De Gustibus Non Est Disputandum, but Usability is Not a Matter of Taste

Mikko Rajanen [1]

[1] *INTERACT Research Unit, University of Oulu, Finland*

Abstract

"*De gustibus non est disputandum*", or "In matters of taste, there can be no disputes" is an ancient Roman maxim. It posits that everyone's individual preferences are subjective opinions that cannot be right or wrong, and therefore such matters of taste should not be argued about as there is no universal truth to be found. Usability is an important quality characteristic of software, systems, and services, and it is vital in facilitating the rich interaction between users and technology, the social systems and technical systems in the socio-technical context. Although the concept of usability has been evolving over time to match the constantly developing socio-technical landscape, many developers, managers and users still view usability as a subjective matter of taste, therefore undermining its importance. This position paper highlights the importance of separating subjective characteristics related to user satisfaction in usability and user interface design, such as look and feel, from universal characteristics of good design. By drawing parallels between the concept of usability and the Vitruvian architectural design principle of *venustas* or beauty, this paper argues that usability and user interface design can be more objectively characterized through concepts of universal beauty such as symmetry and harmony, while the more subjective matters of taste could be better encompassed by the user experience and service design. Furthermore, this paper discusses the relationships between user interface design, usability, user experience, and service design.

Keywords

Usability, Socio-Technical Systems, Conceptualization

1. Introduction

"*De gustibus non est disputandum*", or "In matters of taste, there can be no disputes" is an ancient Roman maxim, indicating that everyone's individual preferences are equally subjective opinions that cannot be considered right or wrong, and therefore such matters of taste should not be argued about as there is no universal truth to be found. This maxim certainly holds true in contexts such as art, music or gaming, where individual taste is a matter of personal experience and preference. However, when this maxim is applied in socio-technical context, it creates a stalemate for designers, users, and researchers of socio-technical systems development. The socio-technical systems approach consists of interactions between technical systems and social systems, with the aim of reaching a common goal (Bostrom & Heinen, 1977). Therefore, these interactions between individuals and technology must be designed well in order for these common goals to be reached (Mumford, 1983). The socio-technical HCI design focuses today on innovative and balanced relations between technology, organization, tasks and users (Clemmensen, 2021). Furthermore, socio-technical HCI has less participatory focus, aiming at designing for organizational capacity enhancement and the interests of both users and organizational management (Bannon et al., 2018; Clemmensen, 2021). Therefore, bringing up matters of subjective

7th International Workshop on Socio-Technical Perspective in IS development (STPIS 2021) 11-12 October 2021, Trento, Italy
EMAIL: mikko.rajanen@oulu.fi (Mikko Rajanen)
ORCID: 0000-0002-3281-7029 (Mikko Rajanen)

individual taste in the design of socio-technical systems only hinders the design for the common goals and the interaction of social systems and technical systems by and large.

Usability is an important quality characteristic of software, systems, and services, and it is vital in facilitating the rich interaction between users and technology, the social systems and technical systems in the socio-technical context (Rajanen and Rajanen, 2020a). One issue that user interface designers and usability practitioners face, is that both developers, managers, and users may consider usability and user interface design to be largely a matter of subjective taste and therefore apply the maxim "*De gustibus non est disputandum"* as their trump card, ending the meaningful discussion about the possible and needed improvements to interaction and interface then and there. Because of this subjective aspect of usability design and evaluation, the developers and managers may disregard even the absolutely objective usability measurements as merely opinions of the usability practitioners and users, and discard these measurements as not having objective validity in the reality, no matter how much objective usability measurement data and analysis is presented (Rajanen and Iivari, 2015; Rajanen and Iivari, 2007). The introduction of more visually appealing user interfaces have led to designers focusing of designing the look and feel, the aesthetics of the user interface, rather than the functional utility and effectiveness of the user interface. Furthermore, the aspect of subjective taste in the concept of usability has necessitated trying to find any means for somehow generalizing the subjective tastes, for example by studying the impact of personality on the subjective assessment of usability (see e.g., Kortum and Oswald, 2018).

