Ensuring Universal Design of ICT: Triggering the Triggers!

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Abstract. Some ICT projects manage to create award winning, inclusive solutions, while others fail. Previous research has gathered data from 34 informants across 23 ICT-projects that have achieved universal design (UD). Their reasons for success are complex, but 15 Critical Success Criteria (CSC) can be identified. This article asks: How can we utilize these insights to promote UD efforts in the ICT-industry? The article proposes a way to model the empirical data for societal utilization; supporting future efforts to promote UD. First, we analyze the relationships between personal, processual, organizational and societal factors, and how the different critical success criteria work together to positively influence the projects in our sample. Next, we apply Hertzberg and Fogg's theories to classify the CSC as triggers, facilitators, motivators or hygiene factors. Based on this deeper understanding, we model the data and propose 3 trigger factors for UD of ICT. Using our model, we propose the following three strategies, which have a high effect potential for "triggering the triggers": 1) Legal interventions, 2) Awareness interventions, and 3) Training interventions. The contribution of the article is theoretical: a) providing richer insights into empirical data, by modeling their relationships, and b) predicting the impact of future interventions on the ICT-industry based on our modeled findings.

Keywords. Universal design, ICT, success criteria, high-impact interventions

1. Introduction

Universal design (UD) contributes to societal, ethical and commercial benefits. A political stance on the importance of UD has already been made by international stakeholders such as the UN, US, Japan, China and EU [1]. Despite legal efforts to secure UD of ICT, numerous inaccessible websites still exist [2-4]. There seems to be a gap between the societal intent of UD, and real-life industry practices and results. In order to help bridge the gap, research proposes best practices for achieving UD of ICT. One such study has interviewed 34 informants across 23 UD award-winning ICT-projects [5, 6]. Here, 84 characterizing factors for UD success in ICT-projects are identified. 15 of them are considered Critical Success Criteria (CSC). There is a need to make these empirical insights more applicable in order to facilitate that CSC are met in future ICT-projects. We re-examine the interview data to identify the dynamics in play in the sample – how factors affect each other. Hertzberg (1964) and Fogg (2009) both have theories relevant for describing and modeling the data [7, 8]. Based on improved

insights, the article proposes interventions with the potential to trigger chain-reactions to efficiently promote UD of ICT. We ask the following research questions:

1. What is the relationship between the Critical Success Criteria (CSC)?
2. Using Herzberg's theory, are the CSC motivators or hygiene factors?
3. Using Fogg's model, are the CSC motivators, facilitators or triggers?
4. What are likely high-impact strategies for UD of ICT?

2. Heading

In our previous work, interviews from 34 informants are transcribed and analyzed, and 84 characterizing factors are identified from 23 ICT-projects that have successfully delivered universally designed ICT-solutions (see Figure 1). The characterizing factors were identified through emergent coding of full textual transcribed in-depth interviews, supported by audio recordings. We separate between obstructive and promoting factors, classified as Societal, Organizational, Processual or Personal.
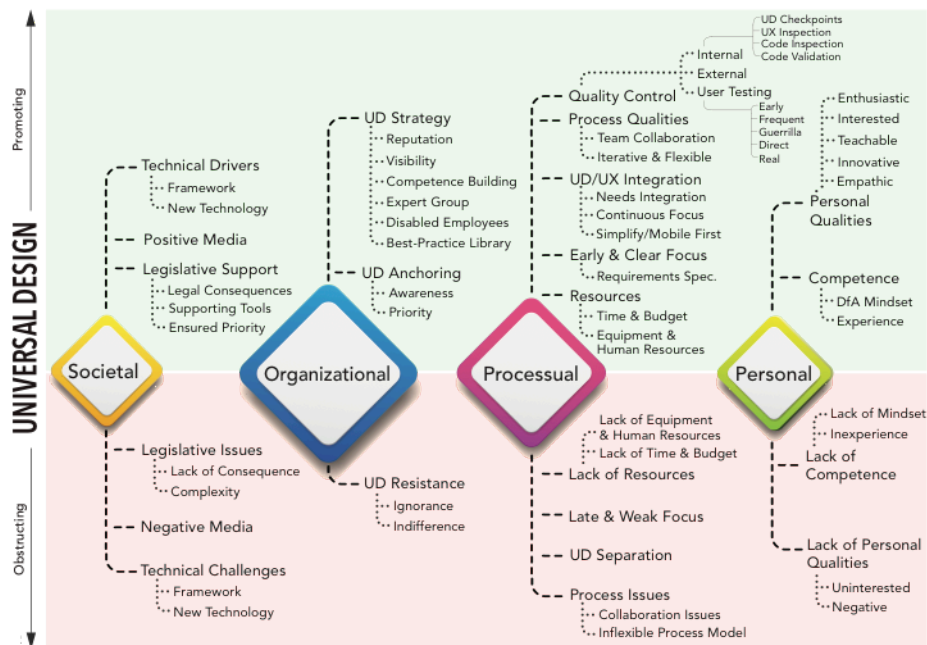

