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Faculty of Information Technology
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Designing for Positive Mobile User Experience: The Case Study of TUT SIS app

Master's Thesis

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Author's Declaration

Herewith I declare that this thesis is based on my own work. All ideas, major views and data from different sources by other authors are used only with a reference to the source. The thesis has not been submitted for any degree or examination in any other university.

	Ksenia Viksne
(*date*)	(*signature*)

Abstract

The main objective of this thesis is to present a viable design solution for a mobile ÕIS application for iOS through a design process aimed at achieving a positive user experience. The mobile ÕIS application is to be adapted from the desktop version of Tallinn University of Technology student information system.

The first section of this work is devoted to establishing the notion of UX, determining its applicability to practical considerations for native application development and determining if there are any best practices to be borrowed from analogous apps.

The central part of the thesis focuses on conception and design process of a high fidelity interactive mobile ÕIS prototype that is firmly grounded in regard for the selected UX factors and guidelines. The resulting design is then evaluated with potential users during a testing session and a follow-up completion of AttrackDiff survey. The results are later examined and a number of possible improvements on design process are proposed. The sufficiency and fit of previously selected guidelines and UX factors is also surveyed.

Even though it is concluded that the resulting design is not flawless, the overall UX is judged to be positive and application adoption rates are projected to be high. Furthermore, a selective preference for the app over the desktop solution is exhibited. It is anticipated that conducted research may be useful for TUT and other universities that seek to mobilize their SISs. The results also imply that designing for positive UX is not necessarily a resource-heavy undertaking and can be a viable ICT objective for a public organization.

The thesis is in English and contains 94 pages of text, 4 chapters, 29 figures and 1 appendix.

Annotatsioon

Magistritöö ülesandeks on esitleda võimalikku ÕISi mobiilrakenduse aplikatsiooni disaini iOS jaoks läbi disainiprotsessi, mille eesmärgiks on luua positiivne kasutajakogemus. ÕISi mobiilrakendus adapteeritakse TTÜ õppeinfosüsteemi desktopi versioonist.

Uurimistöö esimene osa keskendub kasutajakogemuse mõiste rajamisele, uurides selle praktilisi võimalusi erirakenduste arendamisel ja selgitab, milliseid praktikaid võib laenata analoogsetelt aplikatsioonidelt.

Uurimistöö põhiline osa keskendub loomutruu interaktiivse ÕISi prototüübi loomise kontseptsioonile ja disainile, mis on tugevalt juurdunud valitud kasutajakogemuse faktorites ja suunistes. Lõpptulemust hinnati testsessioonil potentsiaalsete kasutajate poolt, kes omakorda täitsid AttrackDiff'is küsimustiku. Hiljem tulemusi uuriti ning pakuti välja mitmeid muudatusettepanekuid disaini parandamiseks. Samuti vaadeldi ka varem valitud suuniste ja kasutajakogemuse faktorite piisavust ja sobivust.

Olgugi et leiti, et lõpptulemus pole laitmatu, hinnati üleüldist kasutajakogemust positiivseks. Samuti prognoositi app'i kiiret omaksvõttu potentsiaalsete kasutajate poolt. Lisaks määrati app'i valikuline eelistus desktopi lahenduse üle. Oodatakse, et tehtud uurimus võib olla kasulik nii TTÜle kui ka teistele ülikoolidele, kes soovivad teha oma ÕISi mobiilseks. Tulemused näitavad samuti, et positiivse kasutajakogemuse loomine ei ole ressursimahukas ettevõtmine ning võib olla avaliku organisatsiooni IT-prioriteetides olulisel kohal.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 94 leheküljel, 4 peatükki, 29 joonist ja 1 lisa.

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Abbreviations

API *Application Programming Interface*

HIG *Human Interface Guidelines (Apple)*

IA *Information Architecture*

ICT *Information and Communications Technology*

OS *Operting System*

SIS *Student Information System*

TUT *Tallinn University of Technology*

UX *User Experience*

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1. Introduction

Handheld mobile devices supporting Internet connectivity and practically enabling ubiquitous computing are now prevalent on the market (Gartner, 2014). The trend also accounts for unprecedented demand for dedicated mobile applications (Evans, 2013) that enable people to attain diverse objectives and are playing a crucial part in the daily routine of people's lives. Multiple studies have shown that users exhibit strong preference for native applications over websites adapted for web and expect them to be more responsive and perceive them as providing a more wholesome user experience (Charland & Leroux, 2011; Yarow, 2012; Compuware, 2013).

It is hardly a coincidence that user experience (UX) has begun to move to the forefront of development process considerations in the past years too. The constraints of mobile platform and novel touch interface – at least, novel in its success (Honan, 2013) – and, hence, the peculiar nature of interactions inherent in these devices have expedited the shift of perspective. The limitations of mobile platform and the highly contextualized use of mobile devices conditioned a more thorough and creative design approach. The importance of paying due regard to both the context and users themselves in the design processes is beginning to be recognized. In the highly competitive present day market of smartphones and native applications UX is becoming the central concern and is actively seen as invaluable competitive advantage in the emerging "experience economy" (as defined by Jetter (2007)).

The aforementioned preference for native applications drives many establishments to develop mobile applications that would adapt contents of their web services and desktop counterparts or somehow compliment them providing additional value to the users. A lot of Estonian organizations (banks first and foremost), including public ones, are putting forth their own respective native applications for Android OS and iOS. With such outward pressure it is becoming increasingly evident that there is hardly a question whether other major establishments will present their respective applications to the market, but rather when they will. As of yet, Tallinn University of Technology (TUT) hasn't publically announced any plans to offer a mobile application in any capacity. In this light it appears utterly perplexing that the university educating the brightest technological minds in Estonia is this overdue.

The survey conducted back in 2011 (Tallinn University of Technology (2011a; 2011b)) uncovered the growing trend of mobile Internet usage and smart phone ownership among students (over a quarter of the respondents owned a smartphone and almost half of them accessed mobile internet on weekly basis). According to the survey, both students and personnel considered the student information system ÕIS to be the most important segment of TUT ICT services. In the light of that the level of satisfaction with it was seen as insufficient. As it happens, some of the information needs it caters to are essentially supportive of daily student routine and accessing that information through a handheld device remains inconvenient to this day. All of these circumstances govern the relevance of the present research and determine its high topicality.

1.1 Research Problem and Objectives

This thesis is envisioned as a starting point of addressing the problem of the absence of adapted mobile access to critical information contained in the student information system (SIS) of TUT, ÕIS, and as a proposition of a viable and satisfying design solution to it. The argument for the topicality of research is furthermore strengthened by the reported insufficient level of satisfaction with usability - and hence the overall user experience - of desktop version of ÕIS (Tallinn University of Technology (2011a; 2011b)). There is also a high probability that endeavors to create such an application may run into the same set of difficulties desktop ÕIS's improvement has encountered, especially considering the relative novelty of designing and developing for touch interfaced mobile platforms.

There are numerous challenges associated with a proper adaptation of a web application for a mobile platform and extensive research on this issue is ongoing, though general recommendations already start to surface. Another issue is the absence of academia and industry (understandably so) interest in student information systems. Therefore characteristic caveats and peculiarities of designing such software remain a grey area and even more so as far as adaptation of SISs for smartphone OSs are concerned.

Direct research objectives

The thesis will strive to present a design of an adaptation of student information system Tallinn University of Technology, ÕIS, as an iOS application that would support positive user experience. The main objective of the research and design process would be to attain a good user experience from the interactive prototype employing modest resources and it can be fragmented into finer set of goals:

- Select UX aspects most appropriate for the context of a given problem to focus on.
- Discover the subset of best practices and guidelines that would enable design of SIS application that would support positive user experience.
- Ascertain positive user experience through user testing of an interactive prototype.

The above can easily be paraphrased to constitute the primary research questions. However, as the context of the study is the industry applicability and is, to a degree unique, a few supplementary questions have been poised to establish the study's real world value for the situation the university in question is in, and certain other universities are likely to be in too.

Additional research questions

The supplementary research questions that ought to be answered as a result of the evaluation of the interactive prototype are articulated as follows:

- Is it possible to design for positive user experience with minimal resources?
- Would users, based on their experience with interactive prototype, be likely to use the application?
- Can an application thusly designed be preferable to a full-scale web application for completion interaction heavy routines? (i.e. can paying a careful attention to interaction procedures result in preference of mobile application?)

The underlying goal behind the supplementary questions is to prove that it does not require an inordinate amount of resources and does not necessarily depend upon monumental practices to

achieve a positive user experience and public institutions shouldn't shy away from including positive UX in their ICT objectives.

1.2 Research Scope and Limitations

In the context of this study the notion of user experience is regarded primarily as applicable to software product. The focus is further narrowed down to what is presently known about UX in relation to mobile applications, namely those developed for smartphones with multi-touch interfaces. The scientific plane is regarded as supportive of real-world applications and such fields of studies as cognitive psychology, neuroscience, sociology and other humanitarian disciplines lay wholly out of scope of this research. The focus will be primarily on attested applicable recommendations, practices and approaches that are viewed as directly enabling positive UX, not on their theoretical underpinnings.

The design is, however, limited to an interactive prototype, imitating gesture responsiveness and real application behavior. Developing a full-fledged production prototype was refrained from due to variety of causes such as absence of API (application programming interface) from developers of web application of ÕIS, the absence of Objective-C skills or access to a specialist willing to contribute to the study as a developer, the cost of developer's license in Apple App Store and temporal limitations. Some non-crucial functionality is also to be constricted to the basic representation and not all edge cases will be designed for in the scope of this research.

1.3 Research Methodology

The work conducted in the scope of this master thesis qualifies as a "design research" and more precisely, encapsulates two facets of the broad term defined by Faste & Faste (2012):

- "Design through research" – hands-off consolidation of new knowledge through studious examination of available information;
- "Research through design" – the prevalent methodology in this master thesis when new artifacts of knowledge are accumulated as a result of design process

At the first stages, roughly equal to "design through research" the domain body of knowledge is being examined to gather insights that would support the successful completion of practical

design study. The “research through design” itself implies empirical application of the subset of recommendations, guidelines, methods and theoretical viewpoints gathered during the first research phase.

The domain of knowledge being regarded closely includes studies of UX notion, peculiarities of smart phones with touch interface, design of native applications for iOS and applicability of UX design considerations to mobile application design. The practical study strives to methodically put all the gathered knowledge to effective use that would result in an interactive prototype of TUT student information system ÕIS. The effectiveness of previous research stages is verified by testing the prototype with actual users.

1.4 Thesis Structure

The master thesis at hand is divided into following sections:

Literature review serves as an introduction of the notion of user experience, its peculiarities in mobile context and skims over views on designing for positive mobile UX.

First chapter examines the multiple and inhomogeneous definitions of user experience (UX). It briefly discusses the existing divide between academic and practical perspectives on UX and provides an overview as to what makes up the practice of designing for positive UX. The chapter also looks at the alignment of different types of methods used for UX evaluation along the 3-dimensional classification.

The second chapter narrows the notion of UX down to its applicability to mobile devices and outlines their most stark peculiarities. It is examined whether placing UX at the forefront of mobile app design entails any special process. The chapter also explores the primary sources for guidelines and recommendations on designing for positive iOS user experience.

A brief inquiry into the state of analogous applications is presented and it is explained why they serve mostly as an example as how not to design such apps.

Research chapter focuses on concrete sequence of actions that shaped the mobile ÕIS interactive prototype and evaluation of the resulting user experience.

Project description is devoted to a detailed examination of evolution of the project concept, its design, justification of the design, toolset and process choices.

Results and analysis section describes the UX evaluation process applied to determine the validity of design choices and the resulting appraisal of the mobile ÕIS prototype. Discussion goes on to retrospectively analyze the results and the preceding design process and suggest points of improvement.

Conclusion chapter summarizes the main objectives of the research and provides condensed answers to the primary research questions.

2. UX and Domain Overview

2.1 User Experience

User experience and design thereof appear to have risen to extreme prominence as buzz terms verging on a new paradigm in the recent years. However, there is an acknowledged a lack of common unified understanding as to concrete definition of the "User Experience" term (Scapin, 2012). If one were only to glance at the collection of 27 definitions of User Experience presented by Roto et al. (2012) gathered from various literary sources and Internet publications one would be overwhelmed by their variety. This discrepancy, given the volatile and subjective nature of the phenomenon itself, which is generally agreed upon by majority of definitions (Roto et al.), appears somewhat understandable.

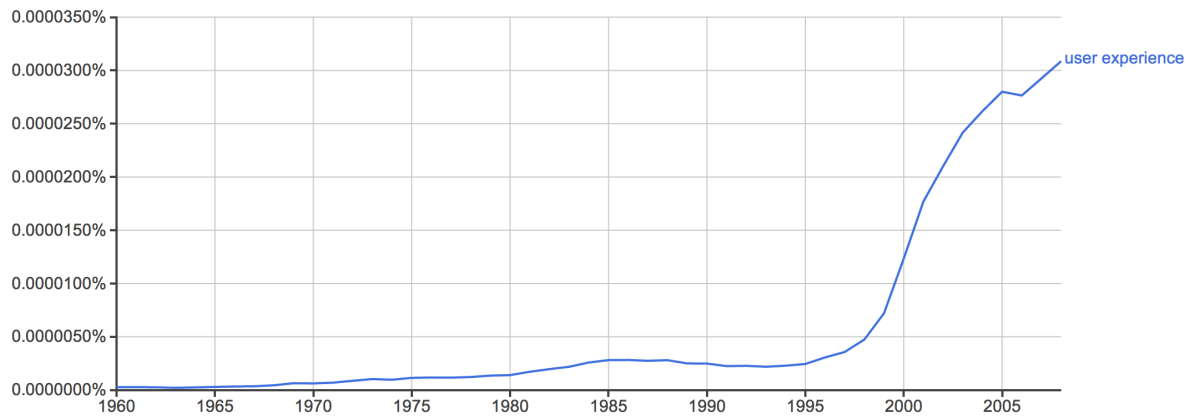

Figure 2-1. An N-gram graph showing a volume of mentions of "user experience" circa year 1960 until 2008 (adapted from Michel et al., 2010).

The term "User Experience" received a wider recognition in mid-1990s after being mentioned in Proceedings of HCI (1995) by Donald Norman (**Figure 2-1**). Ever since then, partly as the aforementioned document didn't include a concrete definition, the notion and understanding thereof evolved on its own accord (as mentioned by Scapin, 2012). Attempts have been made to formalize the field and breach a common understanding (Hassenzahl & Tractinsky, 2006; Roto, Law, Vermeeren and Hoonhout, 2011; Law et al., 2008; Law et al., 2009), yet thus far no absolute definition and scope had been universally agreed upon.

Few definitions, however, deserve a mention as one of the most cited and officious ones and can grant an overview of how the concept is viewed by the industry and academia. Such is the case of ISO standard: ISO 9241-210, which provides requirements and recommendations for human-centered design principles and activities throughout the life cycle of computer-based interactive systems. According to *ISO 9241-210 (2010),* User Experience is "person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service."

Complimenting explanatory notes elaborate on the list of affective characteristics of the user (1) as well as expand on the conventionally accepted temporal dimension (2): "(1) User experience includes all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments that occur (2) before, during and after use." Another section of explanatory notes elaborates, though not conclusively on the list of factors contributing to user experience (1), presents some characteristics of the user from UX standpoint as well as adds another inevitable dimension of complexity to the notion (2), that of the context:

> (1) User experience is a consequence of brand image, presentation, functionality, system performance, interactive behavior and assistive capabilities of the interactive system, the user's internal and physical state resulting from (2) prior experiences, attitudes, skills and personality, and the (3) context of use.

One more authoritative definition is given by UXPA with acronym UE instead of UX:

> Every aspect of the user's interaction with a product, service, or company that makes up the user's perceptions of the whole. User experience design as a discipline is concerned with all the elements that together make up that interface, including layout, visual design, text, brand, sound, and interaction. UE works to coordinate these elements to allow for the best possible interaction by users.

Another prominent definition is authored by Hassenzahl & Tractinsky (2006) and clearly defines the presence of three factors entwined with user experience notion often referenced by academics and industry professionals alike:

> UX is a consequence of a user’s internal state (predispositions, expectations, needs, motivation, mood, etc.), the characteristics of the designed system (e.g. complexity,

purpose, usability, functionality, etc.) and the context (or the environment) within which the interaction occurs (e.g. organisational/social setting, meaningfulness of the activity, voluntariness of use, etc.).

Unfortunately, all three definitions are not without their faults and do not withstand an ultimately critical survey. ISO 9241-210 definition of UX, though considered sound by Jokela (2011), was a degree of semantic divergence in the first clarifying note of the interpretations, where subjective aspects of user experience (emotions, beliefs, perceptions) were aligned with the objective outcomes ("accomplishments") as constituents of experience (intrinsically subjective). As far as UXPA's definition in concerned, despite UX is necessarily being perceived as an inherently holistic concept, Hassenzhal (2008) finds the ambiguity encoded in the collocation "every aspect" renders the definition would allow to interpret it as "everything", which is to vague and is rather unhelpful as far as definitions go. Scapin (2012) finds that for both ISO and UXPA definitions, major criticisms concern theirs impreciseness and the wide gap between practitioners and academics in their understanding. Both UXPA's and Hassenzhal's definitions lack a concrete and easily readable reference to the temporal aspect of the notion.

Consequently, in order to grasp the truly multi-faceted and multidisciplinary notion of user experience, a differentiating approach (such as proposed in The UX White Paper by is Roto et al., 2011) would be helpful.

2.1.1 UX as a Phenomenon vs. UX as Practice

The prominent work in the field of UX (*UX White Paper*) separated handling of UX notion into three perspectives for the sake of clarity and adequacy of approach. Perspective on UX as a phenomenon aims at describing what UX is (and what it, consequently, is not), establish different types of UX and explain the circumstances and consequences of UX. The view on UX as a practice, however, is startlingly different and focuses on applicable aspects of the concept, such as how it constitutes the overall design practice, representation of UX (i.e. through prototypes), evaluation of UX and practicalities of design of specific UX. Hovering between those views is the linking perspective of UX as a field of study. As a field of study UX does appear to be biased towards the academia, though it certainly contributes to the practical viewpoint as well – if not in studying the phenomena itself, then in its potential ability to identify

the means of designing for particular UX and development of assessment and design methodologies.

2.1.1.1 UX as a Phenomenon

As Roto, et al. (2011) have established, the phenomenon of user experience is a subset of "experience as a general concept" pertaining to experiences of using a system, includes passive experiences (observing others interacting with the system), is unique to an individual (this was also a major point of agreement in the study by Law, Roto, Hassenzahl, Vermeeren & Kort, 2009), and is influenced by previous experiences and expectations as well as cultural and social context.

The study (Law et al., 2009) of both industry and academia professionals also shed some light on how UX phenomenon is viewed by informed individuals, where consistent agreement was expressed on the point of UX being subjective, context dependent and dynamic, which compliments the points of phenomenon definition by Roto, et al., 2011 as well as mirrors certain aspects of the definitions cited in section 2.1 User Experience of this master thesis.

As Fredheim (2011) states, there seems to be a general agreement among researchers and industry practitioners alike that UX takes a broader approach to communication between computer and human than traditional HCI field (which is now well established theoretically and is concerned with easily quantifiable variables such as task solution, final goals and achievements). Even though usability is generally accepted as a measurable factor affecting overall UX, the integral aspects (emotional, hedonic, aesthetic, affective and experiential variables) perplexing the academia are much harder to encode and account for (Fredheim, 2011; Roto, Law, Vermeeren & Hoonhout, 2011).

The temporal notion is also addressed by the academic perspective on UX and Roto et al. (2011) notes that in certain situations it is important to distinguish between momentary, episodic and cumulative UX (**Figure 2-2**). As the UX is dynamic the researchers deem it important to be able to distinguish between visceral spur of the moment reactions, reflections on the episodic use, and cumulative experience. Overall the temporal dimension is of high relevance, though it adds further level of complexity to both academic research and practical methodologies.

Through Hassenzahl & Tractinsky (2006) definition of UX we can gain a further valuable insight into circumstances of UX, namely distinguish the three main categories of factors that affect person's user experience: those pertaining to the system, to the user themselves and to the context of use. This view is extremely valuable for practical considerations as it allows for

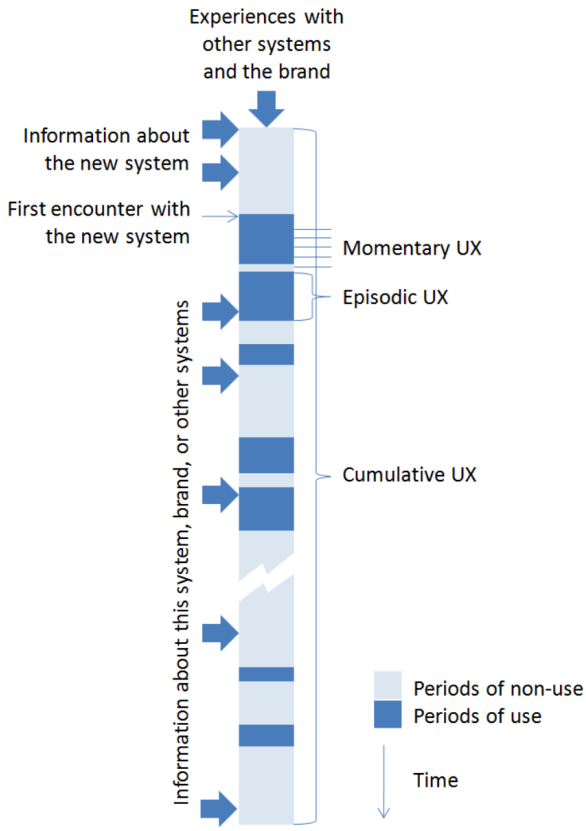

Figure 2-2. UX over periods of use and non-use (Roto et al., 2011).

different methodologies and approaches of assessment and design to be applied to each category of affecting factors. Roto et al. (2011) have elaborated upon such differentiation of properties:

- System: UX is influenced by how the user perceives the properties of the system: the properties that have been designed by its creators (such as functionality, responsiveness, aesthetics etc.), properties that the user has influenced (customized skins, signs of wear and tear, etc.) as well as the image the creating entity has (i.e. the brand is widely considered elitist).

- The User: UX is intrinsically dynamic and dependent on such factors as user's mood, expectations, previous experiences, and immediate mental and physical resources.
- Context: Environmental factors such as social, physical, task and technical/information contexts do contribute to UX and influence the response elicited from the user.

It is duly noted that elements of respective categories describe the situation when a particular UX had taken place and can help identify the factors resulting in a concrete UX.