The user interface design is nowadays usually done by graphical designers and service designers, who are more focused in the visual outlook of the user interface than core usability perspective and improving the interaction between the social and the technological systems. As a result, while there is more need than ever for better usability and user interface design due to the digitization of the society, objective perspectives on usability and user interface design are pushed more and more into the sidelines while the research and practice is focusing on subjective taste of individual, therefore creating a conundrum between designing for an individual vs designing for all users.

Therefore, in order for usability to shed its burden of subjective taste in the eyes of managers, developers, users, and other stakeholders, we need to divide the subjective taste component from the satisfaction aspect of usability concept into universally objectively beautiful, appealing, and nice looking component, and to keep it separate from the individually subjective taste component. This question of objectivity vs. subjectivity in usability definition, theory, practice and measurement has been an issue since the development of first usability definitions and standards. In international standard usability is defined as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use. Although the concept of usability has been evolving and adapting to the changing sociotechnical landscape through a cybernetic circle (see e.g. Rajanen and Rajanen, 2020b), the issue of subjective taste has remained integrated into the very concept of usability as part of the satisfaction. In this position paper we posit that the usability in sociotechnical context should be an entirely objective quality, rather than subjective quality subject to individual tastes. Furthermore, we recognize that while usability is considered very important in the contexts of both productivity (see e.g. Rajanen, 2011) and entertainment systems (see e.g. Rajanen & Marghescu, 2006; Rajanen & Nissinen, 2015), the role that usability plays in entertainment systems (i.e. games) design is different than in productivity systems (i.e. information systems). Therefore, this paper focuses mainly on usability in productivity systems, and more research is needed on applying the usability in general and the Vitruvian design principle of *venustas* in particular to the context of entertainment systems.

In order to understand why the subjective taste was included in the satisfaction component of usability conceptualization, we need to first understand how and why the very concept of usability has been emerging and evolving through the decades.

2. Usability and user interface design

At first, the developers of computer systems and information technology developed these systems for themselves and thus knew exactly how to tailor the system for their own requirements and how to use them effectively. Over time, however, the user base of the information and communication

technology (ICT) systems grew rapidly as the businesses started to use ICT as part of their everyday operations and as part of everyday life by the masses. This led to user base of ICT systems growing from ICT experts to users of any age, background, skills, being experts of their own work rather than experts in ICT design and use. This created a disparity between designers and users, the designers not having any more inherent insights on the users, work processes, mental models, and the contexts where the system was to be used. As a result of this gap between designers and users, where the developed ICT systems might not fit the organizational processes or work processes of the users, might not contain vital functionalities while having completely unnecessary features, and where these systems could be very difficult to learn and inefficient and frustrating to use for the users in their everyday work. In the early 1980s it was recognized that the designers of ICT and socio-technical systems need to have methods and processes for gathering and analyzing objective information about the users, their contexts of use, work practices, and mental models, and ways to turn this information into good designs for systems that would be easy to learn and to use from the users perspective. This need led into development of conceptualizations, shared language, methods and processes for understanding the user and the technology, and the multifaceted interactions between them, therefore creating the spark for the human-computer interaction (HCI) community. As a result, this community developed the concept of usability in the early 1980s to act as one of the quality attributes for designing and evaluating visual displays and interactive systems from the user perspective (Bevan et al., 2015; ISO 9241-11, 1998).

The concept of usability has been constantly evolving to adapt to the advances in technology and other emerging needs in the socio-technical landscape and as a result, the focus of usability research and practice have been constantly expanding (see, e.g. Rajanen and Rajanen, 2020b). These different usability standards (e.g. ISO 9241-11, 1998) act as time capsules, having different approaches, viewpoints and conceptualizations to usability, thus representing the views and best practices of their time (see e.g. Marghescu, 2009). At first, the concept of usability mainly focused on how effective the system was for the users to use and to what degree the designed interface enabled the users to accomplish their intended tasks, therefore focusing on *effectiveness*. However, as the use of ICT systems became more common, the need to minimize the cognitive and other resources a user needed to expend to achieve their tasks was identified as an important concern, so the concept of usability was expanded to include also *efficiency*.