Figure 1. Overview of identified characterizing factors.

Based on the frequency of factors mentioned in the interviews, the following 15 factors are considered CSC:

1. Legislative Support (Societal)
2. UD Awareness, (Organizational)
3. UD Priority (Organizational)
4. Strategic UD Competence Building (Organizational)
5. Requirement Specification of UD (Processual)
6. UD/UX Needs Integration (Processual)
7. Continuous Focus (preferably iterative, Processual)

8. Cross-disciplinary Team Collaboration (Processual)
9. User Testing (preferably with real and disabled users, Processual)
10. Internal quality control (code validation, inspections etc.) (Processual)
11. Enough Time & Budget (Processual)
12. Enough Equipment & Human Resources
13. Design for All (DfA) Mindset (Personal)
14. Interest in UD (Personal)
15. Enthusiam about UD (Personal)

Our findings seem to fit well with related studies, for example Lazar, Goldstein and Taylor [9] on organizational aspects and process guidelines; Khang and Moe [10] on the competence of the team as well as motivational and awareness barriers (such as the importance of project management being dedicated to success); and inclusive development principles as outlined by Fuglerud and Sloan [11] and Røssvoll and Fuglerud [12].

3. Research Approach

The overall research approach is qualitative, using an exploratory interview study to map empirical factors for UD success. This is appropriate for eliciting subjective views on informal and complex practices [13:5, 14:91]. The study gains knowledge of project members' perceptions of a situation, and is as such interpretive with phenomenological traits [15]. The data is analyzed through thematic content analysis, which is iterated to deepen insights. Thus, the study has hermeneutic traits; incrementally deepening our (post-) understanding. Narrative evidence is used in order to describe relationships between the CSC factors and applying theoretical perspectives.

Hertzberg's dual-factor theory revolves around employee motivation [7]. Herzberg identified how someone being satisfied or dissatisfied at work might arise from different factors, and that what motivates people may be different from, and not simply the opposite of, factors causing dissatisfaction (hygiene factors). While hygiene factors must be *sufficiently* present to *avoid* dissatisfaction, motivational factors increase satisfaction when increased. Hertzberg dual-factor theory is used to investigate if CSC are motivators or hygiene factors.

Fogg's theoretical model for human behavior [8] is focused on how factors influence human behavior. According to Fogg, behavior (B) can be triggered (T) if adequate motivations (M) and abilities (A) are present (B=MAT). The theory has been successfully applied to persuasive design. Its strength and weakness is the simplified and static view on behavior and motivation, and the lack of individual (project) difference. Nonetheless, Fogg provides a starting point for understanding the dynamics of what is (not) working in our sample, and is applied to theorize which CSC are the triggers for UD. Based on insights into the type and nature of the factors, we model the empirical data, and use insights to propose actions that could "trigger the triggers".