Hassenzahl & Tractinsky (2006) have also come up with the idea of combining the observed "threads" in the then available relevant literature into a supplementary view of facets of UX. The resulting model didn't gain a penetrating popularity (unlike their definition of UX), but it showcases how existing notions of HCI and usability were built upon and expanded to constitute the domain of UX. Hassenzhal & Tractinsky briefly described the trends thusly:

> "one thread predominantly deals with addressing human needs beyond the instrumental; a second thread stresses affective and emotional aspects of the interaction; and a third thread deals with the nature of experience".

Figure 2-3 illustrates the conceived notion of scope of UX.

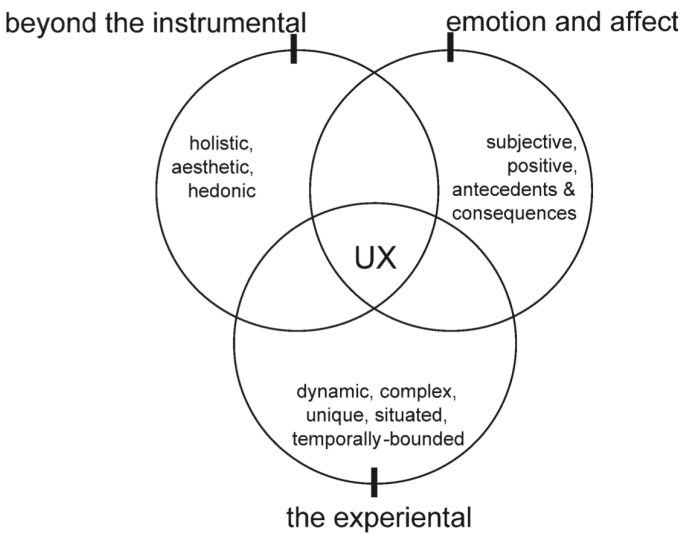

Figure 2-3. Facets of user experience (Hassenzahl & Tractinsky, 2006).

The positive nature of user experience as a phenomenon is often noted as a defining success factor and contra posed to usability aspirations (where traditionally absence of pain and mistakes

is considered a measure of success) hence making the UX perspective advancement in the HCI field (Scapin, 2012; Hassenzahl & Tractinsky, 2006).

2.1.1.2 UX as Practice

One of the leitmotifs practitioners of UX design encounter in many publications is the conviction that user experience cannot be designed directly; it can only be designed for by taking into considerations the relevant factors of usage in the design process (Hassenzhal & Tachinsky, 2006; Roto, et al., 2011; Fredheim, 2011; Law et al. 2009).

The practical perspective on UX evolved from principles of Human Centered Design (Roto, et al., 2011). Those are officially formalized in ISO standard ISO 9241-210. HCD seeks to regard the user as the starting and finite point of the design process and seeks to involve the user in every design stage. User experience design (UXD) elaborates on concepts and methods of mature HCD and adds its own dimension of complexity. The factors that are superimposed relate to affect, interpretation and meaning (including such concerns as aesthetics and cultural context). The practical approach requires a contextual selection of the most crucial factors that affect UX as attempting to design for all of them is utterly impractical.

Practical design considerations will be regarded in chapter 2.1.2 Designing for positive UX in more detail as they are in high correlation with the subject matter of the research.

As was stated above, practical perspective focuses on all aspects of design practice, from conceptualizing to retrospective assessment of the product, all bearing the multifaceted and multidisciplinary nature of UX in mind. However, the practice does not exist in isolation and readily draws upon the academic (research that contributes to understanding of both UX as a phenomenon and as field of study) endeavors and advancements.

Jetter and Gerken (2007) have noted that it is the “experience economy” that oftentimes drives the user’s purchasing decisions, not merely usability and functionality considerations. As positive UX is seen as an edge by the industry, the interest and support for development of UX practices (mostly empirical, i.e. Babylonian (Kuutti, 2010) continues to gain momentum.

2.1.1.3 The Versus Part

Academia is frequently contraposed to industry and the case of UX field is not an exception. Kuutti, as a representative of the academia, has even gently rebuked the industry for the inertial complacency as far as the advancement of conceptual theory is concerned.

According to Kuutti (2010) even researchers are reluctantly agreeing to the Landauer coda[*], which dates back over 20 years and essentially condemns the practicality of endeavors to construct an absolute theoretic baseline for the field of HCI (the statement is applicable to the broader UX notion too). The coda Kuutti cites states the advantage of empirical methods in the field as chaotic, complex and ruled by many unpredictable variables and theory will remain constrained, modest and imprecise. This belief is largely shared by our contemporaries from the industry and can serve as a partial excuse for the lack of interest in the theoretical foundation of the UX; practitioners from the UX field even tend to favor definitions that are more directly applicable an make better sense to them (Byrom, 2012).

While Kuutti (2010) condemned the absence of conceptual research in the face of sufficient empirical supplement, Hassenzhal & Tachinsky, 2006, found that even formal empirical studies in the field were scarce and inconclusive and promoted the UX field as a research agenda.

2.1.2 Designing for positive UX

For the purpose of this master thesis a concrete standpoint will be taken on few debatable aspects of UX will be taken

- User experience cannot be designed directly. However, it is possible to design for user experience (Hassenzhal & Tachinsky, 2006; Roto, et al., 2011; Fredheim, 2011; Law et

[*] For the most part, useful theory is impossible, because the behavior of human-computer system is chaotic or worse, highly complex, dependent on many unpredictable variables, or just too hard to understand. Where it is possible, the use of theory will be constrained and modest, because theories will be imprecise, will cover only limited aspects of behavior, will be applicable only to some parts of some systems, and will not necessarily generalize; as a result, they will yield little advantage over empirical methods. (Landauer T.K. (1991) Let's Get Real: A Position Paper on the Role of Cognitive Psychology in the Design of Humanly Useful and Usable Systems. In Carroll, J.M. (ed.) Designing Interaction. Cambridge University Press, Cambridge, p. 60)

al. 2009). In the view of that using the now seemingly preposterous notion of "user experience design" or "UXD" will be refrained from

- Usability will be considered as a factor contributing to the overall UX, as majority of academia papers and practitioner publications appear to agree with this postulate (Jetter and Gerken, 2007; Hassenzhal & Tachinsky, 2006; ISO 9241-210, 2010, Roto et al., 2011; Gube, 2010; Fredheim, 2011). At the opposing end are a few who suggested that the view of UX as a phenomenon and practice should focus on the purely affective aspects and exclude traditional HCI and usability notions (Kuniavsky, 2003; the academia referred to by Scapin (2012 p. 2)).

Referring back to the first postulate about usability's relationship with UX, there does seem to be an inadequate frequency of misuses of UX term in respect to usability and HCI practices among people not intimately familiar with the subject matter (Scapin, 2012). Such mistakenly and interchangeable use is, obviously, related to the absence of a satisfying and clear definition (Law, Roto, Hassenzahl, Vermeeren & Kort, 2009), the novelty of concept and human factors (such as laziness to do proper research before employing a novel term). Notably, most influential practitioners, however, are familiar with the notion behind UX as a phenomenon and are actively informing the community and propagating UX evolvement towards a paradigm (Gube, 2010; Fredheim, 2011; Byrom, 2012).

I was originally educated in the field of … *(53 Missing)*

Human-Computer Interaction	55
Psychology, Social Sciences	49
Technology, Software	40
Arts, Design	27
Other	51

Figure 2-4. Educational background of respondents (Law et al., 2009).

Designing for UX implies a truly multidisciplinary effort – the selection of respondents in the study by Law, et al. (2009) illustrates the varying reality of educational background of UX "researches and practitioners from academia and industry" quite nicely (**Figure 2-4**).

A more concrete breakdown of narrower disciplines can be gleamed from Boersma T-Model (**Figure 2-5**) often referred to as a baseline for strategies for hiring experts from the relevant fields (Davis, 2011). As the scope of this work was defined to be limited to software products and only extends so far into the tangible realm as ICT-enabled gadgets, more complex models may prove to be excessive and overwhelming.

This T-model, though not being extensive and excluding dedicated research disciplines, indicates some actual activities usually conducted when designing for UX.

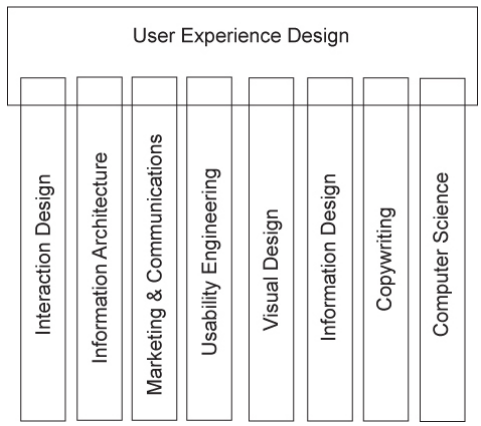

Figure 2-5. Boersma's T-model (Davis, 2011).

In order to provide an overview of the UX practice 3 more models by Hassenzahl (2005, p.32), Garrett (2010) and Revang (2007), establishing UX from different perspectives, will be examined. The models will be discussed in order of diminishing theoretical quality and increasing applicability.

2.1.3 Hassenzahl's View

Hassenzahl (2005) dual view of UX highlights two primary aspects - the great divide between intended product characters and how the characteristics of the product are perceived (and contextual influence upon the perceptions). The model (**Figure 2-6**) and distinguishes between pragmatic attributes (those usually addressed by usability studies) and hedonic attributes (those most directly associated with psychological well-being) and their contribution to users feelings.

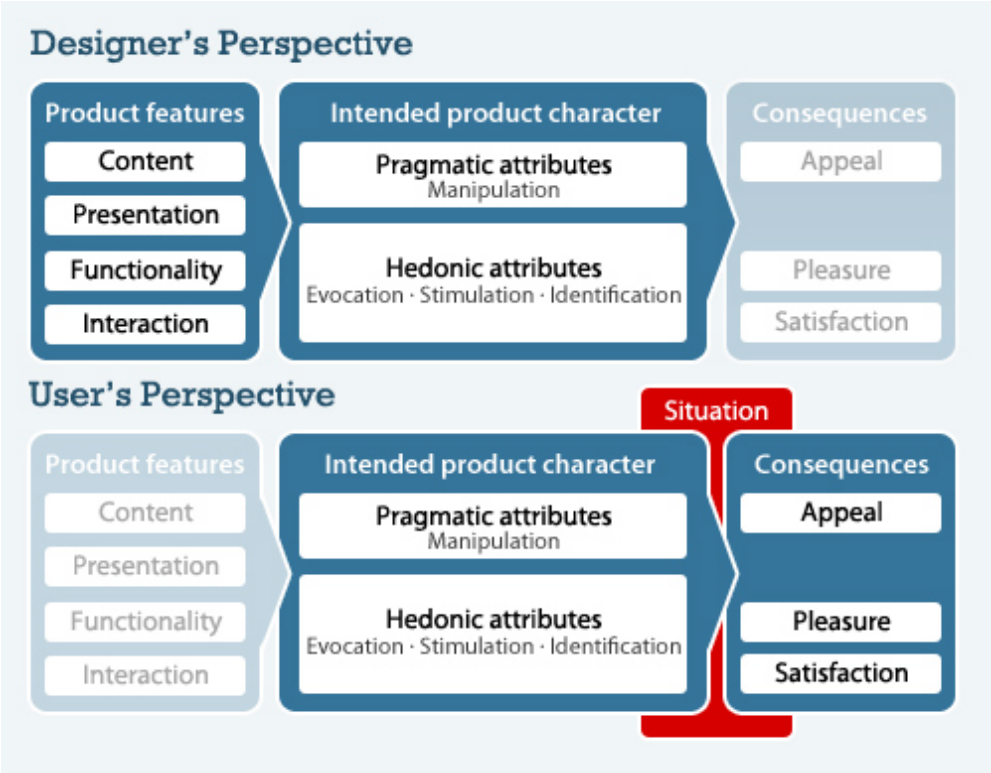

Figure 2-6. Key elements of the model of user experience (Hassenzahl, 2005).

This model strives to elaborate upon conceptual theoretical understanding of UX and to present further stepping stone for its further development. Still, it provides useful insights for the practitioners.

On one hand, Hassenzahl's model illustrates the circumstance of experience itself not being designable, that, even though design may be conducted bearing a so-called "happy path" in mind (extended to the personified user characteristics, the most likely context of use), it cannot possibly account for every possible situation and state of the user (i.e. current mood and motivation). Hence, the consequences, the experience itself, may differ for the same user, even in case of a stable context.

On the other hand, the model puts into perspective the fundamental differences of characteristics that can be encoded into the system, and, having been processed by the user and gone through the influence of context and user's own persona, very differently decoded.

Pragmatic Attributes

Hassenzahl's model treats pragmatic attributes as those relating to instrumental characteristics of the system. Those represent the functionality designed to aid the user achieve "externally given or internally driven behavioral goals". These are the attributes to which the usability metrics can be applied. Pragmatic attributes, should they be perceived as enabling the user to achieve their goals, can have the positive effect on user satisfaction as consequence (Fredheim, 2011). Pragmatic attributes relate to manipulation of the system.

Hedonic Attributes

Hedonic[*] attributes received their name as model's author perceived them as more subsuming the stronger potential to the overall user's pleasure and enjoyment and wanted that to be reflected in the terminology itself. Hedonic qualities are more elusive and vague and self-centric. Hassenzahl (2005) distinguished three primary means of achievement of perception of hedonic attributes – identification, stimulation and evocation. Identification happens when a user feels the system allows them to exude their own identity through it, to project the expression of themselves into the world. Stimulation is attached to those attributes that are not presently used by the user, but their presence is nevertheless appreciated as they provide the room for growth and personal development. Evocation is the ability of the system to invoke a positive collocation by virtue of reminding the user of past enjoyable experiences. As may become obvious from the above definition, hedonic attributes require significantly more effort to be measured.

From the industry perspective, it might be important to remember to leave room for hedonic concerns in design of a system, even though they may appear impractical from the onset. For example, allowing user to customize ones profile in a service where it is not strictly necessary for achievement of any pragmatic goals and thus enabling identification could have a positive effect on the overall user experience. Including the statistically rarely used, but potentially stimulating

[*] Hedonic - "of, relating to, or marked by pleasure" (American Heritage Dictionary of the English Language)

functionality, despite Pareto principle[**], can also result in a greater measure of satisfaction with the system. The model can also help justify a very intentional evocative design.

2.1.3.1 Garrett's Model of Elements of User Experience

The model **(Figure 2-7)** was initially envisioned by Garrett (2010, pp. 20-33) to address the duality of the web space, which was conceived as a "hypertext information space" yet due to advancements in both front and back-end technologies have grown to embody more of a remote software user interface. With the planar visualization Garrett sought to define the key considerations that go into the "development of user experience" on the Web circa 2002. Two problems may be spotted with this statement as far as this research work is concerned – the use of the proposition "of" instead of "for" (development *of* UX instead of development *for* UX) and web-orientedness. The first has to be written off as inadvertent fallacy (the discussion of the of/for matter surfaced significantly later than the first publication of Garrett's model); the second one, however, as we shall see, is not very consequential, as the model is very much applicable to mobile application development.

The Surface plane, the most concrete one, implies the graphic treatment of interface design; it represents the "look" of and look-and-feel of the finished product. The Skeleton plane incorporates such elements as presentation of information to facilitate understanding, optimized basic placement of navigational elements, control elements, texts and illustration. The underlying Structure plane is the overall logic of interactions (application flow) and information structure. Scope plane deals with determining and forth bringing of "feature set" and content elements that would satisfy the user needs, determined in the Strategy scope alongside the internally derived concept of the application.

[**] Pareto principle, also known as the 80-20 rule, states that 80% of the available resources are typically used by 20% of the operations (Pareto, 1927).

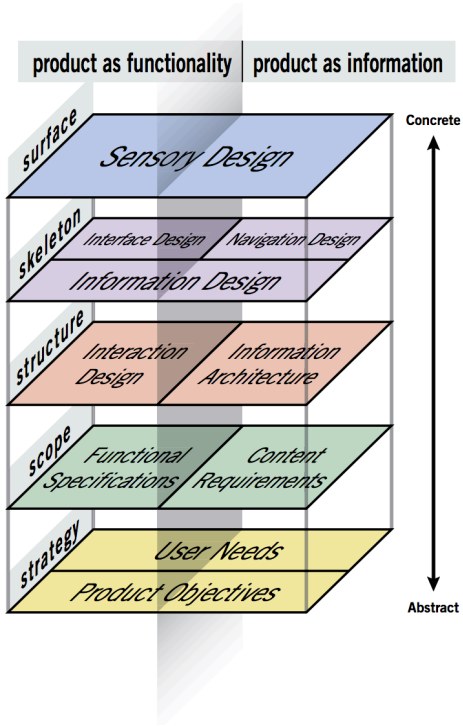

Figure 2-7. The Elements of User Experience (Garrett, 2010).

The model neither presents concrete attributes of UX nor illustrates the design process of developing for UX; it showcases an approximate correlation between UX considerations addressed and project stages and hints at some crucial interdependencies between planes. The choices made at the more abstract planes are defining the possible choices of the more concrete planes and a subsequent change on the lower one causes a ripple effect of required tweaks of the overlying one(s). From the practical perspective, it provides a valuable insight on how to approach a UX project and which design questions a UX practitioner should ask at which development stage.

2.1.3.2 Revang's User Experience Wheel

Magnus Revang's UX wheel (2007) builds upon the famous Morville's UX honeycomb model (Morville, 2004) by expanding the 6 subjective - and not very applicable - facets (the third circle) of a user experience to a whole set of new dimensions (Maier, 2010). Most notably, the wheel (**Figure 2-8**) subjectively lists concrete deliverables linking them to both the facets they are meant to positively affect and development phases they belong to.

The deliverables on the wheel essentially describe the system factors, the context and the user lie outside of the scope of this representation. Despite that, even though user experience is a holistic phenomenon with the whole being greater than the sum of the parts, the positive

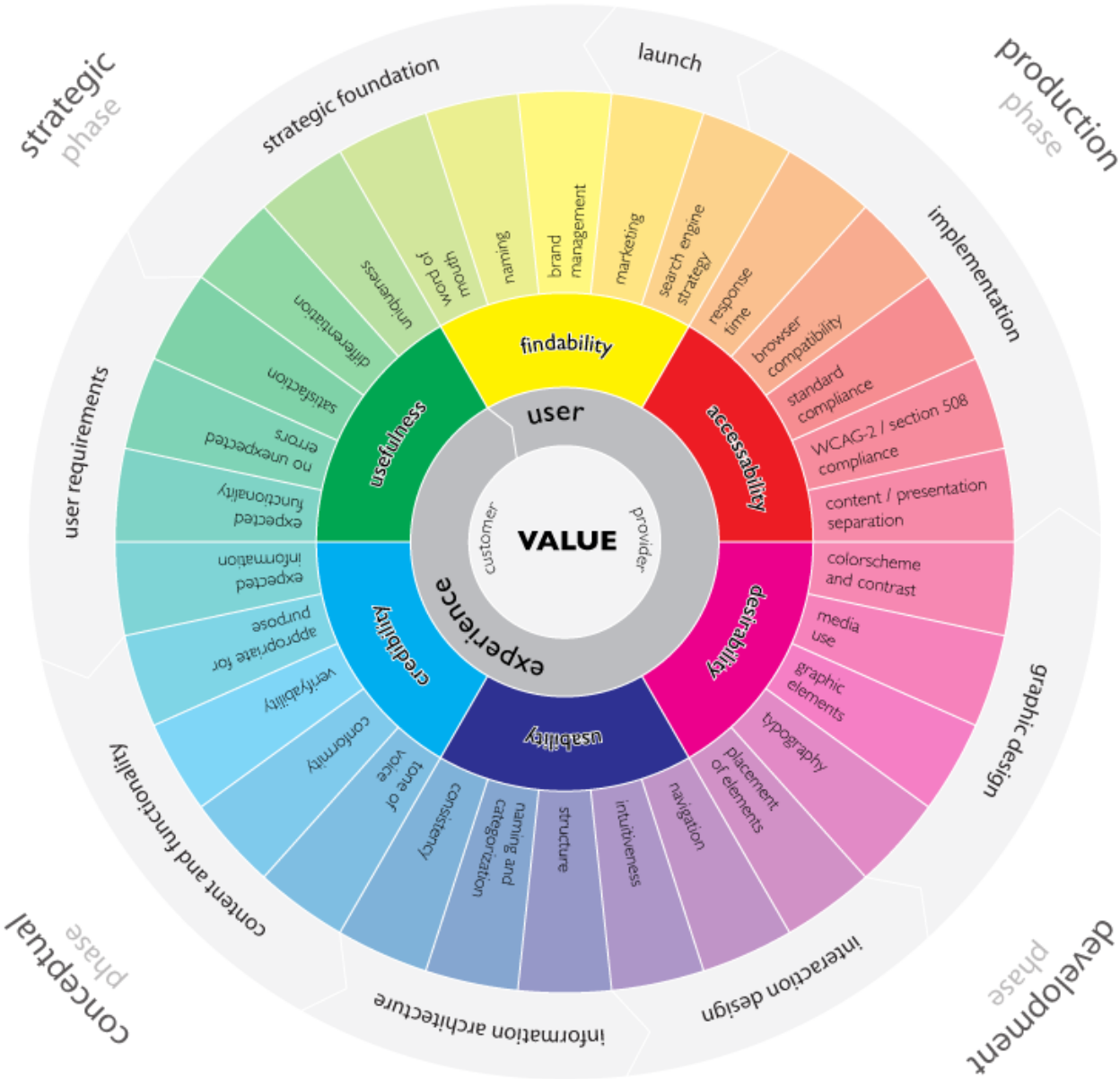

Figure 2-8. The UX Wheel (Revang, 2007).

assessment/attitude towards every listed factor does contribute to the overall positivity of user impression. The positive user experience, as a pinnacle of UX effort aspirations, is considered a win-win center point of value creation for both the customer and the organization.

Maier (2010) found that such a diagram is a valuable tool for practitioners to conceptually place the UX problem of the client software and propose an appropriate design solution. It can also be utilized as great checklist to (selectively) test one's system against.

2.1.3.3 Evaluation and Design Methods

A number of researchers have set out to do a review of evaluation and research methods most applicable or developed specifically for the evaluation of user experience (Roto, Obrist & Väänänen-Vainio-Mattila, 2009; Vermeeren et al., 2010; Rohrer, 2008; Sauro, 2013). Those studies and collections address a rising demand for best practices in the field and strive to provide some understanding of which methods work best in which situations and what kind of insights they're providing.