As the use of ICT expanded from the work context into the everyday life, designers had to take also into account the more subjective pleasantness and ease of use as experienced by an individual user so that the system would appear more appealing to that user and therefore have an advantage over its competitors. Thus, the seminal works in HCI research have included the subjective *satisfaction* as integral part of their definitions of usability (see e.g. Whiteside et al., 1988; Doll and Torkzadeh, 1988; Norman, 1988; Nielsen, 1993; Shneiderman, 1998; Norman 2013; Shneiderman et al. 2018). This inclusion of satisfaction as part of usability was further codified into the international standards of usability (see e.g. ISO 9241-11, 1998; ISO 9241-11:2018, 2018). This has led researchers and designers to try to understand the emotions of users before, during and after the use of the technology, as well as why some users would prefer one design over the other. Thus, researchers have tried to find ways to predict and theorize subjective satisfaction of users to help designers in their practical work (Shneiderman et al., 2018). However, as a result of difficulties in predicting emotional reactions, the researchers have turned to intuitive judgments and market testing to complement theoretical predictions (Nah and Bilal, 2007). The usability studies showed that appraisal of technology was also influenced by aesthetic aspects of the design, as well as user's expectations before and reflections after the use (Thüring and Mahlke, 2007; Hassenzahl, 2004).

As a result of this change in the socio-technical landscape, the concept of usability was further expanded with in early 2000s with *user experience* aspect, at first as a component of usability definition itself as satisfaction and later also as its own distinct domain of design and evaluation (see e.g. Bevan et al., 2015). Furthermore, the user experience aspect was further expanded as online services became more widespread and the concept of *service design* was introduced for approaching the designing the interactions between a user and service provider from a holistic perspective.

However, user experience designers and service designers seems to have a preference for design aesthetics over functional utility and usability, likely due to many of them having a background in arts or industrial design. In such cases, the designer of user interface might concentrate on making the user interface of the software, system or service subjectively beautiful, pleasurable, or exciting by drawing

concepts applicable to art, media, and marketing, rather than core concepts of usability. This kind of user experience design or service design polishing may indeed make the user interface look nice, but in terms of usability and from the point of view of the user this approach can make the interface more limited, less efficient and more difficult to use. Furthermore, such design is conducted without using any objective assurances that the individual user with their subjective taste will experience the user interface and the system as a whole in the way the designers intended, or that any larger number of users will find the design appealing.

Therefore, while these expansions and evolutions in the concept of usability have helped to meet the changes in the socio-technical landscape, they have also pushed focus away from objective usability and its core of designing good interfaces and interaction between the user and the system. Therefore, we need to examine how to separate the universal good, beautiful, and appealing design from subjective taste in the context of user interface and usability design and evaluation. In order to identify a potential universal objective view on usability and user interface beauty that could apply to all people at all times in the sociotechnical context, we look at the design of architecture and the works of the father of the architecture, Vitruvius and his concept of *venustas*.

3. Vitruvian design principle of *venustas*

The architectural design focuses on how a building would look and how it should look, combining both the objective beauty and the subjective beauty, and drawing from vast repository of objective rules for beautiful design, symmetry, and clean design spanning over two millennia of experience. The roots of architecture as a discipline and its objective rules can be traced back to Vitruvius in the 1st century BC, who introduced in his books of architectural design three universal core principles: *utilitas* (suitability), *firmitas* (durability), and *venustas* (beauty) (Vitruvius Pollio, 1960). Vitruvian aspects of architectural design have been used in sociotechnical HCI and usability to argue for the importance of usability in the sociotechnical context in general (Rajanen and Rajanen, 2020a). The last, and often overlooked, principle in the design of socio-technical systems, namely *venustas*, or beauty, is closely related to aesthetics, which is a concept of beauty found in both art and nature. This universal Vitruvian core concept of beauty is by nature more multifaceted and complex than the other Vitruvian concepts of *firmitas* and *utilitas*.