4. Findings and Discussions

4.1. CSC Relationships

On the Societal CSC "Legislative Support", informants express how the Anti-Discrimination and Accessibility Act [16] boosts mandates to create inclusive solutions, while the threat of fines ensures a minimum priority from stakeholders. Informant 23 states: *"It's a shame to say it, but it's the law and regulation that promotes it here (state agency)".* A "pointing fingers" approach of critizising others for doing things wrongly is however not always motivating, as informant 22 indicates when talking about using legislation to push UD priority; *"Then you have no choice, but that's not to say that it is the main driver to do the job well".* An alternative approach is influencing Personal CSC: "Enthusiasm", "Interest" and "DfA Mindset". Informant 29 explains, *"Because if you understand why you do something, then you have the motivation to do it. But if you only see it as a checklist that you have to read through and comply to, it'll be, like, substantially harder"*, and Informant 2 says: *"But if they don't care if the contrasts are good enough or not, it (designers or developers skillsets) doesn't matter. Then it (the solution) won't be (universally designed)."*

Personal attitudes are not formed in a vacuum. Indifference to UD on management levels is described as detrimental to the enthusiasm and focus on UD in a project. This coincides well with [10]. Three Organizational factors are CSC: "Awareness" and "Priority" which are both within the "UD Anchoring" factor, and UD "Competence Building". Quite a few of the success projects in our sample have established "Expert Groups" as part of the organizational competence development. Some have persons with a special UD responsibility within sections, while others have dedicated UD sections. The common denominator is that someone within the organization has been assigned a mandate to ensure or promote UD. These persons are often described as "UD beacons", and are as such persons with a high degree of enthusiasm. They typically try to promote UD awareness and knowledge among colleagues, management and clients. Another interesting strategy is hiring people with disabilities, such as developers with severely reduced vision. Disabled employees provide organizations with in-depth assistive technologies competence, access to real-life marginalized users for testing and experts for quality reviews and design guidance. Having disabled colleagues seems to make the issue of inclusion more real, and promote organizational awareness.

The majority of factors influencing UD success in our sample are Processual factors. Here we find the last 8 CSC. Two are related to Resources, which all informants mention. "Time and Money" are the primary concerns, with "Equipment and Human resources" a close second. Having an UD focus from the start is expressed in the CSC specifying "Requirements for UD". Informant 1 says: *"So, I think it's very important to have it from the very beginning. It applies to almost everything (...) it will be abandoned if you wait to implement it."* Finding the time to do thorough quality control of technical and usable accessibility needs is also critical. Wide ranges of assessment methods are used, with two CSC; early, direct, informal and frequent "User Testing" (preferably with real and disabled users), and frequent "Internal quality control" (code validation, peer review inspections etc.). The CSC cross-disciplinary collaboration is needed for optimal results. Informant 21 states: *"I think if I'm to be completely honest, I think the customer had decided to do it. And they ordered it from us – they wanted to be good at it. I think that was absolutely crucial. That means we*

could, and in some way had to, spend a lot of time on it, on universal design. But if it hadn't been part of their order, we would probably not have done it, so .. that the customer was a good procurer, I think was absolutely crucial."

Our data suggest there are large overlaps between UX and UD work. Informant 10 explains; "*As I see it, it's part of the quality of use, user experience like the big umbrella, then it's usability, and then you have accessibility, universal design for everyone*". In fact, based on our data, UD could be interpreted as "UX for all", expressed in the CSC "UD/UX Needs Integration". The successful projects see UD as an extension of UX, with a DfA mindset pointing to user focus: *"When we say 'design for all' - then we think basically 'good for everyone'"* (Informant 26). A "Continuous Focus" on user needs – not separating between UX and UD work – is another CSC.
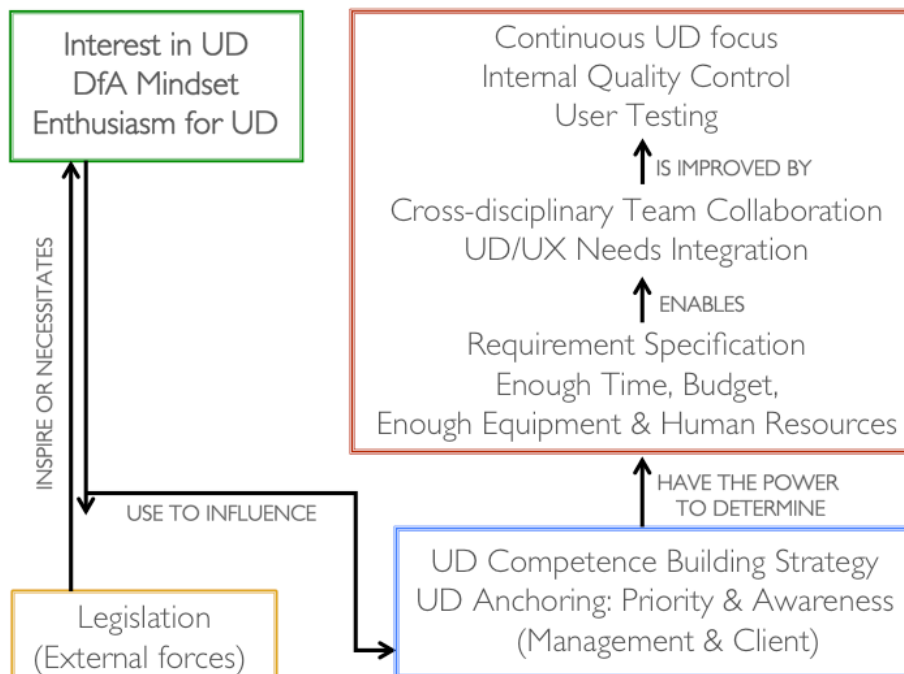