Vermeeren et al. (2010) effort meticulously classified 96 UX evaluation methods, categorizing each one by a multitude of scales, such as study types (lab studies, field studies, questionnaires etc.), development phase, studies period of experience, evaluator (user formations vs. expert), data (qualitative vs. quantitative), application fields and special requirements (e.g. specialized equipment for eye-tracking or specific knowledge of a trained researcher). The study has determined 74 of the classified methods to be applicable for evaluation of mobile software UX.

Sauro (2013) has regarded both design decision aiding methods and evaluation methods and placed them along the relevant development stages of the product categorizing the methods within each stage by the questions they're addressing. The list is not definitive but it can be appraised at a glance and useful insights can be easily gleaned from this collection.

Rohrer (2008) focused on clusters of methods bearing similar characteristics and placed them along two axis – data approach (qualitative to quantitative) and data source (behavioral to attitudinal) (**Figure 2-9**). Rohrer additionally classified the methods into 4 categories by the context of the product use, which ranges from the natural or near natural use of the product to de-contextualized methods, which are conducted without direct manipulation of the system. He additionally noted the divide between how people react to product and what they actually say and also gave recommendations on the types and clusters of methods that are more suitable to three rough phases of product development (strategizing, optimizing and assessment).

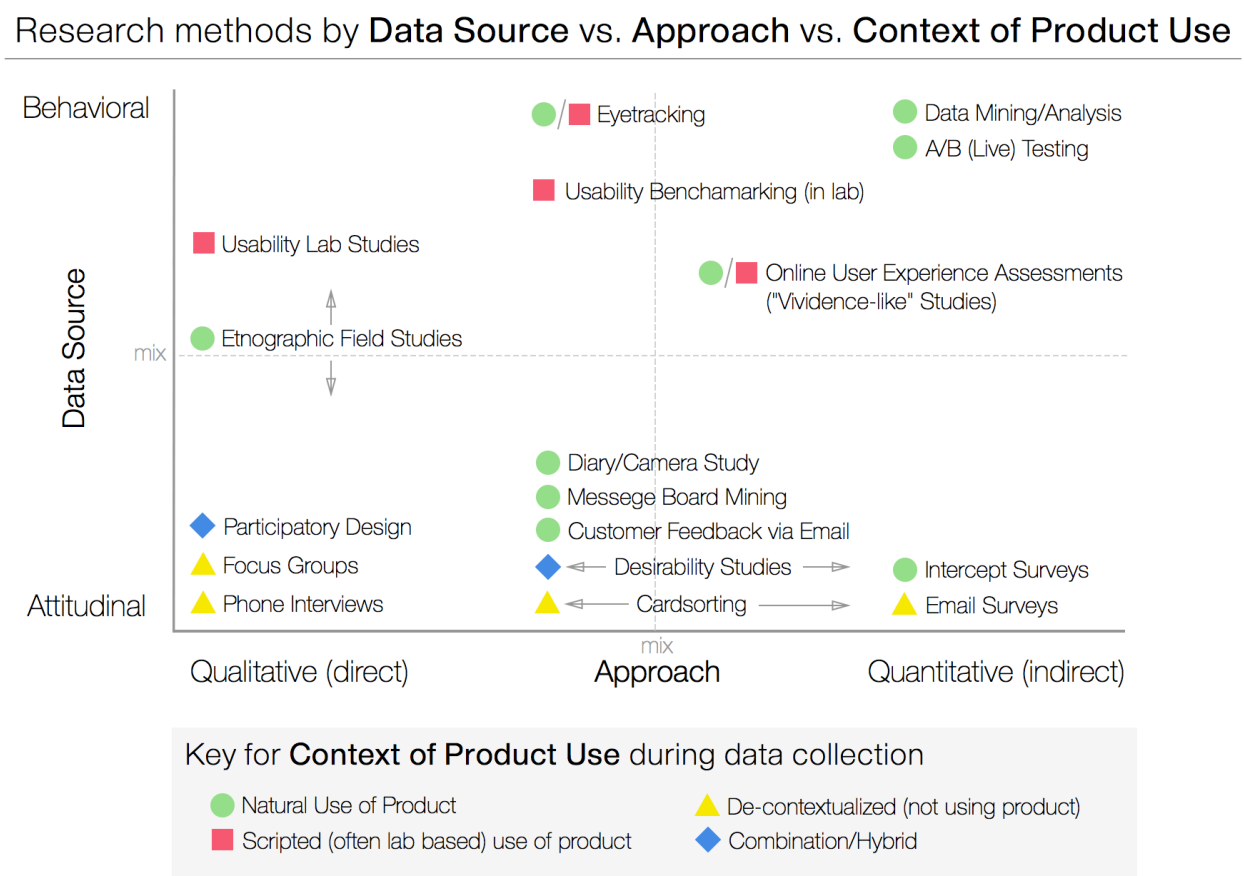

Figure 2-9. When to use which user experience research method (adapted from Vermeeren et al., 2010).

Naturally, the majority of methods reviewed by Vermeeren et al. (2010), Sauro (2013) and Rohrer (2008) overlap, the primary point of discussing three different perspectives (instead of only the most "comprehensive" one) is the diversity of approaches towards UX methods so as to gain varying toolset for selecting the methods most appropriate for the context of this study. Vermereen et al. (2010) concluded that a majority of UX evaluation methods are applicable to mobile software and this implies a high probability that many design methods that result in good UX are probably shared across their applicability too.

2.2 Mobile UX

Mobile user experience (MUX) field constitutes the expanding (roughly proportionally to adoption of mobile devices) subdomain of user experience field of study. However, in essence, the phenomenon of MUX is not drastically different from the broader notion of UX – should a generalized concept of "a system" or "a product" in any of the UX definitions be replaced with a "mobile presence", that definition would virtually transform into definition of mobile user experience (Cerejo, 2012).

User experience with a "mobile presence" can, conversely, be distinguished from "desktop" (for the sake of argument, "desktop" here refers to a portable computers also) user experience by some defining characteristics of mobile devices and mobile usage. Briefly, such characteristics can be enumerated as:

- a smaller screen size;
- alternative and varied input methods;
- high relevance of the context (mobility of the user);
- additional capabilities (one cannot call directly from one's PC, neither can they locate themselves precisely);
- personal nature of the device (in case of mobile phones, tablets are often shared in the family according to Budiu & Nielsen, 2011), always on and always at hand;
- unique usage patterns (interruptibility).

Characteristics above were amalgamated from numerous sources that were gone through in the process of the research - articles, books and papers (most prominent sources being Grigsby, 2011; Cerejo, 2012; Ginsburg, 2010; Wood, 2001).

These distinctions along with the very nature of mobile devices dictate certain usage patterns that were remarked upon various researchers and studies.

Clark (2010) split the usage mindsets into three large subgroups of boredom, microtasking and staying context-aware. According to Clark (2010) bored mindset is most likely to see the user turning to mobile device for distraction, be that a game or a diverting read; microtasking refers to

many productivity-related endeavors, like writing down a note or looking up bus schedule; context-awareness is linked to locality of the user and is related to locating and making sense of the surroundings. Kaasinen (as cited by Roto, 2006) linked the mobile context of being on the move to a very similar usage division – he categorized it into services that provide utility, communication or fun. The classification is strikingly similar to Clark's (2010) with a small modification of utility embodying both microtasking and context-awareness and communication separating from micro-tasking to form an indepenent entity. Wood (2011) identified five use cases, also very similar to the already mentioned ones: communication, entertainment, location-based services, commerce, utility. The nature of division is fairly similar and supports the claim for characteristic interruptibility of mobile user experience and high relevance of the context. Roto (2006) also notes that it is very characteristic of a mobile device user to go on short bursts of activity - finding very specific information, and not engage in a prolonged information gathering.

These findings are extremely relevant for the present study because they provide general characterization of a mobile device user and showcase that there is a very definite niche for what mobile ÕIS is surmised to accomplish.

2.2.1 Factors influencing the quality of experience

Researchers struggle to come up with a definitive list of factors that bear influence on the overall quality of mobile user experience. Roto (2006) conducted a thorough study where he incorporated into his own research multiple works that tried to conclusively identify factors affecting UX in general and MUX in particular. That proved inconclusive. However, in the name of applicability, certain factors can be highlighted as most inherently relevant to MUX.

Context-related factors

Contextually conditioned factors are the cornerstones of peculiarity of mobile user experience (Cerejo, 2011). One could make a fair amount of stable assumptions about desktop usage context, while mobile devices are used throughout much more varying conditions. People are very often on the move: walking, standing temporarily in a queue, sitting in a moving vehicle. Those were all considerations of physical context, according to Roto's (2006) summation of views on MUX factors. Social and temporal contexts factors are another two groups of factors contributing very majorly to the nature of user experience – these factors would most often come into play as the

interaction with a mobile device is happening. Most often interactions do not happen in isolation – multiple types of contexts are affecting it, prone to suddenly demand user's attention. Therefore their concentration is limited, as the context is continually evolving and may demand their attention at any time. This evokes the attention starved nature of human interaction with mobile devices according to Nakhimovsky, Eckles & Riegelsberger (2009).

Terminal and connection related factors

In other words, the device the interaction is happening with, the operating system (OS) installed on it, and whether it is connected to the Internet and if so, the characteristics of the connection.

The device itself naturally plays a very prominent role in the interaction – an independent layer of UX factors applies to it. The input methods (physical keyboard, OS provided keyboard, voice commands etc.) and additional capabilities like compass, camera, Bluetooth and many other integrated solutions. Most often the make of the mobile device will also dictate the OS it has and this, according to Pfeiffer Consulting (2013) also has a significant effect on how user experiences a given application as it will dictate many aspects of its design and operation.

Connectivity is also a major issue (Cerejo, 2011). One of the initial causes of mobile devices success is human drive to stay connected (Roto, 2006). People do prefer for applications to cache as much information as sensible in case they later do not have a connection or connection speed deteriorates. It is not a rare occurrence, considering the mobile nature of the context. This puts additional strain on application developers and echoes the device factor – the memory capacity facet of it.

The application-related factors

The application can be fairly regarded as a product in itself and all the factors that according to Reavng (2007) are applicable to software and web-services are valid here. However, the nature and the intent of the application governs,the extent of their influence on the UX. Garrett's view (2010) on elements of user experience is also vastly applicable here. Moreover, it can be turned to for guidance of the design process concept.

None of the factors live in isolation – it is fair to say that they are cross-influencing each other, contributing to the overall user experience (Roto, 2006). For example, if the screen of the device is

cracked, the UX of watching a video on such a device won't be quite equal to UX with a device with a undamaged screen.

There are, of course, other classifications and breaking-downs, but in majority of cases they are handling the same components, only being differently fractioned. For instance, an article by Ma (2012), manifests the description of three layers of mobile user experience and denotes them as (1) mobile device hardware, (2) mobile device operating system, (3) mobile applications and mobile websites.

Mobile devices and mobile usage characteristics define the inherent distinctive MUX factors and conditions shaping the many mobile-specific guidelines and recommendations.

2.2.2 Designing for Mobile UX

The landscape of handheld devices is prone to quick changes, and even if some monumental design truths remain, the minute and often defining details can be overhauled in a fortnight (like it happened at the time of iOS 7 announcement). Moreover, the essence of the changes introduced is often a closely guarded secret prior to the advent of announcement, and a period between the unveiling and actual release is customarily short. Neither academia research and publishing process' nor commercial book publishing wheels are turning quickly enough to stay in pace with such abrupt switches. Therefore one is often faced with the fact that the most useful practical design guidance sources are official guidelines and self-published web articles by experienced practitioners.

Designing for mobile UX can generally imply three options – designing for mobile web, native app design or hybrid app design (which uses some native elements, but the bulk of it is not written in the native platform language and uses web technologies). In this study the focus will be on the wholesomely native application design. The reason for this is the large exhibited user preference, reported by Compuware (2013) with a vast majority of users (85%) preferring apps to mobile websites and this majority being of general opinion that applications are more convenient, faster and easier to browse.

The first step any aspiring designer is advised to take is to get familiar with the platform, to use it religiously and extensively for at least two weeks to step into the regular user's shoes. (Sbardella,

2013). This ideally is happening simultaneously with a careful study of respective OS's guidelines and revelations the carefully constructed user experience of the OS (Sbardella, 2013; Wood, 2011). The often referred to principle of handling a redesign of an existing desktop application is to "go back o the drawing board", as it is recognized that mobile design requieres rethinking and mobilization, not "shrinking" and porting. (Cerejo, 2012; Sbardella, 2012; Apple Inc., 2014).

The recurring theme across many publications on positive UX design is to follow, imitate and improve upon best practices and employ UX patterns rather than reinventing the wheel as most of the problems have been effectively addressed already (Ginsburg, 2010; Cerejo, 2012; Sbardella, 2013). In a nutshell, the vast majority of guidelines concentrate on exactly the considerations described as unique to mobile context – ultimate diversity of contexts, limited time-frame of the interaction (therefore the content the user is most likely looking for is advised to be pushed to where they will be most likely to see it), urgency of interaction or immersiveness of the experience. That is also partially the reason of UX being so important to mobile development industry – many commercial apps are very competitive and whoever manages to hold user's attention better, usually wins (Wood, 2011) Alas, going through the guidelines alone is not sufficient for acquaintance with the processes that are concentrating on delivering the delightful user experience. As shown by literature, mobile design guidelines are fairly integrateable into well-established processes supportive of good user experience (Ginsburg, 2010).

The real-world processes directed at achievement of positive UX are most often constructs and not direct applications of frameworks as the survey by Treder (2012) states. It is generally found that user centered design activities support design for positive UX (Ginsburg, 2010; Treder 2012). They normally include preliminary user research, its analysis and summarization (often in the form of user segmentation manifesting itself in personas), conceptualizing, benchmarking, prototyping, evaluating prototypes in interactions, refining the design, and various marketing activities and branding regards. Even small development teams are constructing their processes from these building blocks (Treder 2012; Wood, 2011).

This thesis closely follows a case of design endeavor committed to achievement of positive user experience and general patterns described in this chapter are further explored in section 3 of this study. The primary sources of guidance for this research have been discovered in:

- iOS Human Interface Guidelines (Apple Inc., 2014).
- iOS 7 UI Transition Guide (Apple Inc., 2013).
- Designing the iPhone User Experience (Ginsburg, 2010).
- iOS Wow Factor (Wood, 2011).
- The Elements Of The Mobile User Experience (Article by Cerejo, 2012).

As the case study is tied to iOS as the platform designed for, the literature has been selected accordingly. Justification of the platform choice is presented in section 3.1.4.

2.3 Review of Analogous Apps

Comprehensive review of applications that would fill the niche of mobile ÕIS for other universities is complicated by at least two circumstances: low discoverability and login requirement. Hence the review is limited to applications discovered by a twofold approach:

- Consulting worldwide university ratings to determine the top 10 leading universities and scour the App Store for their respective applications
- Scanning application stores for anything issued by Estonian universities

The first approach yielded some results, although none of the discovered applications resemble what student information systems do. The majority of applications issued by the leading universities represent informative mobile versions of university websites. The ones that do provide access to some personalized studying information are inaccessible without logging in. Another observation was that many applications weren't fully native and would often redirect users to webpages that, in come cases, weren't even adapted to mobile browsing.

One of the applications that deserve an honorary mention is the Harvard Mobile app (Harvard University, 2014). It doesn't require a log in and makes information highly accessible and its usability was perceived as good. Notably, it provides extensive searches through People directory, which allows users to find employees; and Courses directory, allowing one to traverse the faculties and programs to read detailed information about courses. As **Figure 2-10** illustrates, it doesn't look exciting, uses a dashboard for navigation, and has some sections leading to website

as links, but majority of the elements are native, albeit outdated, and work well within the application.

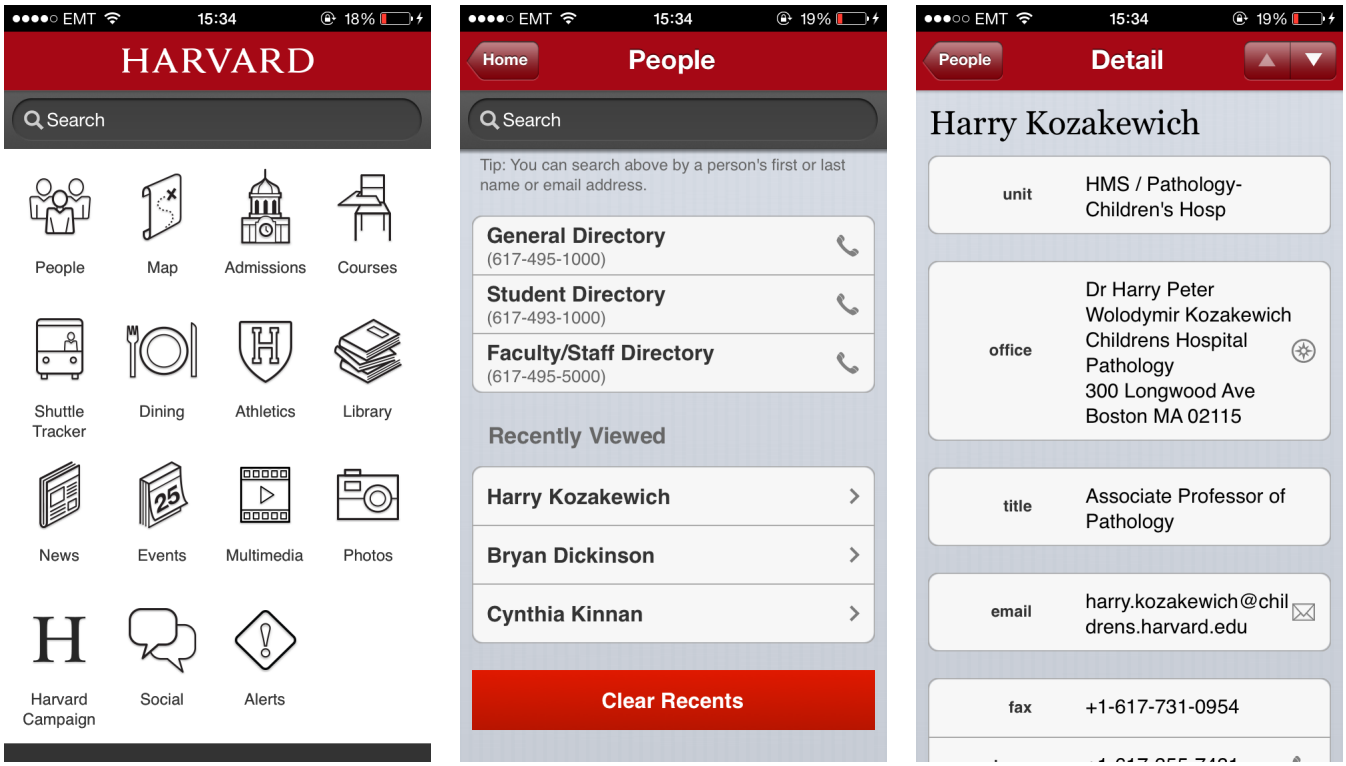

Figure 2-10. Screenshots of Harvard Mobile application (Harvard University, 2014).

The second approach yielded a great example of how an Estonian university tackled the problem – Tartu University has an application out for Android that is connected to their SIS (which is different from Tallinn University and TUT SIS). Out of over a dozen applications that were reviewed, Tartu University SIS app looks the closest to the present case study (Tartu Ülikool, 2013). Some of the screenshots availiavle on Google Play can be seen on **Figure 2-11**. However, its functionality is essentially limited to showcasing personal schedule, information on courses, average grade and enabling some note taking. It doesn't really provide any truly interactive actions that would be changing any information outside of the application. Also, a login is required upon launch in order to see any information, which may even be excused by the absence of typical group schedules.

The problem with majority of reviewed applications is the glaring disregard for Apple HIGs, injections of un-adapted desktop website pages into the app, neglecting delayed login recommendation, lack of consistency and just general and very evident absence of sufficient

preliminary analysis and general lack of thought. This is most likely conditioned by the non-competitive nature of these applications – they do not have any alternatives, which unfortunately appears to doom them. The lack of competition affects the resulting design of university applications very negatively and their user experience leaves much to be desired.

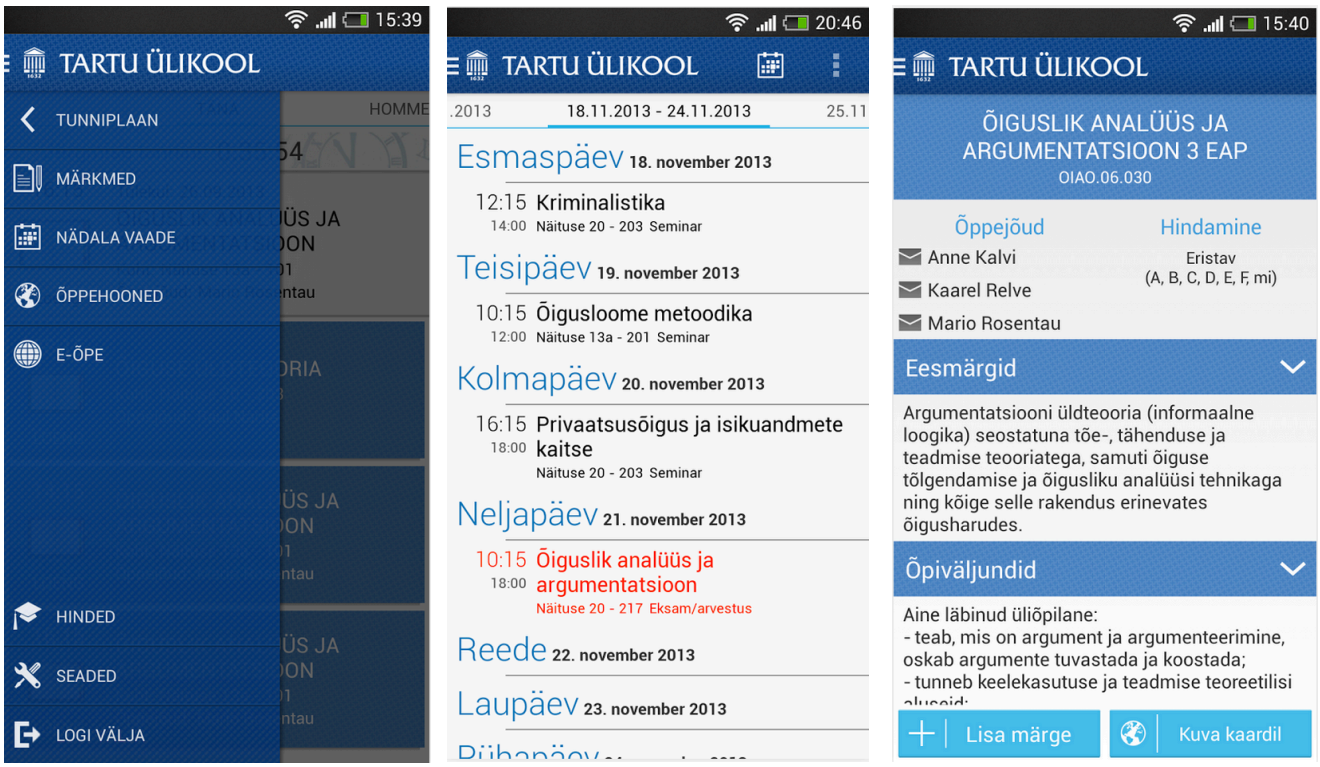

Figure 2-11. Screenshots of Tartu University ÕIS from Google Play Market (Tartu Ülikool, 2013).