However, we look into the concept of *venustas* as it is not a subjective quality but rather draws from universal beauty, symmetry, and harmony of the lines and proportions. Vitruvius posited that a timeless and universal notion of beauty could be found from the nature's designs, as they were based on universal laws of proportion and symmetry (Vitruvius Pollio, 1960). According to Vitruvius, the proportions and symmetry of the human body itself could be used as a model of natural and universal proportional perfection, referring to the ancient scholars who had examined well shaped and beautiful people, discovering that beautiful bodies shared certain proportions and symmetry. Vitruvius argued that the ideally proportional human body fitted precisely and symmetrically into both a circle and a square (later illustrated by Da Vinci as the Vitruvian man). Therefore, Vitruvius believed that a link existed between perfect geometric forms and the perfect body. The human body itself was set as a living guidebook, containing the fixed and faultless laws set down by nature, setting examples of proportion and symmetry for the past, present, and future architects. Therefore, Vitruvius argued that architectural designs must refer to the unquestionable perfection of the symmetry and proportion of the human body. An architect should design the building to create a sense of *eurythmia* (proportion, a graceful and agreeable atmosphere) mirroring these natural laws of harmony and beauty (Vitruvius Pollio, 1960).

In the context of socio-technical systems, *venustas* have been traditionally related to the subjective user experience (see e.g. Rajanen and Rajanen, 2020). Some studies have used aesthetics and the emotions produced by aesthetic experiences to explore why users might prefer one design over the other (Thüring and Mahlke, 2007). The results from these studies have shown that the overall appraisal of technology by an individual user is indeed influenced by the aesthetic aspects of the design (Thüring and Mahlke, 2007). However, focusing on individual tastes on aesthetic aspects is problematic in user interface and usability design, as there might be as many tastes as there are users and finding a common consensus might be difficult or impossible. Some studies have posited that there is a need to first find a balance between cognitive and material aesthetics in order to find balance between individual and

universal aesthetics (Bruns and Richard, 2004). Next, we discuss how this balance between individual and universal aesthetics could be achieved in the context of usability by drawing from the Vitruvian design principle of *venustas*. Furthermore, we discuss the relationships and objectivity/subjectivity of user interface design, usability design, user experience design and service design.

4. Discussion and conclusions

We argue that the inclusion of subjective taste into the satisfaction component of usability is one of the causes behind the change in focus from core user-technology interaction design into visual design in both research and practice, and the dismissal of the usability as subjective matter of taste by designers and managers (see e.g., Rajanen and Iivari, 2015; Rajanen & Iivari, 2007). This subjective aspect has been remaining in the very definition of the usability regardless of its evolutions through the changes in the sociotechnical landscape. Therefore, we posit that further evolution is need and the subjective and individual taste should be removed from the usability concept entirely and should be incorporated into the more subjective user experience and service experience domains. Based on the reflections above, we posit that to achieve the balance between individual and universal taste, the cognitive and material aesthetics, the concept of universal aesthetics as identified by Vitruvian design principle of *venustas* should be applied in the concept of usability and its satisfaction component. Therefore, the usability and user interface design should be based on similar universal rules of symmetry, *eurythmia* (proportionality and agreeability) and harmony. This would allow the designers of user-technology interaction to draw from similar pool of objective design principles as the architects have since the Vitruvius. Many of these objective design rules already exist in the user interface and usability design (e.g. the Fitt's law discussed below), but they are not followed so much in research and practice due to the focus moving from interface design to visual design and cognitive aesthetics. We argue that if the user interface design and usability design are kept as entirely objective domains of user-technology interaction design, it would help the designers and managers to understand the value of this design better and to remove the misconception that usability and user interface design are subjective matters of taste. Furthermore, we argue that this change would help to clear up the relationships between the different domains of user-technology interaction design, namely 1) user interface design, 2) usability design, 3) user experience design and 4) service design. We posit that these domains should be seen as different levels of user-technology interaction design, linked to each other, and each level having its own perspective, purpose, level of objectivity, as well as design objectives, experts, rules and methods. Figure 1 presents the visual representation of these different levels of user-technology interaction, their relationships and characteristics.