Figure 2. Critical Success Critera (CSC) relationships.

4.2. Applying Hertzberg's Dual-Factor Theory

As Figure 1 shows, many obstructing and promoting factors correspond to each other. For example, "Technical Drivers" on the promoting side holds the sub-category "Framework", which commends companies for providing inclusive guidelines, platforms and libraries. The same "Framework" sub-category is found in the category "Technical Challenges" on the obstructing side, referring to e.g. how Content Management Systems generate inaccessible code. Thus, frameworks may both aid or hinder UD. Likewise, media attention can be either "Positive Media" or "Negative Media". Organizational "Resistance" is the opposite of "Anchoring", and sub-categories "Ignorance" and "Indifference" is basically lack of "Awareness" and "Priority". While "Awareness" refers to management and project stakeholders on all

levels holding a positive understanding of UD, "Ignorance" points to viewing UD as something irrelevant, often paired with a lacking focus on user needs in general. "Priority" is taking UD seriously, investing in real-life practice, while "Indifference" points to a weak or missing focus in the organization or from the client. Further, on Personal level; "Lack of Personal Qualities" is divided into the sub-factors "Uninterested" and Negative", where the former is in opposition to "Interest", and "Enthusiasm" is viewed as the opposite of "Negative".

These examples illustrate that many factors could be viewed as on a gliding scale from negative to positive. One could envision Tech frameworks, Media attention, Organizational cultures and Personal attitudes that are "neutral" – neither facilitating nor hindering UD. The question then is whether there is a *sufficient presence* cut-off to avoid *hindering* UD for these factors – e.g. if they should be considered *hygiene* factors.

Hygiene factors do not necessarily promote UD if increased beyond sufficient presence. For some factors, this fits very well. Resource is an obvious candidate, as lacking resources to do UD work are clearly detrimental. However, unlimited access to users, time, equipment and staff is not necessary. What you need is *sufficient* resources in order to choose appropriate approaches.

We argue it is beneficial to distinguish between *hygiene* factors that are obstructive when (too) absent, and *motivators* hypothesize to always increase the likelihood of UD when increased. Investigating the data, we find that all factors categorized in "UD Strategy" are likely motivators, as are the UD/UX Integration sub-factors "Needs Integration" and "Simplicity/Mobile First", all factors under "Quality Control" and the Personal Qualities sub-factors "Teachable", "Innovative" and "Empathic". Applying Hertzberg to the 15 CSC, we find;

10 hygiene factors:
1. Legislative Support (Societal)
2. UD Awareness, (Organizational)
3. UD Priority (Organizational)
4. Continuous Focus (preferably iterative, Processual)
5. Cross-disciplinary Team Collaboration (Processual)
6. Enough Time & Budget (Processual)
7. Enough Equipment & Human Resources
8. Design for All (DfA) Mindset (Personal)
9. Interest in UD (Personal)
10. Enthusiam about UD (Personal)

and 5 motivators:
1. Strategic UD Competence Building (Organizational)
2. Requirement Specification of UD (Processual)
3. UD/UX Needs Integration (Processual)
4. User Testing (preferably with real and disabled users, Processual)
5. Internal quality control (code validation, inspections etc.) (Processual)