In the light of the above it was concluded that analogous applications cannot provide a enough of retrospective insights on developing for positive UX and inspiration and best practices should be looked for in relevant design choices of commercial applications.

3. The Case Study

3.1 Project Description

This section is devoted to detailed account of mobile ÕIS application design. It should be duly noted that design activities are conducted in the scope defined in the introduction of this study and will not include program code composition or any programming development. The effort is focused on actions typically associated with designing for positive user experience.

3.1.1 Pre-conception and Envisioning

The first grain of an idea of potential usefulness of a not-yet-conceived application was somewhat tied to the advent of a new generation of mobile devices. Diamond (1998) has voiced a conviction that technology is necessity's mother and this was the case with the emergent technology and the world not yet adapted to it. The concept sprung to mind when severe difficulties were experienced accessing web version of schedule section of ÕIS from a browser on a 2nd generation of iPod Touch (approximately late March 2009). As it was, the trend of ubiquitous and affordable 3G connection plans, App Store's spread beyond US and Canada, migration of web applications unto native mobile platforms (both Swedbank and SEB haven't issued their respective apps until spring 2011 (Erala, 2011)) was only emerging so the musings were somewhat premature. However, as adoption rates of iOS devices grew (**Figure 3-1**), localized App Stores have become a reality (Roonemaa (2009)), the market experienced an influx of alternative Android platform, the trend for major businesses and institutions settled to develop representative native applications, the TUT or ÕIS app niche remained empty. During all those years ÕIS hasn't even been adapted to mobile platform by a notch, whereas TUT website was thoroughly reorganized and redesigned in the recent years and now is adapted for use on a mobile device.

In the following 4 years (2009-2013) as even usability of checking the schedule – the most basic and recurrent student need - didn't improve, the lack of an adapted mobile web page or, preferably, an app was a persisting notion. Perceived practicability of such notion was reinforced by rapid development of the mobile app trade (the number of app available on App Store grew from 25000 to 800000 in the cited time period (Wikipedia, 2014b)) and active

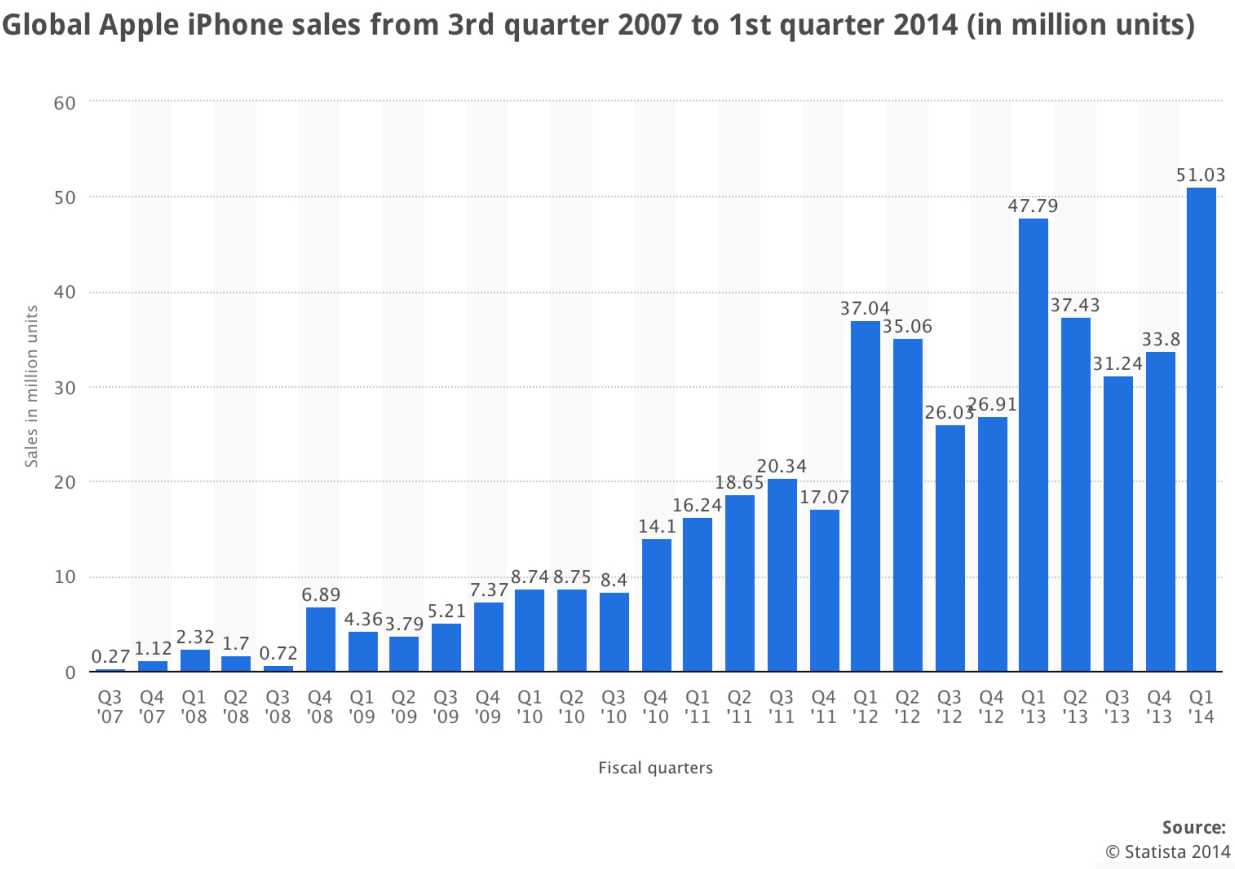

Figure 3-1. iPhone Sales per Fiscal Quarter (Statista Inc., 2014).

participation of local developers and organizations in it (about 18% of the current top applications in the free category Estonian App Store are of local origin). The concept of transferring some of ÕIS functionality into the context of a mobile application finally got a play test in the spring semester 2013.

It is fair to state that to a certain extent a fraction of preliminary work has been conducted during the Spring Semester 2013 in the scope of Interaction Design Methods Course (IFI7156 course at Tallinn University). As course project bore ultimate similarities with the case study (group blog located at http://synergyimke.wordpress.com, course project concept description in a post from 29.01.2013) design experience and even some design artifacts produced therein have been taken into consideration in the present study. The IFI7156 group and course mates, as well as lecturer Hans Põldoja himself provided very favorable feedback on the account of topicality of the concept (the comments to course project group blog post from 29.01.2013), which constituted a strong support for the pleaded cause. Such carefully crafted artifacts as personas, use cases and user

stories proved to be somewhat excessive and are not to be iterated upon in this study. Conclusions drawn from analysis of wire-framing test session were partially considered at the high-fidelity design stage. Concept map created during the course was also borrowed from, especially for the purpose of establishing a unified vocabulary for the Mobile ÕIS app.

3.1.2 User Research

The primary user-centric method of ascertaining requirements for the potential Mobile ÕIS application was an online questionnaire conducted in the period of 27.02.2014 – 10.03.2014. The questionnaire was run in multiple languages and results have been amalgamated into one final selection. Between all languages a total number of 165 responses has been garnered.

The survey platform – Survey Planet - was carefully chosen from among its competitors (Survey Monkey, Survey Gizmo, Survey Crest etc.) as one perceived to provide the best user experience for both surveyed and the surveyor. The subjective assessment was then further reinforced by voluntary feedback by a number of respondents, who ventured to report a notably pleasant user experience they've had while answering the questionnaire.

In order to secure a decent response rate and decreased dropout rate (Deutskens, De Ruyter, Wetzels & Oosterveld, 2004; Galešic*)* the questions were kept to a minimum (6 questions in total) and were designed so as to avoid text entry requirement as much as possible. The majority were multiple-choice questions restricted to one possible answer and focused mainly on demographic data, one among them was a dichotomous question (Yes/No kind of question), and only one question in the whole survey was an open-ended question and allowed a respondent to type in the answer. The most important question of the survey was a scoring question, prompting respondents to assign an importance value to different potential features of a Mobile ÕIS application.

The full list of questions and questionnaire results are provided in **Appendix 1**.

The survey was designed so as to elicit only the most relevant and essential information and some basic demographical data (such as gender, duration of involvement in TTU studies, faculty) – and it has been found that realistically there would be two to three mobile platforms to consider. Smartphones running on Android have the absolute lead with 66% of respondents owning such a device, followed by iOS devices, with 22% share of ownership, and now somewhat insignificant

share of 5% belonging to smartphones operated by Windows Phone OS (this figure is likely to increase in the foreseeable future according to International Data Corporation (2014) – illustrated by data in **Figure 3-2**) [*].

Operating System	2014 Shipment Volumes*	2014 Market Share	2018 Shipment Volumes*	2018 Market Share	2014-2018 CAGR
Android	950.5	78.9%	1,321.1	76.0%	10.7%
iOS	179.9	14.9%	249.6	14.4%	10.2%
Windows Phone	47.0	3.9%	121.8	7.0%	29.5%
BlackBerry	11.9	1.0%	5.3	0.3%	-22.6%
Others	15.1	1.3%	40.7	2.3%	32.7%
Total	**1,204.4**	**100.0%**	**1,738.5**	**100.0%**	**11.5%**

Figure 3-2. Worldwide Smartphone Forecast by OS, Shipments, and Market Share, 2014-2018 (Units in Millions) (International Data Corporation, 2014).

The most fundamental question presented to the public in the survey was aimed at establishing the potential adoption of the conceived application, which, according to respondents' feedback, would be quite substantial, even if we factor out response bias (Hawthorne effect, Adair (1984)) and effect of salience on probability of response (Galešic). According to the survey, 95% of respondents would download the Mobile ÕIS app to determine if they can adopt it as a permanent supplement to desktop ÕIS. This figure alone should pose as a consequential basis for further serious research into essentiality and feasibility of actual development of the envisioned application.

[*] The exhibited platform preference, though being much in tune with generalized European trend (according to Swamy's (2014) citation of Kantar Worldpanel findings), may be somewhat misleading due to the voluntary nature of the survey – the majority of respondents (across all survey languages) reported to belong to Faculty of Information Technology. This may imply a certain platform bias as, if we were to examine data obtained from Tallinn School of Economics and Business Administration (*Majandusteaduskond*), we would unveil a drastically different results – only 50% reported to own an Android powered device, whole 39% - iOS and startling 11% admitted to using a Windows Phone OS (9-7-3). It is most probable that those numbers would exhibit a moderate trending towards the figures of the survey average platform preferences with larger selection, but strong argument exists in favor of retention of much lower Android preference and a higher iOS share. (The argument being that the innate technological savvy of ICT students puts them at odds with certain restrictive policies of Apple's and urges to embrace the openness of Android platform. Further case can be made for expected abundance of iOS devices among TSoEaBA students, as there is a severely limited number of tuition-waiver scholarships available throughout the faculty, which implies that the majority of students belonging to the faculty have to be able to afford the tuition – and at the highest rate in the university. This, in turn, accounts for plausibility of high adoption rate of devices whose price averages at 600 USD worldwide (versus Android's 200 USD (prices cited according to International Data Corporation (2014))).

The last and the most demanding question of the survey aimed to clarify the actual information needs users of handheld devices would like to have satisfied by a envisioned Mobile ÕIS application. Synthesizing options to be scored involved a painstaking methodic analysis of information and functionality current desktop version of ÕIS offers, its subsequent narrowing down to informational and functional needs suitable for catering to on a mobile device (the characteristic attributes of handheld medium as opposed to conventional PC were discussed in detail in Chapter 2.2) and certain fanciful speculation as to what could be convenient, though albeit is not readily available in the useful form neither in desktop ÕIS nor on TTU's official website. Moreover, the findings of previous pilot Lightweight ÕIS prototyping experience were taken into account and interwoven with the results of the current scrutiny. The ensuing options and averaged scores of general public's interest in them are presented in **Figure 3-3**.

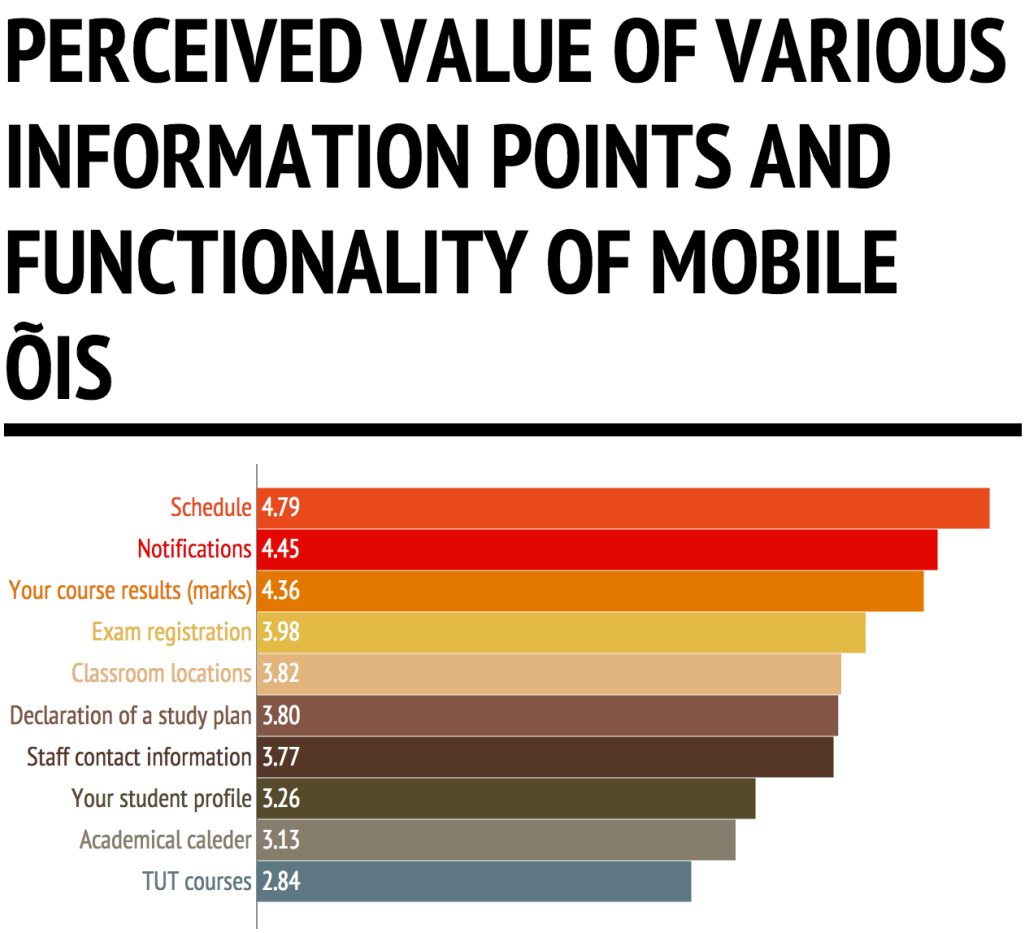

Figure 3-3. The relative perceived importance of availability of features in mobile ÕIS.

Schedule, somewhat predictably, came out as the most in-demand feature of a potential ÕIS application, while probable usefulness of Notifications feature (the survey indicated that inclusion of those would imply alerting users about academic deadlines and upcoming exams that user signed up for) also found a wide appreciation among the surveyed, which was not anticipated. Respondents have expressed a sizeable interest in being able to review their grades, however discarding the potential usefulness of a user profile (which is understandable given the fact that informational benefits, which students' profile can consolidate, weren't clearly indicated in the survey). The contrast in expressed interest is noteworthy precisely due to the fact that upon consideration, the most apparent structure of information would entail that data about one's grades is incorporated into their profile view.

One more attention-worthy observation can be made from consideration of obtained responses: interaction heavy and relatively complex activities, such as exam registration and declaration of a study plan, are placed quite high on the list of desirable features, which can indicate a thorough dissatisfaction with currently available means of completing these tasks. Even though it is imprudent to suppose a penetrating level of conscious awareness of inherent limitations of mobile platforms in respondents, it is still astounding that people voice their willingness to rely upon a yet non-existent mobile solution in order to escape the deficient user experience of a full-blown one.

It was initially supposed that students are more dependent on virtues of information presented in academic calendar, but the survey results have proved otherwise – general consensus is such that if the most important dates and deadlines are incorporated into notifications' schedule, students have little to no need of explicit academic calendar section.

Lastly, quite understandably, a moderately high interest was expressed in Mobile ÕIS being able to indicate room locations graphically. Notably, a correlation has been spotted between desirability of the feature and student status – freshmen and sophomores were more eager to have such guidance in TTU halls and buildings than those with over three years of experience of studying at TTU.

The conducted survey was the primary method of preliminary user research; it was required to attest the preconceptions and assumptions formed during the envisioning stage as well as reaffirm

some feedback received during the IFI7156 Interaction Design course project. As the team of IFI7156 was comprised of four potential users and the design of a conceptually very similar application has been discussed with at least 10 more potential users in the course of the IFI7156 project, it can be stated that an unstructured indirect user research has been accomplished as a side effect. It can be concluded that Subject Matter Expert interviewing was also a part of user research.

3.1.3 Determining the Feature Set of the Application

The student survey was originally envisioned as a principal supplement to establishing a coherent set of features to be used in the case study. True enough, certain preconceptions existed as to which features ought to be implemented in the design prototype of the first version of Mobile ÕIS and which would be more properly placed in the backlog as the most suitable for future development or omitted altogether. Upon retrieval of the survey results some of the preconceived notions, regrettably, crumbled, while others, fortunately, were further verified.

The first and most resolutely confirmed feature was the schedule – it is a perfect fit for the widely acclaimed urgency characteristic of information we seek through handheld devices (Cerejo, 2012; Cui & Roto, 2008), and its value was decidedly recognized among the survey participants. Moreover, the germ of the Mobile ÕIS concept was brought forth due to the deficient usability and overall user experience of accessing university schedules though a mobile device.

The notifications feature was contrived independently during brainstorming sessions for Interaction Design course back in the Spring 2013, prior to any conscious analysis of desktop ÕIS's configuration. It was admitted that keeping track of many important deadlines and events has been continuously posing a conundrum and scattering of the information and unreliability of "keeping the knowledge in one's head" (Norman, 2002) lead to multiplication of inconveniences (exceptional tarry declaration of a study plan, having to reschedule exams, unreasonably distributed study loads). As results of the study have showcased, respondents too have positive projections as to how useful a notification scheme would be, steadfastly assigning very scores to its importance. Taking into account a relative "low cost" of such a feature, it was obvious it had to be included in the design prototype. The recommendation by Cerejo (2012) to include relevant mobile-only functionality compliments the decision.

The poll results have also obviated the need for individual's grades to be readily available, although on some consideration, it became obvious that the most logical placement for this information would be its listing under a student profile, so the interest in overview of ones results "saved" the generally unflavored section from obscurity. Moreover, the student profile might contribute to hedonic factors of user experience (as those were perceived by Hassenzahl (2005)) through supported identification. Hence, it has been concluded that student's profile, alongside student grades section, is also to be included in the design prototype.

The two challenging features of exam registration and declaration of study plan have been grudgingly confirmed into the final selection, as both have received express interest. Admittedly, the functionality they were to offer was to become the cornerstones of the design prototype, especially in the case of the latter, as they are heavy in interactions and require to be handled very intelligently and cautiously in order to work for the mobile platform. Another argument against the inclusion of the study plan declaration functionality would be the general recommendation as to which features should be included in mobile versions of applications – the more frequent the use, the more suitable for mobile version the feature is (Benatar, 2013; Wood, 2012 (pp.54-56); Cerejo, 2011) and study plans are only ever declared once a term. However, according to Hassenzahl (2005), functionality that is not used now can be seen as Hedonically stimulating – users will get greater satisfaction from the application knowing that they do have a "power user" functionality to explore and adopt.

The imaginary line has been drawn at 3.5 score mark, which, judging by the overall distribution, presented a nice dividing point. 7 out of 10 proposed features have been scored higher than 3.5 and the gap between the lowest scoring feature above the dividing line (Staff contact information with 3.77) and the one superseding it (Student Profile with 3.26) exceeds half a point, which in the scope of the results is a very significant drop. As a point of reference, two other notable drops (0.34 point difference between the score of the Schedule feature and Notifications feature; 0.38 point gap between Course Grades feature and Exam Registration feature) appeared in between the top four answer options, and decline in popularity of the 3 following most appreciated features being very gradual, hence making it imprudent to place a dividing margin anywhere else.

The feature that has unfortunately had to be abandoned and excluded from the current design scope was the ambitious Location feature. From the onset the feature was envisioned as a very

promising and novel aid to navigation around the university campus, especially inside its buildings. Even though the technology for proper indoor positioning systems is emerging (Bluetooth LE aka the iBeacons (iBeacon, 2014)) and some tentative plans for implementation of a pilot of real-time positioning system for TUT have been set (as gleaned from private correspondence with Kristjan Luzhkov of 27.02.2014), the amount of design and additional development and research the feature entails are disproportionate to the role it would play in the Mobile ÕIS. It has been decided that design for this features can be deferred until both Mobile ÕIS and the aforementioned system are green lit.

Conversely, some features were meant to be excluded by virtue of general absence of urgent interest of the respondents, but have been reinstated in the design scope as in the course of the actual design their relevance has become apparent. Such features are the Student Profile and the list of TUT courses. The decision was supported by the list of TUT courses playing an important supplementary role in the preparatory process for study plan declaration and Student profile being the sensible upper node in the information architecture encapsulating Students Grades. Both exceptions to the selection by popular vote have had the advantage of apparent low design and development cost and contribution to hedonic aspects of the system.