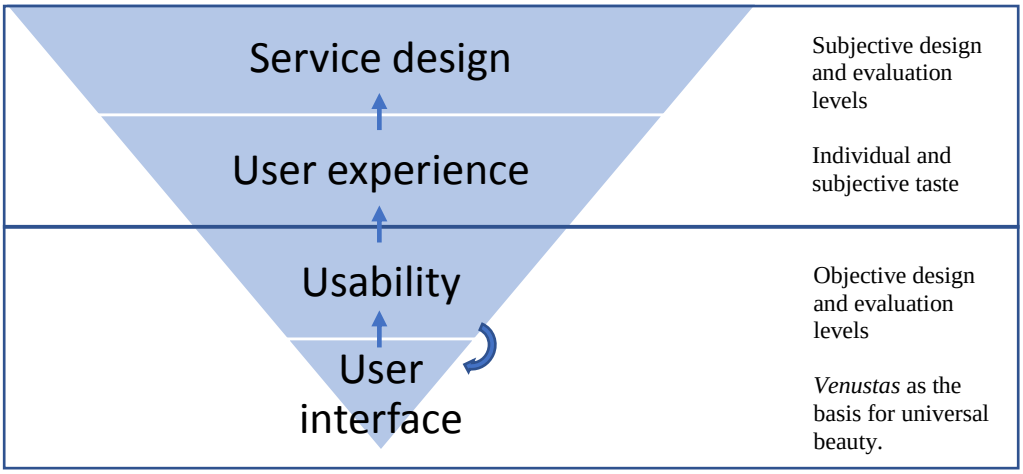

Figure 1: Different levels of user-technology interaction, their relationships and characteristics

We present the *user interface design and evaluation* as the first level and the foundation of the user-technology interaction design. The purpose of the user interface design in its core is to expose the

functionality of the software, system, or service to the user in such way that the user is provided with maximized access to the functionality, while maintaining flexibility and allowing the user to adapt the functionality to their own goals, work styles and priorities. From the user point of view the user interface *is* the system, as the user does not see or care about code, algorithms, databases or networks. Therefore, user interface design is not in its core about how the interface looks, as it is a property of the systems usually called style or look-and-feel. This style or look-and-feel consists of operating system wide standards for user interface design (e.g. colors, shapes, layout, typeface as the look and buttons and menus as feel), and organizational style guides for uniform design and marketing purposes. This has led the companies in some cases to try to protect the look and feel of their own products through copyright, which angered the software developers wanting freedom to choose the best look-and-feel for their designs (Scwartz and Rosenberg, 1990; Lowensohn, 2014).

Therefore, user interface design at its core and drawing from its scientific laws is objective by nature and forms the foundation of user-technology interaction. Thus, we posit that the Vitruvian design principle of *venustas* could form a useful foundation for objective basis for universal beauty and harmony also in user interface design. Furthermore, we posit that it is not meaningful to address the other levels of user-technology interaction if the design has problems at this fundamental user interface level. One example of scientific laws in user interface design is Fitt's law, which predicts that the time required to rapidly move to a target area is a function of the ratio between the distance of the target and the width of the target (Fitts, 1954). This law and other scientific laws, as well as the *venustas* could form the basis of designing for optimal selection, size, and layout for user interface elements in a clear and harmonious way.

One conundrum at this first level of user-technology interaction design could be the role of colors and the design and evaluation. The use of colors in user interface design and evaluation has been found problematic (see e.g. Berg & Pooley, 2012) and the literature suggests that in the basic level of user interface design the colors themselves are not important, but the contrasts they give in the design (see e.g. Goldsmith, 1984). Therefore, in this first level of user-technology design the focus should follow the Vitruvian *venustas* on light and contrast, as no universal design rules on color can be formed due to different positive, neutral and negative associations of color depending of the personal, cultural, political etc. background of the user (see e.g. Berg & Pooley, 2012).

Usability design and evaluation is the second level of user-technology interaction design, building upon and expanding the design of a good user interface in the previous level. The purpose of the usability design is to design the functionality of the software, systems, or service so that the user is able to complete their intended goals with effectiveness, efficiency and satisfaction. The satisfaction component of usability should consist only of the objective aesthetic aspects for Vitruvian *venustas*, namely harmony, *eurythmia*, and symmetry, applied to the aesthetics of the combination of user interface and usability, as the satisfaction is context dependent and cannot be separated from the user goals and contexts of use. This would clarify the role of usability design in the eyes of managers and developers, and highlight its importance as a required quality property rather than subjective matter of taste. While the usability design and its requirements (i.e. designing the interactions related to specific goals) also influences the user interface design, we argue that user interface design level forms the foundation for usability design, as any problems in user interface level (e.g. wrong types, sizes or proportions of user interface elements) would render the usability design meaningless.