4.3. Applying Fogg's B=MAT Theory

In Fogg's model, hygiene factors can be translated into *abilities*. But which, if any, CSC are *trigger* factors in Fogg'd B=MAT model? We find that the *legislation* is sometimes the only thing forcing UD in ICT projects. Informant 12, a consultant, says: *"We try not to use the law more than necessary, but we can resort to it if nothing else works"*. Even though the current legislation is vital to enforce resources and protect

against budget cuts, it is not always the key to UD dedication; *"Then you have no choice, but that's not to say that it is the main driver to do the job well"* says informant 22. Instead, informants try to spread a positive attitude – e.g. targeting Personal factors.

This brings us to *enthusiam* about UD as the second trigger. The law is often used as leverage to secure a mandate for taking on UD responsibilities. Sometimes, this empowers individuals to call for increased prioritization and competence. In parallel with the leverage approach, several funnel their professional enthusiasm and knowledge of UD to colleagues, clients and management. In some cases, UD awareness seems to slowly be internalized in the organizations originally *not* interested. Grass-root movements also use external factors apart from legislation to influence; e.g. if media attention and awards create a positive external UD image, management can be inspired to keep up the good reputation.

An organizational UD culture provides focus and priority beyond what the legislation is able to ensure on it's own. When a project owner orders UD requirements, the resources for meeting these requirements are also allocated. Informant 7 summarizes: *"Cause if they have the awareness, they will probably find money."* Thus, *specified UD requirements* is the third trigger identified. Informant 17's explains: *"we had a client – Project 16 – who was willing to pay for this, for them this was important. And that's what made it possible. And that's the problem today. It isn't that we can't do universal design well enough. One can surely never be good enough, but we can do it quite well. The reason why we don't do it in many apps today is because the customer isn't interested in buying it."*

Applying Foggs to the CSC, we find;

8 hygiene factors:
1. UD Awareness, (Organizational)
2. UD Priority (Organizational)
3. Continuous Focus (preferably iterative, Processual)
4. Cross-disciplinary Team Collaboration (Processual)
5. Enough Time & Budget (Processual)
6. Enough Equipment & Human Resources
7. Design for All (DfA) Mindset (Personal)
8. Interest in UD (Personal)

4 motivators:
1. Strategic UD Competence Building (Organizational)
2. UD/UX Needs Integration (Processual)
3. User Testing (preferably with real and disabled users, Processual)
4. Internal quality control (code validation, inspections etc.) (Processual)

and 3 triggers:
1. Legislative Support (Societal)
2. Enthusiam about UD (Personal)
3. Requirement Specification of UD (Processual)

Figure 3 shows how increasing *abilities* decreases the needed *motivation* – and vice versa – in order for a *trigger* to be successful (green area).
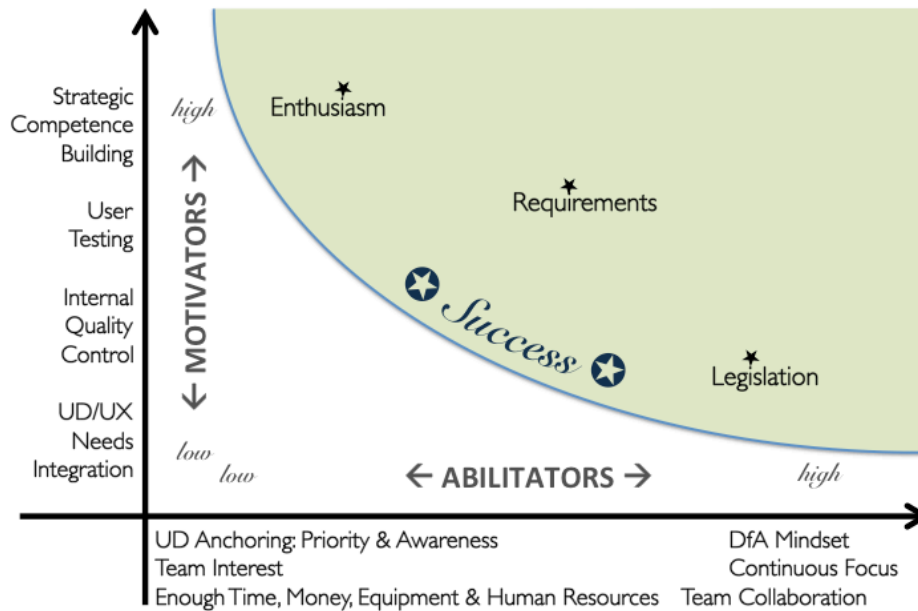
Figure 3. Mapping CSC *triggers*, *motivators* and *abilities* into Fogg's B=MAT model.