3.1.4 Platform Choice

As evident from the questionnaire results and previously cited market statistics, the two options worth considering for native mobile app development are the Android platform and iOS. From the onset of the project it was seen as a dedicated iOS design effort for many reasons. The familiarity with the iOS, device ownership and access to subject matter expert input were the paramount factors driving the decision. Some research has also shown that it is generally considered that devices running iOS offer a more positive user experience than those housing Android (Pffeifer consulting, 2013; Hixon, 2014). Understandably so, as Android OS is faced with the very challenging requirement of running on different screen resolutions and even screen ratios, on devices with very varying processing power. Moreover, designing for a standard screen resolution is also an easier experiment than coming up with an adaptive solution. The platform choice does go against the statistics but there are many factors in favor of the preference in the given context.

3.1.5 Developing the Design

The aim of this research was to come up with a viable application design that would support a positive user experience. The underlying objective was to base the creation of such a design on established state-of-the-art industry-wide accepted and effective rules and guidelines for successful and efficient application design as far as relevant user experience is concerned (since crashes and other technological glitches also affect user experience, but are not really dependent on the design as understood in the scope of the present research). The following account commits to bridging the gap between the sought result and a score of scattered guidelines, recommendations, acceptable foregoing of those, academic and non-formal research findings and observations.

3.1.5.1 Design process

Having, to an extent, ascertained the functional scope of the project, a decision had to be made as to which conventional steps of design process will be undertaken and which methods employed in order to reach the desired design artifacts. Based on previous experience in the scope of Interaction Design course (a collection of artifacts retrievable from http://synergyimke.wordpress.com) it has been decided not to employ such design deliverables usually associated with design for positive UX practice (Ginsburg, 2010; Garrett, 2010) as Personas, Use Cases, User Stories and Concept Mapping. Also, an extensive separate wire-framing stage has been foregone due to caveats often associated with it, such as inability of test subjects to treat it with the required level of abstraction (Ginsburg, 2010; Turner, 2010) and timeframe of locationally conditioned absence of suitable test subjects.

According to research conducted by Treder (2012) the real life process of designing for user experience falls extremely short of romanticized thorough user-centered design process. The industry constraints in the vast majority of cases force UX practitioners to use as many shortcuts as possible and monumental processes as their building blocks elaborated upon by Ginsburg (2010) that employ many iterative methods usually do not survive in the stifling industry conditions. The process is said to morph according to projects requirements and other factors, such as team composition, communication organization within the project team and other aspects (time and budget granted to the team, teams involvement in other activities etc.).

During the design stage of this study the need for a steady repeatable design routine exhibited itself. It has been determined that such a process cannot be borrowed from the industry or UX practitioners' publications directly. It would neither fit the purpose well, as both the domain (design of iOS application counterpart for existing student information system) and circumstances are unique (one UX practitioner without much field experience in both areas of expertise). The cue was taken from Ginsburg (2010), Cerejo (2011), Sauro (2013) and Treder (2012) – a custom process constructed from building blocks of UX practice has been adopted. In a few iterations, through trial and error, a workflow that appeared to work for the purpose of static design phase has been established. The individual elements of the process are all based on literature reviewed and are generally associated with practices involved in designing for UX.

The design process of the user interface (UI) and interaction outlining can be broken down into 4 sub-steps that were taken for every major view and screen layout:

- Determining the best design and interaction practices for certain design element (or ascertaining and quantifying the default standards i.e. paddings quantified in pixel numbers for standard elements)
- Drawing up possible information points for each view, aligning them by perceived priority and finally confirming those to be included in the design experiments
- Rough pen sketching of both grouped information points (such single event line in the schedule view) and full paper prototype screen (at times many options were visualized so as to determine the most promising information alignment)
- High fidelity visualization of user interface resulting in the final screen layouts with consideration to concrete guidelines and professed rules of the thumb and other industry accepted recommendations
- Note-taking as to what screen transitions would be appropriate for the interactions with the elements of the given screen layout (this step, unlike prior four, is not sequential and could be undertaken at any point of the design workflow).

All the actions in the process can be referred to steps on various stages described by Ginsburg, 2010). For example, the first described step is comprised of learning of best practices from competitors and simply applications utilizing the same views as the designed app, verifying platform standards and getting acquainted with current design trends by visually reviewing the latest tendencies. The process described above is clearly more complex and overarching than UI design – it encompasses information architecture, information design, choice of vocabulary, identity design, and interaction design among other practices inherent for designing for UX.

The general recommendation (Garrett, 2010; Apple Inc. 2014 (pp.57-59)) is to ascertain a unified vocabulary (for example, incorporating into a concept map according to Hans Põldoja lecture"Concept Mapping in Interaction Design") as a preparatory stage for more detailed design. However, finalizing this design artifact has been postponed until the final stages of honing the static prototype and partially interwoven into the design process, as big-design-upfront was severely impractical in this case. The vocabulary needs grew in the process of creation of the static design and formulation of interactions. A number of reasonable options have surfaced for every concept and choices have predominately been made in favor of those more familiar or intuitive for the intended users. The level of familiarity was ascertained empirically, during brief consultations with fellow students as well as through observation of language used on student message boards and online communities. Official TUT documents in English, such as Student ABC have also been consulted (Paavo & Kougija, 2013).

The UI design was carried out in a Mac OS exclusive vector application Sketch, which supplies art boards exactly the pixel-size of iPhone screen, allows a preview of every screen on the target device through a dedicated Mirror app, and allows for reuse of standard iOS UI elements.

3.1.5.2 UX factors

The selection of factors was primarily guided by the peculiarities of the approved feature-set and a gleaning familiarization with guidelines done in the course of literature review. The factor pool used was the Revang's UX wheel (2007) as it nicely covers a diversity of very concrete UX considerations. There were 13 factors out of 30 that were selected as most appropriate for the nature and the scope of this work. The factors that were chosen were most suitable for a very practical application, that wouldn't rely too heavily on graphics or immersiveness, but wouldn't

need to inspire rock hard confidence in security. The selection was based on user survey and the chosen feature set – all the factors below serve well to support the selected features. As is the application, so are they somewhat conservative and basic. The factors were:

- Naming and Categorization
- Tone of voice
- Structure
- Navigation
- Color scheme and Contrast
- Typography
- Placement of Elements
- Intuitiveness
- Consistency
- Conformity
- Appropriateness for purpose
- Expected information/expected functionality
- Satisfaction

Naming and Categorization and the Tone of Voice

As the application designed was by no means intended to be immersive or conductive of killing time while engaging the user. Very sober factors, like the overall vocabulary and communication style were appreciated. Great amount of stock was put into naming sections clearly and concisely so as not to leave room for misinterpretations. For example, at some point a section where examination registration was handled was named “Exam Registration”, while when it became obvious that this is where personal examinations should be managed, it was renamed into the more suitable ”Examinations”. Different sources were consulted to enable the app to speak with users in their own language (Paavo & Kougija, 2013). Being aware of the role hedonic qualities play in the overall perception of the product, an effort was made to keep all of the in-app text informal and approachable, yet not overly familiar (**Figure 3-4**). This factor relates to the Structure most closely as Categorization overlays it.

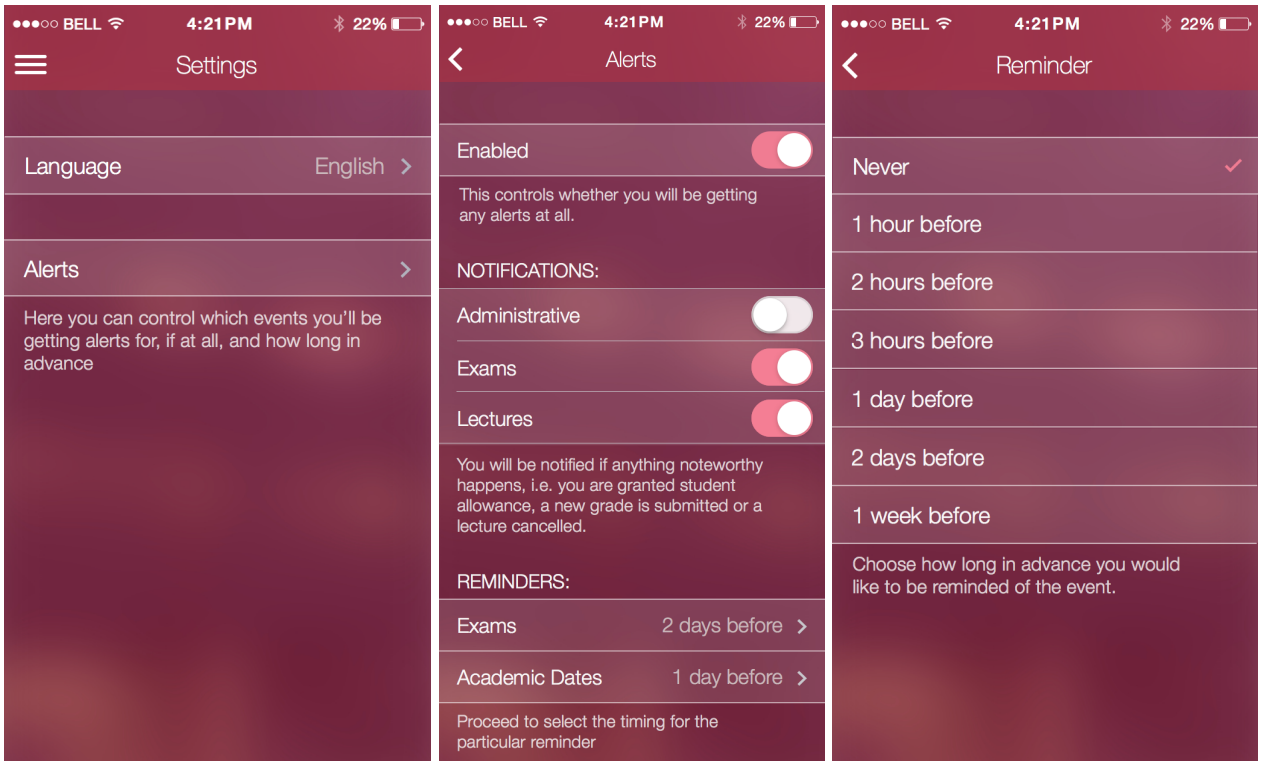

Figure 3-4. Mobile ÕIS settings first page and Alerts page details.

Structure and Navigation

Structure stands for the general information architecture (IA). The general mobile-specific recommendation is to keep the structure broad and shallow (Cerejo, 2012). Thanks to a very limited feature-set; the placement of the features into traversable structure was a relatively simple venture. The structure as a factor differs from the naming and categorization – while underlying IA may essentially stay the same, the presentation, the naming of the elements might have variations. It was found that the structure must match the phrased categorization successfully in order for the two to work well together.

Navigation relies on the underlying structure or, in this case it's fair to say, information architecture. It is for the sake of supporting the conventional navigation that the structure was kept shallow – there is only so many back-button taps that the student will be fine with. The navigation principle chosen for the app is not covered in Apple iOS HIGs, but it's one of the most widespread approaches now recognized across many platforms (Yarmosh, 2012). It was presumed that local iOS users would be familiar with the side-drawer navigation paradigm as many non-gaming top-ranking applications use this style of navigation.

Color Scheme, Contrast and Typography

The choice of color scheme is advised to support the overall branding of the parent organization (Apple Inc., 2014 (p. 49)). The chosen colors were meant to reflect TUT general identity strategy (**Figure 3-4**). The back-ground picture, though blurred, is a shot of the now famous new library building. The overlay of color closely resembles the burgundy of the official TUT coloring. The contrast (**Figure 3-5**) is maintained by using white as the font color, given a slight transparency sheen in order to look more sophisticated. The contrast ratio in the views where readability is paramount and many points of information are essential is maintained by reversal of color – light background with a trademark tint and dark set of letters. The chosen fonts – Helvetica Neue Thin and Apple SD Gothic Neo Thin - are standard Apple fonts and maintain the thin to ultra-thin look introduced by iOS7.

Placement of Elements and Intuitiveness

Here practices from information design and findings of mobile eye tracking research were consulted (Tobii Eye Tracking Research, 2012). Most important elements were made more prominent and placed where they were most likely to be seen – as was the case with main schedule view where the start of the event was placed to the left in big letters (**Figure 3-5**). Also, conventional icons (location icon, contact icon in schedule view) were used to help the intuitive navigation and save the very sparse screen royalty. The icons were also used to aid distinction between tappable elements and static ones. All of the conventional approaches (the native navigation bar on top, context aid by providing page titles, clear labels next to action buttons) used in placement of elements and navigation style were also aimed at facilitating intuitiveness.

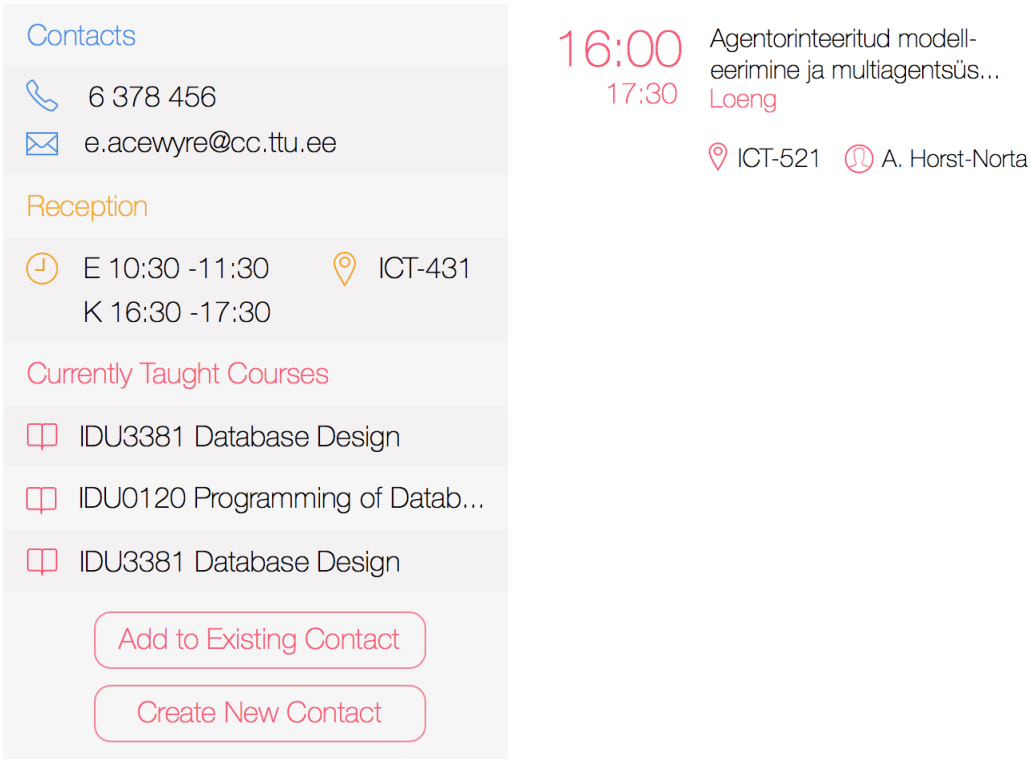

Figure 3-5. Primary content section of a Contact screen and schedule event list item in mobile ÕIS app.

Consistency and Conformity

For any native application consistency would play a major role in supporting positive UX – consistency makes handling of the app easy to appropriate, especially coupled with intuitiveness. Hence it was really important for the design to reflect that value. Consistent look was maintained through the whole application, alternating between two primary styles – transparent background and white text, light background and dark text as seen on the **Figure 3-6**. The light background was used where the readability was extremely important (schedule, profile page for infographics, contacts page) – and in cases of lists indicated additional actions that could be revealed by swiping gesture.

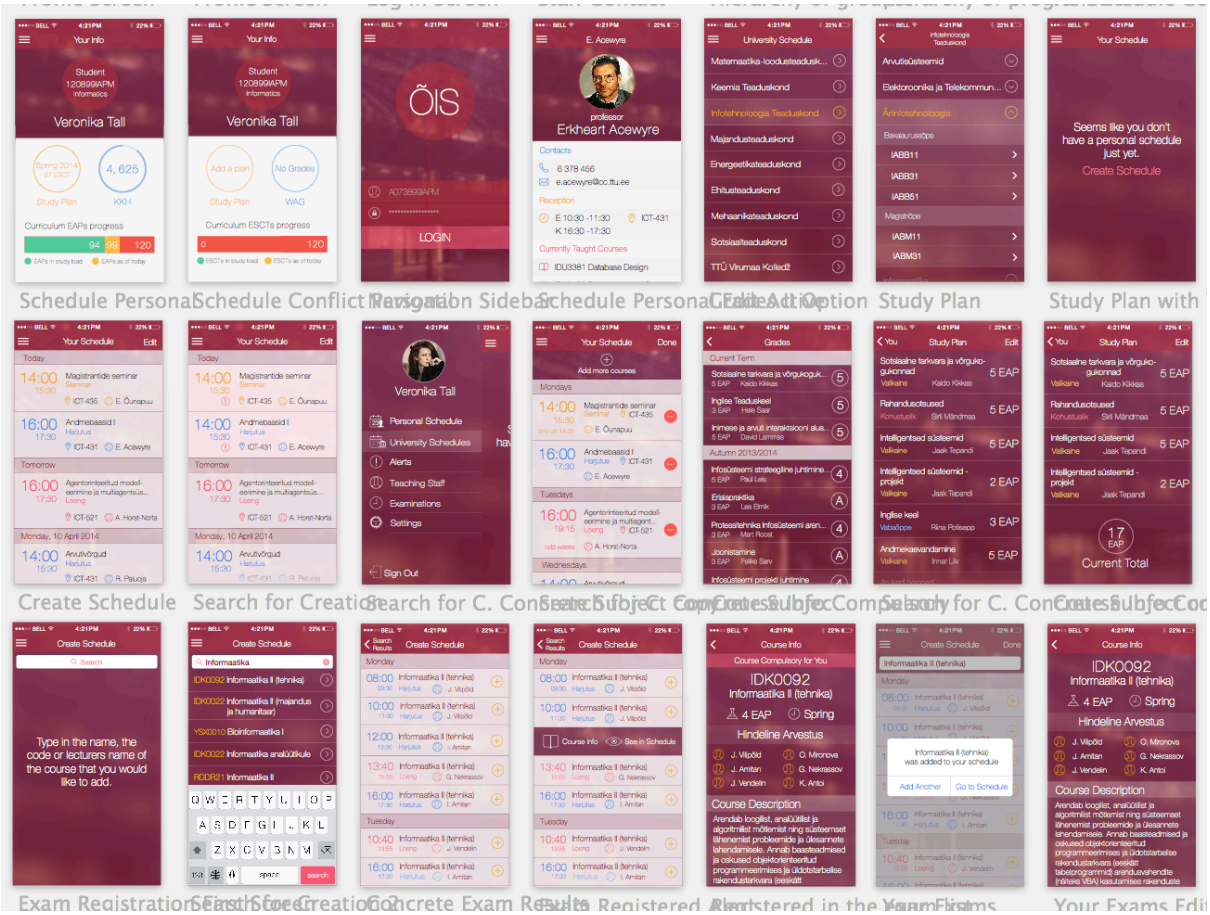

Figure 3-6. Overview of visual consistency of roughly one third of the screens designed for mobile ÕIS app.

Conformity in this case can be read as creation of correlation between desktop ÕIS and the mobile ÕIS being designed. It manifests itself in the drawing of clear parallels between the names and the content of ÕIS that is being ported. While the styling is meant to add sheen of up-to-dateness, the content at heart conforms to desktop ÕIS traditions.

Appropriateness for Purpose and Expected Information/Functionality

Throughout the development it was very important to keep in mind that the app was designed to be useful first and foremost. Other aspects, more related to hedonic qualities, were also pressing, but if the app would fail to serve its purpose all other effort would have been forfeit. Hence more fanciful decorative elements and animation undertakings were abandoned. The expected information and functionality was dealt with by analyzing results of student survey and the outcome is presented in great detail in section 3.1.3.

Satisfaction

The ultimate factor that the present design is aimed to achieve is the satisfaction with the mobile ÕIS app. It is especially relevant as the fault of the desktop ÕIS is largely in not being able to make the user experience a pleasurable one. Desktop ÕIS merely enable students complete their tasks, but does not make the process satisfactory or easy. Hence a lot of minute details were paid attention to in the course of design, such as information aids, evident feedback to user actions, logical animations and transitions (Apple Inc., 2013), intuitiveness, structure of sections and information. It is evident that a lot of more concrete UX factors go into achieving broader UX goals.

The range of factors required for the development and launch of an actual application would, of course, be broader and certainly include factors linked to findability, such as naming, marketing and search engine strategy; and accessibility – response time, handling of absence of connection and reliability. The factors that were in detail described above were the ones applicable in the scope of this research.

3.1.5.3 Guidelines Driving Design Decisions

Based on variety of sources from literature review, but mostly on official Apple iOS Human Interface Guidelines as of 2014 and Cerejo (2012) article, competitive analysis and careful consideration of ascertained feature-set, a set of design guidelines has been singled out. Those guidelines were viewed as the most appropriate for the nature and context of the application. They were also picked out as directly supportive of the UX factors listed in section 3.1.5.2. Some of the guidelines are partially intersecting, though in such cases they are resolving issues of different granularity.