User experience design and evaluation is the third level of user-technology interaction design, further building on and expanding the design of good user interface and usability. The purpose of the user experience design is to study the personal preferences of individual users and their preferences and expectations before, during and after the use. The user experience design level should incorporate all the subjective elements from the satisfaction component of usability. This would further clarify the differences between usability design and user experience design, highlighting their distinct purposes and characteristics. We argue that user interface design and usability design form the foundation for user experience design, as any problems in those levels of design (e.g. wrong interface elements, unintuitive work flow) will result in negative user experience. This level could encompass the aspects (e.g. joy, excitement, novelty, emotion) that have been currently categorized as hedonic usability (see e.g. Hertzum, 2010) and technology as experience (see e.g. McCarthy and Wright, 2004). Furthermore, this level could also include the design of colors in the user-technology interaction, as the colors are

experienced in very different ways by users from different background, therefore being a personal preference of an individual user.

Service design is the fourth level of user-technology interaction design. It further builds on and expands the design of good user interface, usability, and user experience, by specializing into the overall holistic service aspect of the user-technology interaction.

There have been calls for building an agreement on definitions of key elements of usability among HCI researchers so that the HCI theories would lead and guide HCI practice (see e.g. Hassenzahl, 2004; Shneiderman et al., 2018). We argue that by presenting this kind of clear distinction and relationships between these different levels of user-technology interaction, the roles and purposes of each level would be made clearer and would allow better separating the objective design aspects from the subjective design aspects, thus helping both theorizing and practice. Persons with background and interest to disciplines such as arts, media and industrial design might focus on more subjective levels of user-technology interaction, while more technology and psychology –focused persons might focus on more objective design and evaluation levels of user interface design and usability design and use the Vitruvian design principle of *venustas*. We posit that this differentiation would greatly help communicate the importance and the results of user interface and usability design specifically towards the management and designers. Furthermore, we argue that usability researchers would benefit from this differentiations, as it would be easier to develop new conceptualizations, processes and methods for usability from objective perspective, without having to reconcile different and sometimes conflicting objective measures and subjective taste. We hope that this position paper will further revitalize the discussion and research on the importance of objective usability measures as the core concept in socio-technical systems development and create an understanding that usability is not a matter of taste.

5. References

L. Bannon, J. Bardzell, S. Bødker, Reimagining participatory design. Interactions, 26(1), pp. 26-32. 2018.

T. Berg, R. Pooley, Rich Pictures: A valuable means to explore complex IS issues. In UKAIS. 2012.

N. Bevan, J. Carter, S. Harker, ISO 9241-11 revised: What have we learnt about usability since 1998? HCI 2015, LNCS, Springer, vol. 9169, pp. 143–151, 2015.

R. P. Bostrom, J.S. Heinen, MIS problems and failures: a socio-technical perspective, part II: the application of socio-technical theory, MIS Quarterly, vol. 1, no. 4, pp. 11–28, 1977. Available: https://doi.org/10.2307/249019

W. Bruns, J. Richard, Aesthetic cybernetics: turning towards senses of man and machine, IEEE International Conference on Systems, Man and Cybernetics, vol. 1, pp. 105–110, 2004.

T. Clemmensen, Human Work Interaction Design: A Platform for Theory and Action. Springer. 2021.

W. J. Doll, G. Torkzadeh, The measurement of end-user computing satisfaction. MIS Quarterly, pp. 259-274. 1988.

R. M. Fitts, The information capacity of the human motor system in controlling the amplitude of movement, Journal of Experimental Psychology. 47(6), pp. 381–391. 1954. doi:10.1037/h0055392.

E. Goldsmith, Research into Illustration: an approach and review. Cambridge: Cambridge University Press. 1984.

M. Hassenzahl, The interplay of beauty, goodness, and usability in interactive products. Human–Computer Interaction, 19(4), pp. 319-349. 2004.

M. Hertzum, Images of usability. Intl. Journal of Human–Computer Interaction, 26(6), pp. 567-600. 2010.

ISO 9241-11, Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) – Part 11: Guidance on Usability, International Standard Organization, 1998.