4.4. Theorizing High-Impact Interventions

What interventions are likely to have the largest effect on promoting and ensure best practice CSC in place from the start of ICT development? We first explore impact perspectives related to *legislation*. Legislation seems effective to *trigger a minimum of UD quality*. However, several informants worry that the focus on technical accessibility (the minimum legislated in Norway) derails from the DfA mindset. One could consider adding to the regulation to promote DfA perspectives, e.g. demanding process documentation. Further, some mention lack of real-life consequences for breaking the law. Any UD efforts in projects with a high degree of UD resistance are likely to depend on legislative enforcement. UD focus could end if possible negative consequences can be avoided. Larger organizations seem to view the threat of fines as more real than small businesses, which point to the ICT provider as the one responsible. Thus, current legislation may not work for "less serious" actors. EUs proposal of placing responsibilities for ensuring UD across all links in the development process is interesting [17].

Requirements effectively trigger priority and resources. In order to encourage more projects to specify UD requirements, one needs to trigger top-down strategies derived from management levels. Creating tools to support UD discussions with the project owner at the start of a project is considered a potential tool to anchor UD values among the project stakeholders. Creating checklist-based integrations to project management tools is also an interesting approach to highlight UD best practice at a management level – e.g. propose quality assurance and DfA activities at certain intervals or in certain phases. Anchoring *UD values* among project owners is a powerful approach to *inspire a maximum of UD quality* within the available limitations of a project. We

propose increased attention on raising awareness among procurers of ICT-solutions, especially in public sector.

Finally, we ask how to trigger *grass-root movements*. Some informants complain that developers are not skilled in legislated UD requirements from their education. If engineering and design students are not being adequately trained in accessibility responsibilities, they might be resistant to regulations in their professional work. However, if best practice and quality control are ingrained as part of their education, they are considered likely to apply and share this competence in their workplaces. For industry practitioners, we propose in-situ training interventions targeted at ICT designers and developers. Informant 24 describes the WCAG guidelines as a *"wall of text"*. Focusing on *"hundreds of thousand of requirements"* is demotivating and makes it hard to create enthusiasm among peers who do not (yet) have a UD interest. Thus, simplifying regulations seems an appropriate strategy. The Norwegian Agency for Public Management and E-Government (DIFI) have started to take action in this respect, by offering advise through seminars and online guidelines [18]. This work should be continued, especially "how-to" guides minimizing complexity.

We argue that action plans for promoting UD in the field of ICT should focus on triggering the identified CSC triggers to have the highest impact potential. We discuss a handful of possible interventions for triggering positive change. Early findings are presented at a national "Universal ICT" expert network [19]. The results received a warm reception and exceedingly positive feedback, providing some tentative external validity. Future research will focus on increasing validity, investigate characterizing factors not considered CSC and investigate "low effort, but effective" interventions.

5. Conclusion

This article re-analyzes interview data from 34 informants across 23 ICT-projects awarded for universal design (UD), in order to a) deepen insights on critical success criteria (CSC) and start modeling empirical data; b) assess the likely impact effects of future interventions. We find CSC must to be present at Societal, Organizational, Processual and Personal levels in order for a single ICT-project to succeed. By applying Hertzberg and Fogg's theoretical models, we model the relationships between CSC, identifying eight *hygiene* CSC that only needs to be sufficiently present, four *motivators* its always beneficial to increase, and three *triggers* creating positive CSC chain-reactions. We propose that future steps to promote UD of ICT focus on triggering these triggers; 1) Legal interventions to enforce a minimum level of UD, 2) Awareness interventions to inspire maximized UD priority and 3) Training interventions to facilitate UD grass-root movements.

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