Allowing for Hedonic Considerations

Thanks to the familiarity with Hassenzahl's model of user experience, decisions to implement hedonic design solutions were informed and confirmed. Hedonic qualities of a product are rooted in user's sentiments and stimulate positive user experience. Such design solutions as having

student's photo in their profile, professor's photo in contacts view, infographics on student's page, revelation of additional manipulation options on a low-discoverability swipe gesture were directed by those considerations. Some examples can be seen on **Figure 3-7.**

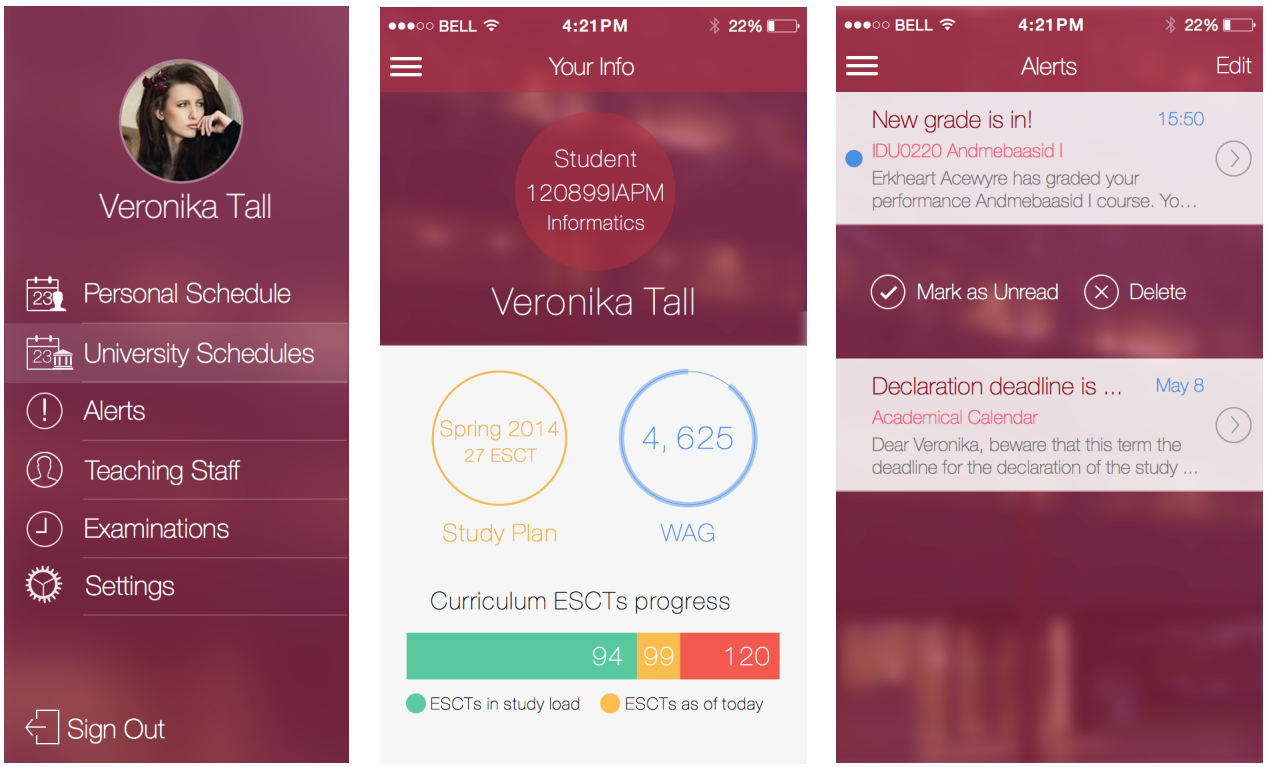

Figure 3-7. Hedonic considerations manifesting themselves in ÕIS design.

Following Conventions and Patterns to Reduce Learning Curve

Careful study of Human Interface Guidelines (Apple Inc., 2014) and survey of latest design solutions were driving creation of every view of the application and principle of interactions and transitions. No solution has been invented from scratch and standard interface elements were used throughout. For example, the Settings view (**Figure 3-8**) is constructed from standard iOS7 elements and only their colors and transparency levels are changed; all interaction principles from iOS standard Settings app are also adhered to. Another example of standard elements usage are the use of encircled plus icon for item addition (used for adding examinations and course events to one's schedule) and red stop-like-sign icon for deletion. Many other patterns were adhered to also, such as the whole hierarchy of navigation, swiping gesture that reveals additional options.

Figure 3-8. Patterns applied in mobile ÕIS aimed at reducing the learning curve.

Adapting Content to Mobile Screen

It is strongly advised to adapt the content, rearrange elements' position or eliminate some of the elements altogether when porting to mobile. As Cerejo (2012) cites both Ballard B. and Nokia's guidelines, it is important to rethink the presentation of information and the whole user interface rather than shrink or miniaturize it. In the light of this, HIG (Apple Inc., 2014 (p. 54)) recommendation for minimal point size of font (22pt) was adhered to and the view of a schedule event was heavily adapted from desktop version. Best practices of showcasing calendar events from popular applications (such as Sunrise, Eventbrite) were observed and imitated in the Schedule screen (**Figure 3-9**). The Student Profile (**Figure 3-7**) was even more heavily revised and all the unimportant information weeded out to present a clear overview of the most important student data. The data that was seen as most important for routine overview was the Study Plan (and the number of ESCTs or *EAPs* in it), grades - with weighted average grade showcased in the profile right away, and program completion or study load adherence, also presented as illustrative infographics. Another good example is the view of the Study Plan with all of the unnecessary details eliminated and a very succinct representation of the Course Info (**Figure 3-9**).

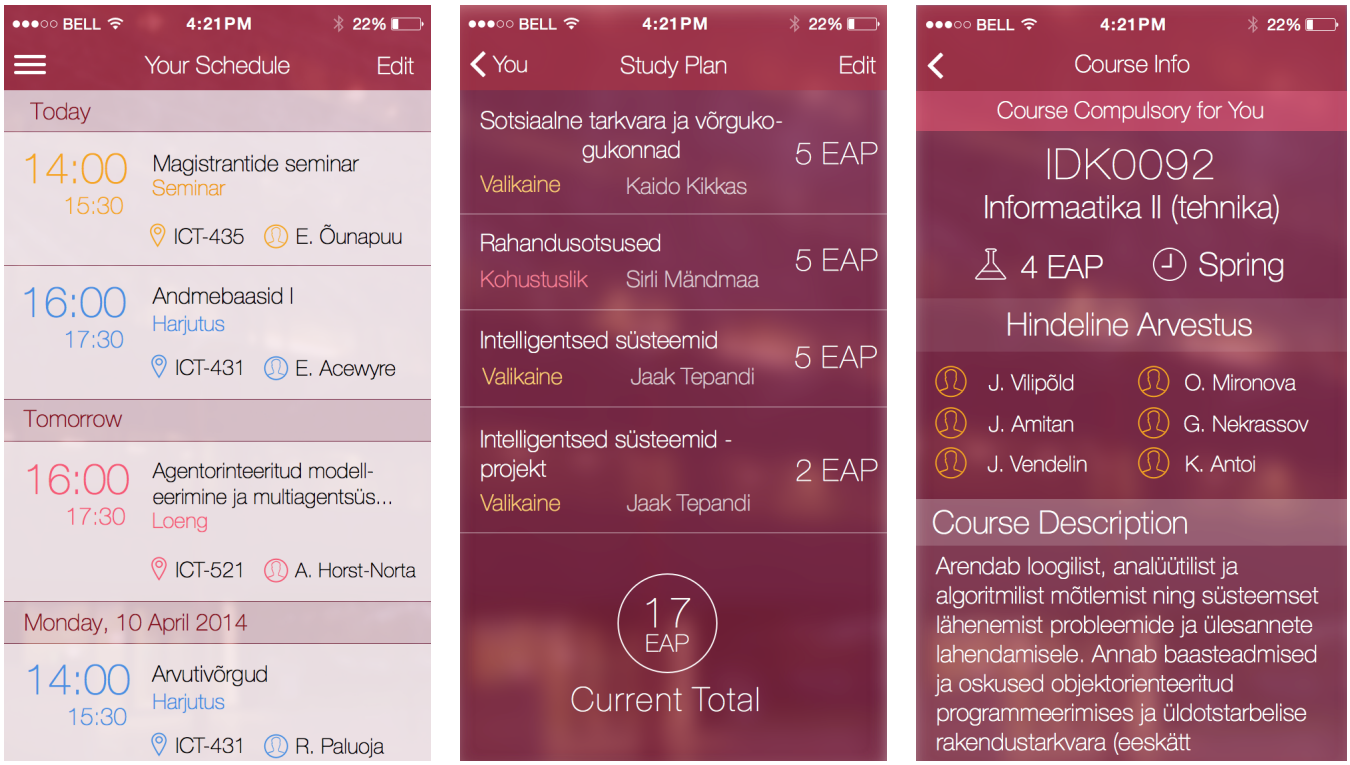

Figure 3-9. Adapting content for mobile ÕIS to be appropriately readable on mobile screen.

Reducing cognitive load

One of the cornerstones of HCI practices, the reduction of the very measurable cognitive load, has a major role to play in developing a pleasurable user experience. The low cognitive load, though not promoting positive impression by itself, is the foundation upon which positive user experience needs to be built. The design strives to achieve that by presenting:

- Search options in addition to hierarchy traversal (**Figure 3-10**).
- Different aids in decision making, such as offering of ones study plan or typical group schedule as a basis for personal schedule creation (**Figure 3-10**); ability to preview the course event one is about to add to personal schedule in the said schedule (**Figure 3-8**); picking examinations to register to from the list created on the basis of one's study plan.
- Alerts to always keep the student informed of the approaching academic deadlines and his examinations (**Figure 3-10**).
- Prompt on the login screen as to what prefix the student number should have for the correct login procedure (**Figure 3-11**).

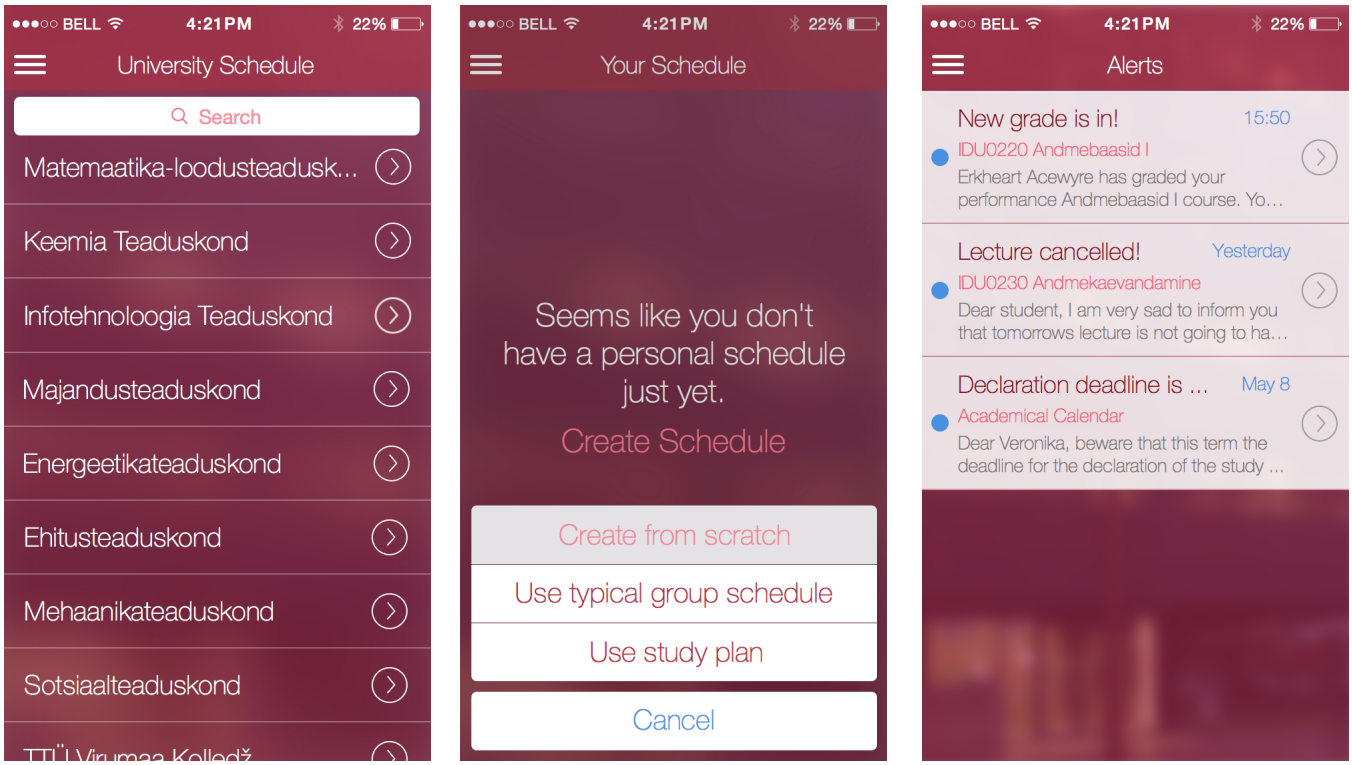

Figure 3-10. Reducing cognitive load with mobile ÕIS.

Providing Contextual Cues

Ideally, users should always be able to locate themrselves in the context of app navigation. It is recommended to make clear what view is active now and where back button might lead. The standard utilization of navigation bar at the top of the screen in the mobile ÕIS application was envisioned exactly as such an element. Moreover, the highlights in the sliding down list depicted in **Figure 3-15** and the highlight of the active section in the navigation menu in **Figure 3-7** is also representative of fulfillment of this guideline.

Speaking Users Language and Clarity of Labels

The vocabulary of the application interface can be a deciding factor in discoverability, understandability and perception. If the labels are misleading and diverge from what is expected the user may glance over the information they are seeking. Hence it was of paramount importance to keep the interface wordings as close to students' expectations as possible. A variety of sources was consulted in order to establish the appropriate vocabulary.

Prioritizing the Information

Prioritizing information is an essential part of information design practice. When designing for glanceability, it is important to assist the user in locating the most frequently sought information as quickly as possible (Cerejo 2011). In accordance with findings of eye-tracking for mobile devices (Tobii Eye Tracking Research, 2012), the most important and frequently used elements were placed to the left of the screen, just roughly above the middle part of it, in sequence of the alleged frequency of use in the navigation list (**Figure 3-7**); and events' times were listed on the left of the screen as well in big font size so as to ensure attention (**Figure 3-9**). Dedicated prioritizing considerations were also employed for information design for the Staff Contact view (**Figure 3-11** (right)) and Course Info view (**Figure 3-9**).

Form design, whitespace and grouping

As described by McClocloskey (2013), the layout and usability of forms can be vastly improved by placing form labels near the associated text field and by grouping similar fields. Even though mobile ÕIS doesn't imply extensive use of forms, it does have the login screen where it's extremely important to keep users intuitively focused and informed of the fields. This recommendation along with review of best contemporary practices resulted in the Login Screen as shown on **Figure 3-11** (left).

Designing for empty states

HIG (Apple Inc., 2014) specifically goes over the necessity of designing for empty states – users shouldn't be baffled by an empty screen, which they can mistake for connection or data read error. HIG state that there should be a clear indication that there's just nothing to display at the moment and a cue as to how amend the situation. The solution illustrated by **Figure 3-12** (Profile view, Empty schedule) try to achieve just that.

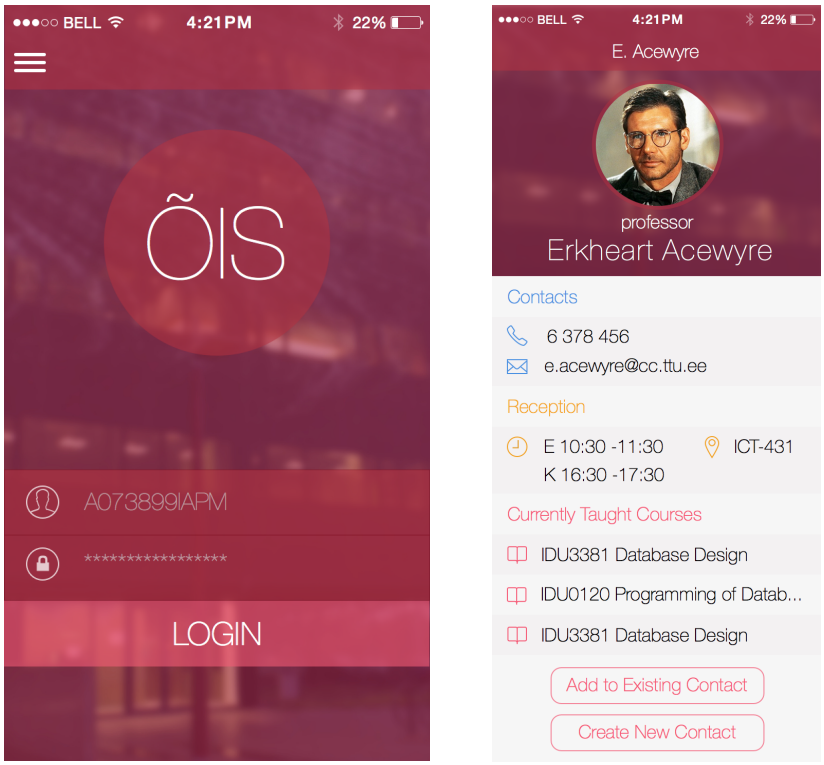

Figure 3-11. Mobile ÕIS handling whitespace and grouping in forms (left) and dedicated rethinking of ID for mobile ÕIS (right).

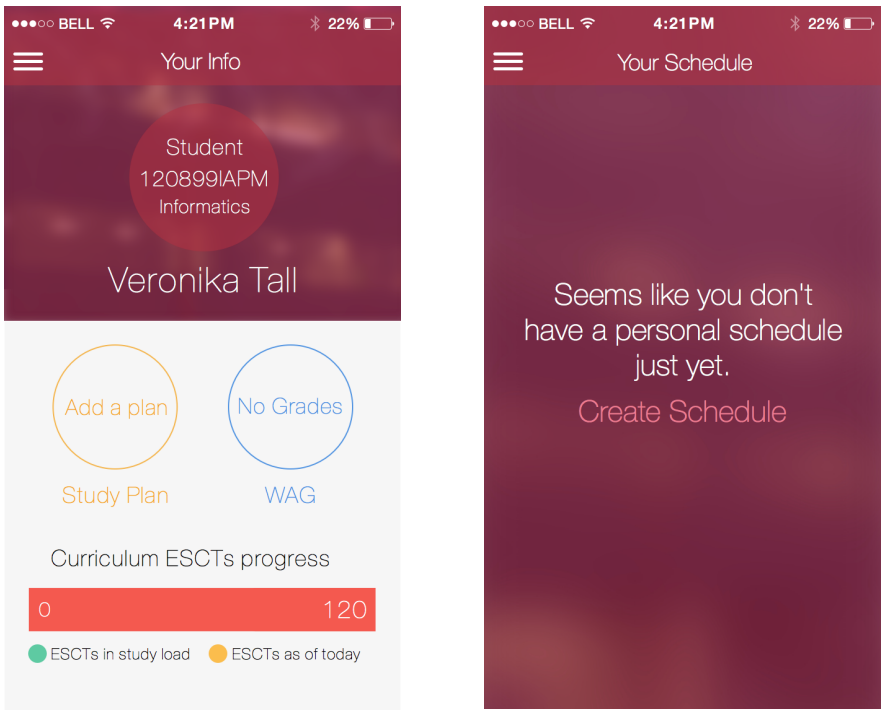

Figure 3-12. Designing for empty states

Minimum Required Text-Input by the Users

Typing on a mobile device is generally considered cumbersome; users try to avoid it whenever reasonably possible. In accordance to this recommendation (Cerejo, 2012) user input has been designed to be avoidable in majority of cases – even study plan can be assembled from a collection of subjects known as typical study plan, recommended by TUT for every term of a certain study program (**Figure 3-10**).

Specialty program (i.e. informatics bachelors program) itself can also be consulted. Then the user would only ever need to type in the search criteria for a few courses that they might wish to take outside of their program. For other major views, such as university schedules (**Figure 3-13**), your own schedule, university contacts, options are provided for reaching the information

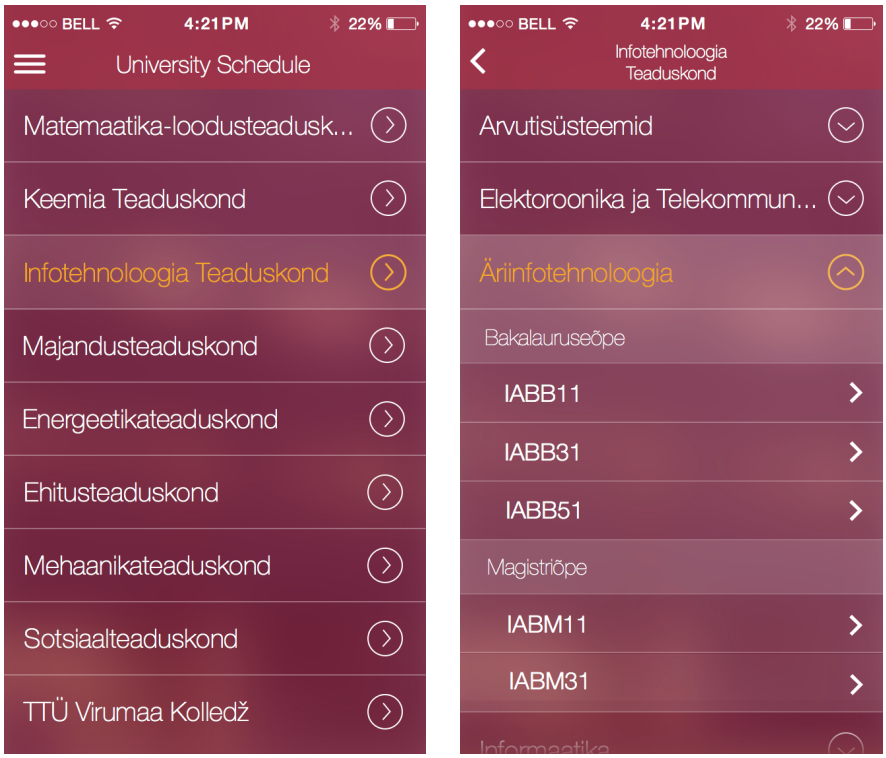

Figure 3-13. Minimizing the text input requirement as applied in mobile ÕIS design

without employing search (which equals to having to supply input). Login, as evident from **Figure 3-11**, is also requiring minimal input.

Designing with consideration for iPhone screen

This is a very technical, yet crucial recommendation. When designing for iPhone screen, it is usually kept in mind that there's a slight variation between devices of different generations. There's super sharp elongated Retina screen of iPhone 5 and later versions, and a little stouter screen of iPhone 4 and 4S and the ones before that were half as sharp as the iPhone 4. Luckily enough for designers, Apple drops the support for obsolete devices pretty ruthlessly, so there are fewer screen sizes to consider. However, many guidelines still suggest making sure that the sizes of all designed elements are devisable by 2. Moreover, it is quite important to make sure when creating slices for UI that all the values are in full pixels. The failure to do so may result in blurry edges and the other visual deficiencies. The Sketch 3, the software, where the static screens were developed, is always keeping the designer informed of element's size and allows exporting at x2 and x0.5 sizes which supports adherence to this recommendation.

Preventing Interference Errors

The employment of this guideline has been largely inspired by Hoober's (2013) article, which explores common misconceptions about touch interfaces. A lot of accidental mis-taps happen when small targets are places too close together. Since fingers often obscure a substantial area of the screen when placing a tap, just a few millimeters worth of miscalculation in application of finger's centroid might result in a wrongful activation. In the scope of design study such placement and sizing was carefully avoided and a great care has been taken to leave a lot of breathing space between tappable elements. It is also advised to keep the touch areas larger than the minimum required 30pt areas, which was designed for in the static UI screen and was later handled in the prototyping environment where areas assigned were larger than the minimum recommendation whenever possible.