ISO 9241-11:2018. Ergonomics of human-system interaction — Part 11: Usability: Definitions and concepts, International Standard Organization, 2018.

P. Kortum, F. L. Oswald, The impact of personality on the subjective assessment of usability. International Journal of Human–Computer Interaction, 34(2), pp. 177-186. 2018.

J. Lowensohn, Round two: Apple and Samsung suit up for another billion dollar patent war. The Verge. 2014.

D. Marghescu, Usability evaluation of information systems: A review of five international standards. In Information Systems Development (pp. 131-142). Springer, Boston, MA. 2009.

J. McCarthy, P. Wright, P. Technology as experience. Interactions, 11(5), pp. 42-43. 2004.

E. Mumford, A socio-technical approach to systems design, Requirements Engineering, vol. 5, no. 2, pp. 125–133, 2000. Available: https://doi.org/10.1007/PL00010345

D. Nahl, D. Bilal, (Eds.). Information and emotion: The emergent affective paradigm in information behavior research and theory. Information Today, Inc. 2007.

J. Nielsen, Usability Engineering, AP Professional, Boston, MA, 1994.

D. Norman, The Psychology of Everyday Things (1st ed.). Basic Books. 1988.

D. Norman, The Design of Everyday Things. Revised and expanded. Basic Books. 2013. ISBN 9780465050659.

M. Rajanen, Applying Usability Cost-Benefit Analysis - Explorations in Commercial and Open Source Software Development Contexts. PhD Dissertation. Acta Universitatis Ouluensis Series A 587. University of Oulu. 2011.

M. Rajanen, N. Iivari, (2007). Usability Cost-Benefit Analysis: How Usability Became a Curse Word?. In Proceedings of the INTERACT 2007. Rio de Janeiro, Brasil. 2007. DOI: 10.1007/978-3-540-74800-7_47.

M. Rajanen, N. Iivari, Power, Empowerment and Open Source Usability. In the Proceedings of the ACM SIGCHI Annual Conference on Human Factors in Computing Systems (CHI 2015). Seoul, South Korea. 2015. DOI: 10.1145/2702123.2702441

M. Rajanen, D. Marghescu, The impact of game usability to player attitude. In Proceedings of 29th Information Systems Research Seminar in Scandinavia, pp. 1-17. 2006.

M. Rajanen, J. Nissinen, A Survey of Game Usability Practices in Northern European Game Companies. IRIS: Selected Papers of the Information Systems Research Seminar in Scandinavia. Issue Nr 6 Paper 8. 2015.

M. Rajanen, D. Rajanen, Usability as Speculum Mundi: A Core Concept in Socio-Technical Systems Development. Complex Systems Informatics and Modeling Quarterly (CSIMQ), no 22, pp. 49-59. 2020a. DOI: 10.7250/csimq.2020-22.04

M. Rajanen, D. Rajanen, Usability: A Cybernetics Perspective. In Proc. of the 6th International Workshop on Socio-Technical Perspective in IS development (STPIS'20). 8-9 June 2020. pp. 28-33. 2020b. http://ceur-ws.org/Vol-2789/paper5.pdf

J. Scwartz, D. Rosenberg, Computing the Cost of Copyright: Programmers fight "Look and Feel" lawsuits. Newsweek. 1990.

B. Shneiderman, Designing the User Interface: Strategies for Effective Human-Computer Interaction, 3rd ed., Addison-Wesley, Reading, MA. 1998.

B. Shneiderman, C. Plaisant, M. S. Cohen, S. Jacobs, N. Elmqvist, N. Diakopoulos, Designing the user interface: strategies for effective human-computer interaction. Pearson. 2018.

M. Thüring, S. Mahlke, Usability, aesthetics and emotions in human–technology interaction, International Journal of Psychology, vol. 42, no. 4, pp. 253–264, 2007. Available: https://doi.org/10.1080/00207590701396674

M. Vitruvius Pollio, The ten books on architecture, Translated by M.H. Morgan, Dover Publications, 1960.

J. Whiteside, J. Bennett, K. Holtzblatt, Usability engineering: Our experience and evolution. In Handbook of human-computer interaction, North-Holland. pp. 791-817. 1988.