Comprehensive overview? (R) Relevant and sufficient instructions? (R) Understandable messages? (R)
Result	Handling time (I) (R) Expected results, when and how this is going to be delivered? (I) (R) (SC)

Our multifunctional template will be further elaborated on in terms of the e-Service concept. Additionally, a further development of the communicability framework is necessary. We would like to encourage other researchers and practitioners to use the framework to develop it in appropriate directions. At the same time, we would like to learn from other user tests on public e-Services and look forward to more case studies in this area.

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