Making Affordances for Tapping

The touch interface cannot employ such change-visuals-on-hover cues, as does a pointer driven interface of desktop web and applications. In touch interface the design of touch targets that are tappable should clearly indicate that affordance. This was taken to heart in majority of the views of the application and even tappable info-graphics, such as Grades and declared Study Plan were designed as the circle buttons, which is a pattern in itself and is separately mentioned in HIG (Apple Inc., 2014(p. 36, p.45, p.191)). Other views also do follow that principle and majority of

tappable buttons are enclosed within a circle. Another strategy is employed for empty states or starting screens for searches, where tappable text is presented in a contrasting color and a clear call to action is encoded in the phrasing. This is also a part of Apple's HIG recommendation to embrace the borderless buttons (Apple Inc., 2014(p. 16)) – the affordance for tapping is indicated either by color, as in the example above, or by a conventional position of the button, say, on the navigation bar.

Reserving additional gesture interaction for power users

It is sometimes advised to have additional control options for rare use cases activated by special gestures, not all of which are easily discoverable. For example, official Apple programs employ swiping list items to the left to reveal such options as deletion, archiving or some other manipulation. Sometimes there's an alternative, more visible way to activate those actions, however, in some cases the swipe to the left is the only way to accomplish the task, like deleting a song from your music collection. It was assumed that introduction to swipe-to-the-left gesture would be included in the short first-time use tutorial – the onboarding experience as Apple refers to it - after all it is a thing that users need to learn only once and it will be remembered and it is a recurring pattern across other applications. Most of manipulations, however, were made available without necessity to employ special gestures. Views of the list items swiped to the left can be seen on **Figure 3-7**, **Figure 3-8**.

Make branding unobtrusive and subtle

Apple HIGs dissuade from wasting the limited screen estate needlessly on displaying a logo throughout the application (Apple Inc., 2014(pp. 49-50)). It is most advisable to devote the screen to the content users actually care about. The brand can manifest itself in trademark colors, fonts and imagery – for the mobile ÕIS prototype this was followed closely and university logo is advised to appear on launch and during onboarding experience, while branding elements incorporated into the design were the trademark hue and imagery – the background photograph is a shot of the new library building.

Relevant keyboards

It is a small detail that can have a sizeable effect on use. For example, it's a widespread best practice to have a custom view of keyboard on login page which asks for user's email, where the

"@" sign can be accessed straightaway, or, in case of Instagram application, the hashtag sign "#" is also placed on the primary keyboard. In the context of the application at hand, this approach was used for the login page and for every view where search was active (**Figure 3-14**).

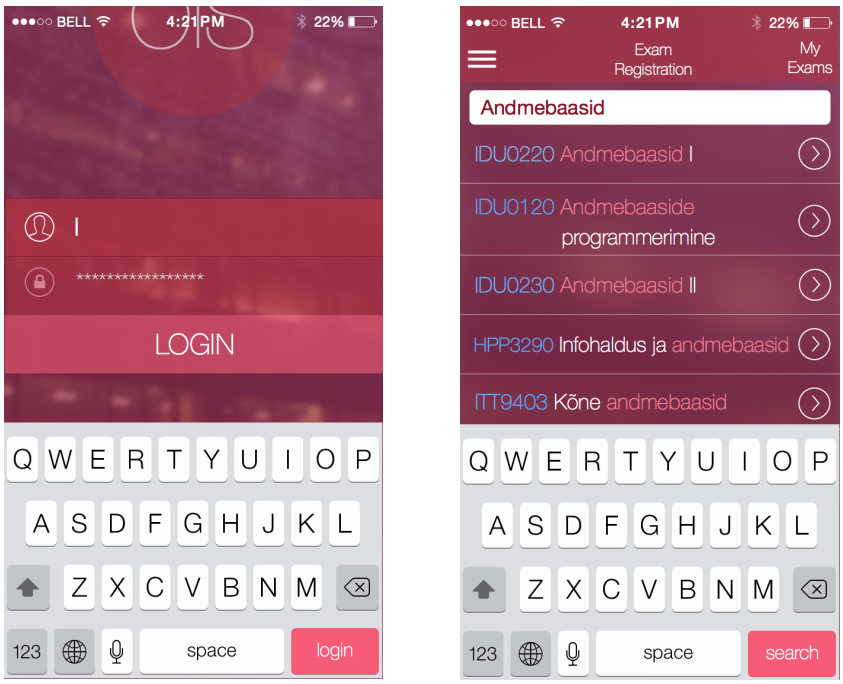

Figure 3-14. Providing relevant keyboards in the right contexts.

Delaying Login Requirement

Apple iOS HIGs suggest making as much content as possible available without logging in (Apple Inc., 2014 (p.46)). This is a great strategy for some applications, for mobile ÕIS feature-set, however, only University Schedules and Staff Contacts qualify for unauthorized access. They are envisioned as being fully available without logging in. However, the unavailable sections remain visible, and a login option is given at their activation.

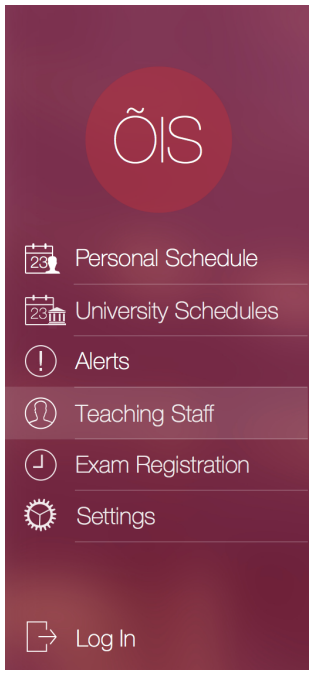

Figure 3-15. Mobile ÕIS delays the login requirement.

3.1.5.4 Important Relevant Guidelines outside of the Scope of Design and Prototyping

Loading image strategy

It is strongly advised by iOS HIGs (Apple Inc., 2014(p. 26, pp.211-214)) and Cerejo (2012) not to employ random branding splashscreens and go directly for launch images instead (launch image is a simple placeholder that iOS displays when an application starts up, splashscreen is usually associated with welcoming messages, branding and requirement of additional taps to proceed). The loading image should resemble the data that the application is about to show the user as much as possible. Thus it is recommended to make the loading screen as invisible as possible or avoid it altogether if the data can load quickly. Even though neither prototype, nor static screen design emulates that, a recommendation still stands.

Keeping the user logged in

It should probably go without saying, but keeping the user logged in is essential for satisfactory functioning of the mobile ÕIS application. As has been mentioned in an earlier guideline, people don't really like to go through the keyboard input on a mobile device and as majority of relevant information that users are going to be returning for is tailored to them personally. And as an application is developed for a very personal device, logging the user out after every session does

not make much sense. The design makes the login button explicitly available, but it is supposed that the log out will only be executed by the user or after a very long period of a non-use as a security measure.

Pay regard to device capabilities

Devices equipped with iOS most often offer many additional features, such as geo-location, gyroscope, compass, calling, e-mailing, etc. Those should be considered when designing applications and if it is sensible to connect any of the application features with the external services of iOS, it is advised to do so. In the scope of mobile ÕIS application design most of this capabilities were explored in the contacts page (Figure 3-12).

Always be ready to stop and start again

The use of majority of applications on mobile phones is a very fragmented experience – users abandon the app suddenly and return to it when they will. It is recommended not to throw them back to some arbitrary home screen, but to allow them to continue right where they left off. State preservation and restoration is paramount. A practical recommendation is to save states as often as reasonable and to the finest level of detail possible (Apple Inc., 2014 (pp.26-27)).

3.1.5.5 Prototyping

Even before the design of static screens was completed, prototyping efforts have been underway. The prototype was envisioned as an interactive representation of how the application was intended to look and feel when running on a real device. Hence, there were a few priorities when choosing the prototyping environment:

- Ability to run the prototype on the target device
- Support of various touch gestures
- Good mimicking of native transitions and other, more complex animations
- Ability to run on test user device
- Affordability
- Moderate learning curve

With that the native xCode environment was ruled out almost immediately as to be able to run anything developed in in on a device one would need to purchase App Store's developer's license which factors at 99$ per year and only allows one to run the application on the authorized device. Moreover, the learning curve for xCode environment is admittedly very steep. The Quartz Composer, a quite popular Apple's own animation environment, was deemed inappropriate, as it is a very low-level tool, requiring a long adoption period to be used efficiently. A survey of presently available dedicated prototyping environments has been made.

A recent article by Shwartzman (2013) was consulted as the primary source for selection of probable candidate environments. Also, the comment section was scanned for mentions of other products that might have been excluded from the initial test selection. Consulting the matrix presented in the article, three most probable candidates have been chosen – Fluid, JustInMind and Proto.io – because they offered the highest interactivity and gesture recognition. In the **Figure 3-16** below the rows of the prototyping environments considered are highlighted by red rectangles, important prototyping characteristics – with blue rectangles.

Evaluation of Prototyping Tools — cooper

TOOL	TIME/SPEED	FIDELITY	COLLABORATION/ SHARING	USABILITY TESTING	SUPPORT	INTERACTIONS/ GESTURES	ANIMATIONS	DEVICE TESTING
Briefs	120 min	Above Average	Low	Average	Low	None	Average	High
Flinto	5 min	Above Average	Average	Average	Low	Low	Average	Above Average
InVision	10 min	Average	High	Average	Above Average	Low	None	None
proto.io	120 min	Above Average	High	Average	Above Average	High	Average	Average
Axure	30 min	Above Average	Average	Average	High	Average	Above Average	Low
Protoshare	40 min	High	High	Average	High	Low	High	Low
Solidify	20 min	Average	High	High	Above Average	None	None	Above Average
Easel	15 min	Average	High	Average	High	None	None	Low
Justinmind	40 min	Above Average	Above Average	Average	High	High	Above Average	Above Average
Fluid	45 min	Above Average	Above Average	Average	Average	Above Average	Above Average	Above Average

Figure 3-16. The table of comparative characteristics of various prototype environments (Shwartzman, 2013).

A brief interaction with all of the three environments has scrapped the possibility of using Fluid due to its lacking sophistication and granularity. JustInMind appeared too unruly and its Java driven cluttered interface reminded the author too much of Eclipse's lacking user experience and unclear logic of usage. Only Proto.io remained an option and in the end was deemed the most suitable. It allowed to implement a reasonably realistic transitions and animations as well as provided great documentation and support for doing so. Moreover, the authenticity of feel during device testing it supported was one of the deciding factors too – the Proto.io player application for iOS was released just in time for making of the prototype.

Proto.io afforded employment of screen states and reuse of elements by providing a container class, which made prototyping faster, though still maintaining changes test subjects would be making in the prototype required an inordinate amount of effort, therefore it has been decided to animate/showcase state change either for one or only a few first elements in the view and to restore the screen to its original appearance on reload. For example, the user would get feedback after adding course events to schedule, but won't be able to actually see courses added to their schedule if he would go back to the Personal Schedule section. In general, the prototyped interactivity was aimed at testing the main usage scenarios and ascertaining the validity of design choices. An extra care has been taken of screen transitions and animations.

One of the functions confirmed during establishment of feature-set was excluded from the prototype. The declaration of the study plan was left out of the mobile ÕIS prototype. It was considered more practical to test the interactivity principles on exam registration and management process and schedule composition before committing to a concrete approach.

The login process was prototyped for partially, but it wasn't integrated into the debugged prototype – the time was running out and it would unnecessarily complicate testing sessions due to very technical reasons.

3.2 Results and Analysis

Arhippainen & Tähti (2003) have concluded in their study that several methods need to be used to evaluate user experience. They have judged that in addition to interviews and observations, researchers will need more implicit ways to gauge feedback – collection and interpretation of body gestures and facial expressions would serve as one example of such. They also note that in order to collect authentic emotions, the context of the test must be as close to the actual context of use as possible. For this study, however, two very conventional methods have been employed.

3.2.1 Structure and Tools

In order to evaluate the perceived UX qualities of the prototyped mobile ÕIS an evolvement of real potential users was called upon. A test session was planned; participants recruited and testing activities were carried out. The user experience that was tested can be classified as an episodic user experience.

Balancing out Nielsen's Group claim that in certain contexts - ones very similar to the study at hand - 5 users are enough to go through qualitative testing of the product, and counter-arguments that minimum appropriate amount is 15, the number of test participants was established to be 10. According to the survey by Sauro (2010) of how many participants are used in the real-life industry in the formative usability testing, the median number has also averaged at 10. As a result, 10 one-on-one testing sessions, each coming in at about an hour length, were conducted.

Every testing session was started with a preliminary relaxing interview, where participants were encouraged to elaborate upon their encounters with desktop version of ÕIS, tell what they're normally using it for, share their general impressions of it and their experiences with accessing ÕIS with a mobile device.

Having eased people in into conversational disposition, a brief introduction to the prototype was given, and the "rules of the game" explained. It was brought home that the prototype is not really connected to any databases and all data in the prototype is represented by a collection of animated pictures and interactivity in some cases is limited to a single element per screen. Then the format of facilitator-participant interaction was explained.

The testing itself consisted of 7 tasks, meant to take participants through almost all of the screens of the prototype. The tasks were presented as concrete situations familiar to majority of students and viewed as very relatable.

After the testing has been concluded, the participants were asked a few follow-up questions about their general impressions and suggestions for improvements. In some cases the questions also concerned some concrete design decisions and participants were encouraged to voice their opinion on them. They were also asked as to what they would do if they learnt that the application such as they have seen was now available on App Store (Google Play Store for those owning Androids). Participants were also encouraged to establish if the tested application would be preferable for them to the desktop version.

The written notes were taken during the first part of the interview and through the completion of testing tasks. In addition to documenting the most important observations, it reassured test participants that their remarks are being taken most seriously. The follow up interview was audio-recorded after receiving verbal agreement from every participant.

After completion of the interview participants were also entreated to take the AttrackDiff survey, meant to place the user experience somewhat quantitatively.

The test session and the survey were meant to directly or indirectly answer following pivotal questions:

- Was an effort to design for positive user experience a success?
- Were UX factors and guidelines that drove the design sufficient and did they fit the problem area well?
- Was the feature set of mobile ÕIS determined appropriately?
- Which are the most glaring UX issues of the prototype?
- How can the design process be improved in order to decrease the likelihood of appearance of identified shortcomings?
- Would mobile ÕIS receive a warm welcome among the students if it were available on the App Store?

- Would users showcase a preference of a concise well-designed (hopefully) app to a desktop solution?

The 7 User Scenarios for Testing Tasks

1. It is the beginning of the term. You need to create a schedule for yourself, the desktop isn't available, but you're holding your phone in your hands with this app loaded. What do you do?

2. You need to see where your fellow group mates are, though you do not have any of their contacts yet, you just know your group classifies as IABM31.

3. You have an examination coming in 2 days. You realize that you cannot prepare properly in the remaining time. You want to cancel your registration and make a new one, for a later date.

4. A push notification just flashed the screen of your phone. It said something about a lecture. You understand it is coming from the mobile ÕIS application and it's pretty important. You want to find out more.

5. You have a very important concern that you need to discuss with one of your professors. You realize that you do not know when and where he might be seeing students for a consultation. You head to find that out.

6. The time for application for student "*toetus*" is coming. You want to see if your weighted average grade qualifies you for the application.

7. Exam session is coming. You understand that it usually takes you about a week to prepare for an exam. You want the app to notify you of your upcoming exams 7 days before.

The participants

The majority of participants were volunteers, proposing themselves for the testing session in response to an invitation placed in a networking environment. The invitation included a screener embedded in its text saying that current and former students of TUT and TLU qualified (because ÕIS system is almost identical for both universities) and that the tested application was designed with iOS paradigms in mind and acquaintance with the platform was desirable. Later, the second requirement had to be relaxed as it proved to be very hard to find a lot of volunteers with iOS

experience willing to sacrifice an hour of their time for a testing session they had a very vague idea of the format of.

4 of the participants were female and 6 were male, all participant were aged 20 to 35. All participants had at least 3 years of experience with desktop ÕIS. Majority of participants were involved in creation of software or design of products and can be regarded as a very demanding audience. 2 of the volunteers were professional iOS developers. Only two participants were detached from the IT/design field. This might have created a certain bias of the results.

3.2.2 Testing Session Results and Analysis

The testing session proved to be a very successful and fruitful undertaking. Test participants appeared to be at ease, keen on sharing their experiences, thoughts and remarks. As the introductory speech induced them, when participants encountered a difficulty completing a certain scenario, they were not treating it as their own failure; they tried to explain the gap between what they expected and what the prototype offered instead.

First off, additional light was shed upon as to what fellow students routinely use ÕIS for and the most frequent regular use cases were making the registration for exams, checking grades and declaring study plan. Administrative business was also mentioned a few times, ranging from application for student "*toetus*" to looking up various deadlines in academic calendar. One participant has also reported checking study programmes a lot in order to determine which courses to take. Another one was obsessed with knowing the progress of her study program fulfillment.

It was reported that personal schedules are most often managed outside of ÕIS and the experience constructing and of exporting personal schedules to Google Calendar was very negative with only a single exception.

The mobile experience of desktop ÕIS was reported to be negative. In fact, the "non-existent" user experience was so underwhelming, that 4 people never even tried to open ÕIS with a mobile device after 3-4 discouraging attempts. Most of the times respondents did try to access ÕIS on a mobile it was due to urgent need to get to schedule information, or those were unique use cases of badly needing to check if the grade was in.

The starting screen of the application was the personal profile screen. The login process has been foregone taking into account peculiarities of the prototyping environment and not wanting to face any glitches and awkward pauses if the reload of the prototype was needed. Also, making the profile screen appear in front of participants first was aimed at signaling them to understand that such a view is available and the only section it can be associated with is the users portrait and name in the main navigation menu.

The first task, though generally accomplished without aid or reinforcement on facilitator's part, revealed some serious design issues and points of insufficient thoughtfulness:

- Color-coding didn't work as intended – people understood that the different colors in their schedule were trying to communicate something to them, but were not sure what. They suggested limiting color-coding to the significant information points, such as the word "Loeng" or "Harjutus" and switching the meanings associated with concrete colors.
- In the prototype, after subject is added, the user is presented with two options – either to be taken to search page to add another course event or to see the current state of the schedule. Some of the test participants expressed bewilderment at the inability to stay where they were.
- Roughly a half of the participants thought that the search results were presented in too fine a print and looked too cluttered. People would have appreciated more clarity and distinction when picking an event to be added to schedule. They wouldn't mind less number of events per screen, but presented in a clearer way.
- Some respondents wanted the events of their schedules to be controllable also by swiping and not only batch-controlled by activation of the Edit.
- Staff icon did not communicate the tapping affordance clearly enough.
- Additional option of seeing the subject in schedule, revealed on swipe, wasn't comprehensible at first glance; hence users weren't interested in its potential benefits.
- Some people admitted that they're often quite clumsy with their phones and they would appreciate additional confirmation for every course event that they were about to add to their schedule.

Overall the design of relevant screens was found pleasant with a few minor exceptions; the search function was seen as standard and additional options for schedule creation were appreciated.

The second task has seen people run into some difficulties, but the wording of scenario was seen as mainly at fault there. According to the scenario it was prohibited to use the search function, which would have made the users bypass the carefully designed hierarchy traversal. It was a mistake. People were experience difficulties mainly because they did not know which choices would allow you to reach IABM groups through the hierarchy of programs. The vast majority, however, understood that "University Schedules" was the section they needed. The one suggestion that kept resurfacing considering the schedule view for university groups was to add text label to the add icon which is revealed on a swipe to the left.

The managing examinations task was also high in possible interactions and hence, a lot of observations and suggestions were made:

- Counter-intuitive placement of "My Exams" link. The list of exams one is registered to should be the first view when the user navigates to the Examinations section. Searching for new examinations should be available from there and not presented as the default view.
- Additional confirmation should be asked before committing people to an exam registration.
- Every item in the list of "my exams" should be swipeable and relevant additional option should get revealed on a swipe.
- Alert icon next to the exams one is registered to is unnecessary. Hardly ever would people want to be notified of selected exams as opposed to all of them.
- "No more places available" strip alignment was unclear – users didn't understand if it addressed the upper item or the lower.
- "Void" was an inappropriate word for the cancellation of the exam registration.

Despite the deficiencies respondents were delighted by the interaction animations, and the connection between exam registration and the study plan.

The fourth task, which prompted participants to locate and read a recent notification the application displayed, was the smoothest task without any actual deficiencies identified.

The fifth task was also suffering from a poorly phrased scenario, which directed users to avoid using the search bar. However, the contact page of a teacher extorted positive reactions with its design and inclusion of professor's photo. It was found that information was also neatly presented. Some participants raised an issue with the "Reception" choice of a word.

Rediscovering personal profile for completion of the sixth task has also presented difficulties to about half of participants. However, the other half was able to recall seeing personal information somewhere and was familiar with the design pattern employing photo and a name to designate navigation to profile. Having found the personal profile section users usually clicked around until, in the most cases, accidentally, they stumbled upon the list of their grades. It has been suggested for the grade button/infographics to have a clearer label, that wouldn't be as correct as "Weighted Average Grade" or "KKH aka Keskmine Kaalatud Hinne", but would simply communicate that Grades live under this button. The overall informative design of the profile page was received positively.

The task aimed at getting users acquainted with settings was also easily accomplished. Some expressed a wish there were more than one reminder before the exam and almost everybody were perplexed by classification of different types of events that could provoke a notification or be reminded of. A case for documentation or "onboarding experience" has exhibited itself here.

Participants expressed a wish to be prompted to provide additional confirmation for their actions, which, if implemented in vein of the present solution, would create a definite overdose of alert-like notifications. This is a marked anti-pattern, which Apple HIGs are explicitly warning against. An overuse of this type of feedback can instill immunity to all alerts and important messages can therefore get ignored. A new strategy would have to be developed to handle the confirmation routine with a healthy balance between prevention of accidental changes and annoying nagging.

During the follow-up interview people have admitted that they found the feature-set optimal. The only addition that was mentioned most frequently was the declaration of the study plan. Test session participants would perhaps like to see more diversity of options in the designed features, like multiple reminders before the examinations, adding courses to schedule right from the study

plan, having calendar view for schedules, having reminders for lectures and marking professors as favorites.

There was a unanimous intention to download the application should any news of such apps existence reach the participants. Some trepidation was expressed however, as to how it would function – how fast it would be and how reliable the transactions. However, people seemed excited and majority of participants shared their hopes that the application will become a reality in the end. They said that the need for it was extreme in this age of mobile computing.

When asked to express a preference for either the app or desktop version of TUT ÕIS, the respondents were divided. Some were resolute that they would prefer doing everything the mobile version enables them to do in the app, and minimizing the interactions with desktop ÕIS. Some said that it would depend on the context and if they were already behind a desktop computer they might use the desktop ÕIS. Some said that the deciding factor would be the speed and reliability of the application – if after a few attempts they would find that it does register them for exams and creates schedule reliably, they would stick to preferring the application. Overall, it can be concluded that there was a selective preference for the mobile ÕIS expressed.

3.2.3 AttrackDiff Survey

AttrakDiff (2014) survey was used to provide a more unified perspective on participant's user experience with mobile ÕIS prototype and place it quantitatively. It is a freely available online survey in the form of 28 semantic differentials. It is aimed at measuring attractiveness of a product in terms of usability and overall appearance and can also help identify areas in need of improvement.

AttrackDiff (2014) has been developed as a result of collaboration between User Interface Design GmbH and Hassenzahl (AttrakDiff, 2014) and builds upon Hassenzahl' model of UX (Hassenzahl, 2003). The 28 word-pairs are separated into 4 groups of seven and each group covers major quality constituent of UX according to the aforementioned model. Pragmatic Quality is strongly related to usability. Hedonic Quality – Stimulation professes product's ability to stimulate user's personal growth and development. Hedonic Quality – Identity indicates identification with the product: both self-contained and external (how users think they are perceived when using the product). Attractiveness stands for the overall perceived quality of the product.

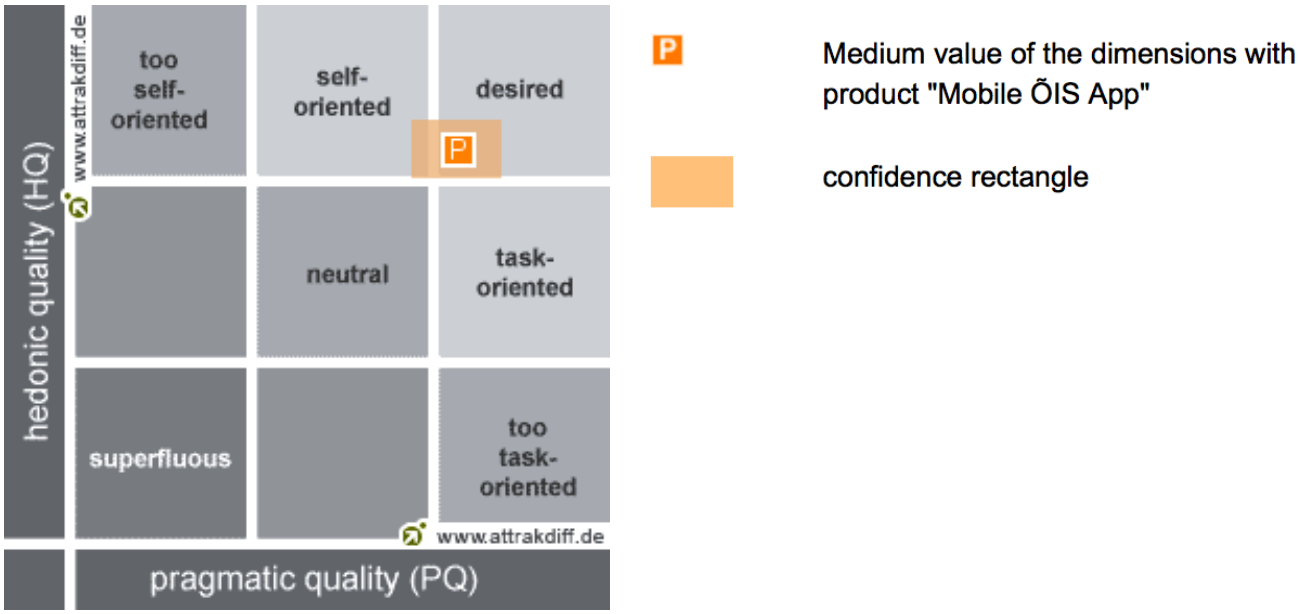

Figure 3-17. Portfolio with average values of the dimensions PQ and HQ and the confidence rectangle of the product "Mobile ÕIS" (AttrackDiff, 2014).

According to AttrackDiff evaluation results (**Figure 3-17**), the mobile ÕIS portfolio is rather positively perceived, though there's room for improvement both in the pragmatic dimension, closely mirroring usability concerns, and the hedonic dimension. The confidence rectangle is overlapping with the "self oriented" square of the portfolio classification, which hints that there is significantly more need for reconsideration and improvement of pragmatic attributes of the product. The level of satisfaction with hedonic aspect of mobile ÕIS prototype was determined to be optimal, at least, for as long as pragmatic qualities aren't completely localized to the "desired" rectangle.

The diagram illustrated by **Figure 3-18** is providing an overview of mean values for all 28 word-pairs that were used for the mobile ÕIS assessment. It can be concluded that the qualities most fit to describe the mobile ÕIS prototype would be "practical", "good" and "attractive"/"likeable". It can also be characterized as "stylish", "pleasant" and "presentable". An observation can be made that the last 7 word-pairs, color-coded yellow, rate higher than the other groups of word-pairs and that Mobile ÕIS scored the highest in terms of attractiveness.

Overall it is obvious that the primary efforts for improvement should be directed at the pragmatic aspects of the application - the improvement of overall usability - as hedonic qualities appear to be at the optimal level for an application of its kind.

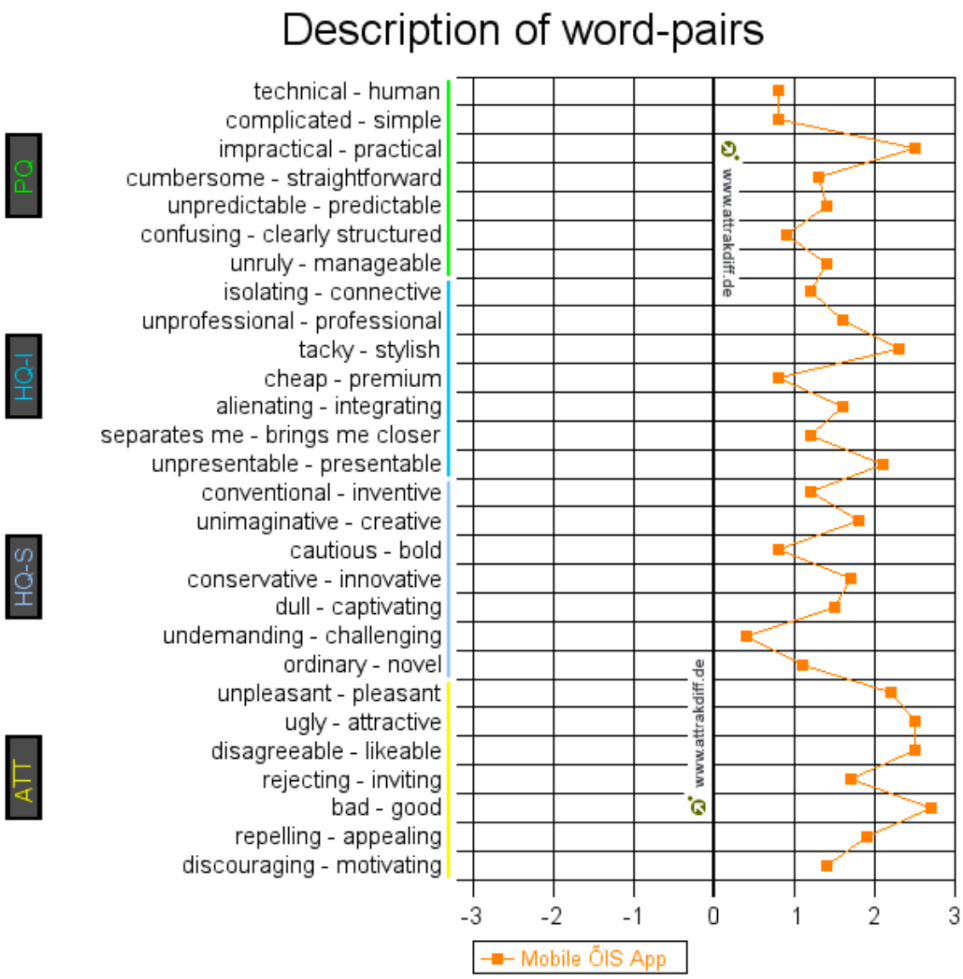

Figure 3-18. Mean values of the AttrackDiff™ word pairs for Mobile ÕIS (AttrackDiff, 2014).

3.3 Discussion

The case study was undertaken on a largely unverified assumption that the abundance and affordability of mobile devices and Internet connectivity created a yet vacant niche for mobile counterpart of TUT student information system. The initial survey results and the preliminary interview during the testing session provided confirmation of the hypothesis that a mobile version of ÕIS would be a very welcome development among students and the lack of it is acutely felt now.

The feature-set established as a result of isolated analysis of desktop ÕIS's functionality and a quantitative survey was admitted to be optimal, and absolutely not too feature-rich. During test sessions many thoughtful ideas were supplemented as to what would compliment the established feature-set, but the location feature, which scored quite high in the quantitative survey, was never mentioned. This result is very reassuring, since realistically the indoor-location feature would be very challenging to implement in a useable capacity and also very hard to design for. On a positive note, nobody wanted to eliminate the initially under-voted personal profile section, mainly because important information fitted nicely within the concept of a personal profile page and the design of the page was well liked.

Many useful insights on how students actually use ÕIS have been gleaned too late in the project, at the stage where adjustments would be "too expensive" to introduce if it were a real industry development. This made obvious the insufficiency of the preliminary user research conducted at the beginning of the study. The design of student information system as a mobile app aimed at positive user experience would have benefitted greatly from user interviews preceding the actual determination of the feature-set. The problem could have also been partially tackled by inclusion of open-ended questions in the user research survey conducted in the beginning of the study.

With regard to AttrakDiff survey results and qualitative feedback received during the test sessions it can be concluded that selection of guidelines and UX factors has been predominantly successful. The application of the guidelines, listed in detail in section 3.1.5.7, however, would have been more successful if a more thoughtful and comprehensive analysis was carried out. Evidently, the paramount consistency recommendation has been unduly disregarded or misrepresented as far as interaction principles for managing schedule and examination registrations were concearned. This

could have been overcome by careful preliminary analysis and "storyboarding" - the drawing up of state-chart diagrams of screen transitions and careful composition of user stories. This would allow identifying similar interaction premises and designing for them with greater consistency.

Overall it can be said that the design process was too lightweight and simplified – it would have additionally benefitted from

- Preliminary qualitative user interviews.
- Drawing up of the initial quantitative survey with regard not only to independent analysis of ÕIS functionality, but to insights received during the inquisitive interview.
- Inclusion of optional open-ended questions in the initial survey.
- Drawing up of user stories as in detailed view of all functionality the app needs to cover.
- Dedicated storyboarding for more thorough analyses of concrete possible user actions were interactivity is involved.

On the basis of ample feedback from interviews and user testing sessions it could be concluded that the project would have benefited from more simultaneous contributors. Even though this case study appears to prove that designing for UX considerations isn't necessary a monumental and expensive process, it still isn't a task well suited to an isolated "UX expert" – the best outcomes where such diverse user audience is targeted come from involvement of more than one person's viewpoint in the design process. Moreover, it would be recommended to inject more UX testing sessions into the design timeline, maybe even focusing on a concrete functionality during every testing effort. In university environment that should be neither complicated nor costly and the number of volunteers that could be reached through the well-established university channels should be sufficient.

The organization of test sessions can also be considered a success – participants eagerly shared their experiences and were open with their criticisms and suggestions, they reacted very positively to the tasks camouflaged as scenarios and were sometimes quite inventive while solving a given problem. However, in retrospect it has to be said that an opportunity has been missed to learn more about unique approaches to study plan composition. Schedule composition made it obvious that many different approaches can be adopted if the courses a person is going to take this

semester are largely decided on. The decision making process and the information aid it requires must be even more complex and diverse when making a semester-long and in some cases also a financial commitment.

Based on both the preliminary survey and the results of testing session, it can be concluded that the adoption rate of mobile ÕIS application would have been tremendous – all test session participants would "rush to the App Store" to download the application and see how it works, and an impressive 95% of the initially surveyed would download the application based on the descriptive concept alone.

It has been concluded that the application, even in the state that it was during the testing sessions, had a high potential of being preferred to the desktop version. Majority of test session participants agreed that they would rather handle their examination registration and schedule composition through the app, than turn to the desktop version for that. However, there was some apprehension exhibited as to whether the app would function properly. The general consensus was that, if it would, and all appointments committed to through it would actually register in the database, people would certainly transfer a lot of their ÕIS workflows to the app.

In order to be more confident of the preference conclusions it would have been advisable to run an A-B testing face off between desktop ÕIS and mobile ÕIS, or, at the very least, to have test session participants take the AttrackDiff survey for desktop ÕIS too - the points of preference would been even more evident and comparable then.

Future Development of the TUT Mobile ÕIS Design

As far as the TUT mobile ÕIS project is concerned a number of actions can be proposed to improve the existent design:

- Analyze exposed problems with exam registration and schedule creation interactions.
- Compose user stories for the problematic use cases.
- Have the state-chart transition diagrams drawn for every actionable tap
- Resolve the issue with requested action confirmations. Get rid of the alert-style confirmations.

- Work on consistency – ensure similar interactions work similarly, all white background list items are swipeable and label and icon sets are alike everywhere they appear.
- Bring the study plan creation into the set of features: investigate students' processes as to how they approach its creation and how their decision-making process works.
- Redesign the screens according to the worked out solutions through the state-chart diagram and design the study plan screens accordingly.
- Rethink color-coding throughout the application.
- Redesign tappable objects to convey the tapping affordance more clearly.
- Design the interaction for photograph addition and change and how the placeholder will look.
- Increase readability of search results.
- Conduct more work on information design, especially for lists.

4. Conclusion

Smartphones and native applications have become indispensible facilitators of people's daily routine and TUT students are no exception. Despite that, access to the essential information provided by TUT SIS remains completely unadapted for mobile devices. As a quick inquiry has shown, there is a general lack of research and reports on developing mobile counterparts to desktop SISs. This thesis addresses the issue, while making UX the central design consideration.

The first objective of this work was to appropriately select the UX factors to support design of a positive user experience in the context of the mobile counterpart to the feature-rich student information system of TUT. The second objective of the study was closely linked and was defined as establishing a subset of best practices and guidelines that would support designing for positive user experience of mobile version of ÕIS. The literature review has shown that no similar project has been documented yet. The attainment of objectives was regarded as a viable starting point for probable development of an actual application by TUT and it was also assumed that the artifacts of such a selection might prove reusable for similar developments by other universities.

The third objective of this study was to verify the choices made in the fulfillment of the first two objectives by bringing the potential users in for an evaluation. In doing so the two major topical questions were sought to be answered: whether the students would actually use an application designed as an artifact of UX centered process and if they would find such mobile application preferable to the desktop solution. These questions were raised as possible impact points on public organization's ICT priorities. It was given that design of a solution will be handled with very meager temporal and human resources. Hence, positive answers to the posed questions would suggest that there is no valid reason to disregard UX as a prime consideration in public organizations' ICT developments.

The research objectives and questions were addressed by creating an interactive prototype of the mobile ÕIS app through a process where user experience was placed as the central design value. The informed design process borrowed heavily from various sources on general and mobile UX practices and was firmly rooted in compliance to selected guidelines and benchmarking, although not directly with analogous applications.

The validity of chosen approach and appropriateness of selected guidelines and central UX factors were investigated during testing sessions and analysis of AttrackDiff survey results. Testing session feedback provided invaluable insights both as to concrete improvements of the case study design and as to how the design process and selection artifacts need to be adjusted to decrease the amount and severity of issues encountered at high fidelity stages of such a project. Despite certain deficiencies, the overall UX exhibited by the prototype was appraised as positive, high demand and selective preference for the application were established.

The results and artifacts of the case study can be further built upon by TUT and other universities in efforts to create mobile versions of their desktop SISs. It can be taken away from this project that such invaluable quality as positive UX is not as demanding in resources quarter so as not to be included in the set of ICT objectives.

Kokkuvõtte

Nutitelefonid ja nende erirakendused on saanud inimeste igapäevaelu abistajateks ja TTÜ tudengid ei ole erandid. Sellest hoolimata, ei ole TTÜ ÕISi süsteem välja arendatud mobiilseadmetel kasutamiseks. Kiire teadete kogumine ja uuring näitab, et see on üleüldine probleem, mis põhjustatud vähesest uurimusest ja kogemusest õppeinfosüsteemide mobiilrakenduste väljatöötamisel. Uurimustöö keskendub sellele probleemile ning võtab kasutajakogemuse loomekeskseks prioriteediks.

Esimeseks eesmärgiks oli õigesti valida faktorid, mis toetaksid rakenduse loomisel positiivset kasutajakogemust võimalustemahukas ÕISi keskkonnas. Teine eesmärk oli esimesega tihedalt seotud ning pidi valima alamhulga, mis sisaldaks ÕISi mobiilrakenduse loomisel positiivse kasutajakogemuse jaoks vajalikku head tava ja suuniseid. Kasutatud kirjanduse analüüs näitab, et taolist projekti veel dokumeteeritud pole. Eesmärkide saavutatust nähti hea alguspunktina tulevikus võimalikuks reaalseks rakenduse arendamiseks TTÜ poolt ning oletati, et väljatöötatud töösaadusi saavad kasutada ka teised ülikoolid.

Kolmandaks uurimuse eesmärgiks oli kahe esimese eesmärgi saavutatuse kontrollimiseks potentsiaalsete kasutajate toomine testimisprotsessi. Nii püüti leida vastus kahele põhilisele küsimusele: kas tudengid reaalselt kasutaksid kasutajakogemusele keskendunud ÕISi mobiilrakenduse ja kas nad eelistaksid mobiilirakendust desktopi lahendusele. Positiivse vastuse korral, võib see mõjutada avalikku organisatsiooni seadma kasutajakogemust keskseks väärtuseks, millest lähtuda IT-arenduste väljatöötamisel . Oli teada, et lahenduse väljatöötamiseks oli etteantud väga kasin aja- ja inimressurss. Seega, posiitivsed vastused tõstatud küsimustele vihjavad, et ei ole mingit kindlat põhjust kasutajakogemuse kõrvalejätmiseks avalike organisatsioonide IT-lahenduste arendamisel. Uurimuse eesmärgid ja küsimused lahendati ülimalt interaktiivse ÕISi mobiilrakenduse prototüübi loomisega, kus kasutajakogemus paigutati rakenduse tähtsaimaks väärtuseks. Rakenduse kasutajakogemuse loomeprotsess toetus erinevatele üld- ja mobiilrakenduste loomise praktikale ning oli tugevalt juurdunud valitud suunistes ja võrdlusuuringutes, kuid ei toetunud otseselt teiste ülikoolide analoogsetele programmidele.

Valitud suuniste ja kasutajakogemuse faktorite paikapidavust ja sobivust uuriti testsessioonide ajal ning analüüsiti AttrackDiff vaatluse tulemusi. Testsessioonide tagasiside andis hindamatut teavet,

kuidas disaini konkreetselt ÕISi mobiilrakenduse parandada ning kuidas seadistada protsessi ja komponente valiku, et vähendada probleemide teket, mis ilmnesid arenduse hilises faasis. Hoolimata teatud puudujääkidest, hinnati prototüübi üleüldist kasutajakogemust kui kõrge nõudlusega, positiivset ning rakenduse jaoks oli loodud ka valikuline eelistus.

Selle töö tulemusi ja töösaadusi saavad nii TTÜ kui ka teised ülikoolid edasi arendada, et luua mobiilrakendus nende ÕISidest. Samuti saab järeldada, et selline hindamatu väärtus nagu positiivne kasutajakogemus ei ole nii ressursimahukas, et seda ei saaks lisada organisatsiooni IT-prioriteetidesse.

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Appendix 1

Survey Questions:

Question 1. (Multi-Choice)
Specify your gender, please.
Options:

- Female
- Male

Question 2 (Multi-Choice)
What faculty does your study programme belong to?
Options:

- Faculty of Information Technology
- Tallinn School of Economics and Business Administration
- Faculty of Civil Engineering
- Faculty of Social Sciences
- Faculty of Mechanical Engineering
- Faculty of Science
- Faculty of Power Engineering
- Faculty of Chemical and Materials Technology
- Other

Question 3 (Multi-Choice)
How long have you been studying at TTU?
Options:

- It's my first year
- 2-3 years
- More than 4 years

Question 4 (Multi-Choice)
What kind of mobile OS is your phone hooked up with?
Options:

- Android
- iOS
- WindowsPhone
- I don’t have a smart phone =(
- Other (please specify):

Question 5 (Multi-Choice)

Would you download TTU ÕIS mobile app if there was one?

Options:

- Yes
- No

Question 6 (Scoring)

If there were a mobile app, how crucial would it be for it to have following functionality and information? (Assign a score on a 1 to 5 scale)

Answers:

- Schedule
- Your course results (marks)
- Room location
- Staff contacts (e.g. e-mail, consultation times and places)
- Academic calendar
- Exam registration
- Courses taught in TTU
- Notifications about academic deadlines, upcoming exams that you've signed up for and the like
- Your student info
- Declaration of a study plan

Survey Answers:

Question 1. (Multi-Choice)

Specify your gender, please.

Options:

Male	81	49%
Female	84	51%

Question 2 (Multi-Choice)

What faculty does your study programme belong to?

Options:

Faculty of Information Technology	90	55%
Tallinn School of Economics and Business Administration	18	11%
Faculty of Civil Engineering	13	8%
Faculty of Social Sciences	2	1%
Faculty of Mechanical Engineering	2	1%
Faculty of Science	6	4%
Faculty of Power Engineering	11	7%
Faculty of Chemical and Materials Technology	15	9%
Other	3	2%

Question 3 (Multi-Choice)

How long have you been studying at TTU?

Options:

It's my first year	39	24%
2-3 years	77	47%
More than 4 years	49	30%

Question 3 (Multi-Choice)

What kind of mobile OS is your phone hooked up with?

Options:

iOS	38	23%
Android	107	65%
WindowsPhone	9	5%
I don't have a smart phone	10	6%
Other	5	3%

Question 4 (Multi-Choice)

Would you download TTU ÕIS mobile app if there was one?

Options:

Yes	156	95%
No	9	5%

Question 6 (Scoring)

If there were a mobile app, how crucial would it be for it to have following functionality and information? (Assign a score on a 1 to 5 scale)

Answers:

Schedule	4,79
Notifications about academic deadlines, upcoming exams that you've signed up for and the like	4,45
Your course results (marks)	4,36
Exam Registration	3,98
Classroom Locations	3,82
Declaration of a study plan	3,80
Staff contact information (e.g. e-mail, consultation times and places)	3,77
Your Student Profile	3,26
Academic calendar	3,13
TTU Course List	2,84