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Agile software development in the public sector - the case of digital learning resources portal e-Koolikott

Master´s thesis

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I hereby declare that I am the sole author
of this master's thesis and it has not been
presented to any other university for examination.

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The master's thesis meets the established requirements

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ABSTRACT

The perception of management, public services design and delivery has changed amongst public administration scholars and practitioners throughout past decades. The debates have resulted in a drive for more agile, adaptive and citizen-oriented management, service design and delivery to be implemented. Despite these overall tendencies, e-Government projects, which are one of the most modern forms of public services provision, seem to still fail because of linear and poor management practices. As an alternative, agile software development has been designed that seems to address the management issues most common to e-Government implementation projects.

This paper sets out to explore the effects of agile software development in the context of a public-sector e-service development project. The research topic is novel and therefore and exploratory approach is taken for the analysis. For the conceptual framework, e-government implementation literature and agile software development concept are reviewed to depict the common management-related issues for e-government projects and describe the principles of agile software development which seem to help address these issues. The empirical analysis focuses on a single e-service development project that has transitioned from traditional (waterfall) to agile development process – the development of digital learning resources portal e-Koolikott. A general research question with a sub-question is posted: How does agile software development process affect a public e-service development project? Does introduction of agile software development help respond to common management-related issues of e-government projects?

The findings of the paper show in the case of e-Koolikott that introduction of agile software development despite theoretical perception associated with initially estimated budget and timeline to be exceeded due to possibility for changes to take place and inclusion of new features during the project. Lessening of long-term vision and sense of ownership for the e-service were also noted. The introduction of agile development did, however, provided better methods for control and monitoring for the public-sector procurer as they were actively included to decision making and retrospective processes oriented for improvement of efficiency and management of project scope. As another interesting finding, end-user and stakeholder inclusion seemed not to have increased, even though it is a paramount benefit described in relation to the adoption of agile development process. The reasons for lessened inclusion of the latter parties seemed to have been reasoned but could be researched further since the phenomenon depicts a difference from the theoretical knowledge.

Additional and overall findings showed, that agile software development does provide tools to address and potentially avoid majority of the management-related issues and factors for failure in e-Government projects, but just the introduction of agile process is not sufficient. Other aspects such as legal framework, planning and budgeting must be paid attention to and to achieve the expected benefits from agile development process.

The paper concludes with suggestions for future research topics regarding agile development in the public sector and for practitioners who plan to implement agile development process in the public sector.

Keywords: agile software development, public sector, e-service, e-education, agile management, e-government, Estonia

TABLE OF CONTENTS

1. INTRODUCTION

Provision of public services is with little doubt a core responsibility for the state (Timonen et al 2003, 11) with the purpose of providing a better life for its citizens (Aristotle referred by Drechsler 2015). The provision of public services has been largely affected by the existing paradigms in public administration - namely the attitudes and approaches towards public services and their provision in general have changed during the past century – starting from very strict and public institution centred approach brought by the traditional public administration movement. This was followed by the New Public Management (NPM) with a rather different approach to public services and citizens – setting efficiency and effectiveness at the centre of attention and describing citizen as a customer of the service with possibility to choose for alternative services. In more recent years, concepts like networked governance (Hartley 2005) or New Public Governance (Osborne 2010) have emerged which stress the need for more interconnectivity, networks and inclusion of stakeholders for public service design and provision and ability to cope with on-going changes.

The modern form of public services are e-services which fall under the concept of e-government. E-government was introduced in the 1990´s in parallel with concept of e-commerce in the public sector (Grönlund and Höran 2005). It has been noted that the basis for e-government expansion is related to similar driving forces as the NPM paradigm – efficiency and more effective provision of public services (Torres et al 2005). There have been many issues described regarding the implementation of e-government initiatives. Important category of such issues has been defined as management-related issues (see for example Rose and Grant 2010; Loukis and Charalabidis 2011; conclusions from Mkude and Wimmer 2016). Being a prominent researcher in the e-government discourse, Pardo & Scholl (2002) have concluded that majority of the e-government project are managed and carried using a linear model which has proven to be quite rigid and provide insufficient support for changes that are common for majority of public sector operations.

Failures in e-government projects (e.g. healthcare.gov case analysed by Anthopolous et al. 2016) have initiated calls for more agile management approaches to be adopted by practitioners and academics within the field of e-government and digital service delivery (e.g. see Janssen and Van der Voort 2016; Margetts & Dunleavy 2013; Balter 2011). The agile development principles and values (see Beck et al. 2001) seem to address the management-related issues described in the

literature. Until now, little research has been done regarding the application of agile management [and agile development more specifically] in public sector and how it might affect e-government projects (Mergel 2016).[1] It is therefore relevant to explore the topic, gain more information and build a foundation for future research. Therefore, the following research question with underlying sub-question are set forth for the thesis:

- How does agile software development process affect a public e-service development project?
    - Does introduction of agile software development help address the common management-related issues of e-government projects?

Deriving from the research questions it is the objective of this thesis to understand better how e-service development project might be affected by the introduction of agile software development – an exploratory objective in its nature. Findings of this case study could provide valuable insight for practitioners who plan to implement agile software development for e-government projects and want to consider different potential effects. From academic perspective, the value of this thesis lies in the attempt to explore the effects of agile software development in an empirical case, compare it to theory and therefore detect further research topics.

The thesis is structured into five different parts. Introduction is followed by overview of existing knowledge regarding public services, e-government and factors for e-government projects failure and concept of agile software development. Conceptual framework for the thesis is composed based on this existing research. The conceptual framework is followed by a description of the research method used to answer the research questions. The fourth paragraph gives an overview and analyses the empirical case. Main findings based on the case review and analysis are described and discussed in the fifth paragraph and suggestions for further research and practitioners planning to implement agile software development in the public sector are made. The thesis ends with a conclusion.

[1] Also, Google Scholar research for key phrases „agile development public sector “, „Scrum public sector “, agile development AND public sector “, „agile process e-government “and “agile management public sector” revealed limited if any relevant results amongst academic research papers.

2. PUBLIC SERVICES, E-GOVERNMENT AND AGILE SOFTWARE DEVELOPMENT – CONCEPTUAL FRAMEWORK

2.1. Essence of public services

The existence of public sector and state might find its roots from peoples need to survive and have a life but at the same time it is there for also achieving better life and secure the well-being of its citizens (thought of Aristotle, referred by Drechsler 2015). Therefore, a substantial part of the existence of the state revolves around supporting its citizens through provision of general services that help achieve that "better life". Public service delivery is one of the core responsibilities of a state per modern public administration research (Timonen et al. 2003, 11).

To initiate discussion on matters of public services and public services delivery, it is important to explain the concept of service as such first. There are indeed many definitions available when discussing what a service is and the understanding is not coherent amongst authors (Parry et al, 2011). Parry et al have argued that services could be defined through characteristics that seem to have been accepted by majority of authors. These include perceptions that services are in nature intangible (not physical), heterogeneous (always different and tailored to the consumer), inseparable (service is evident if there is someone consuming it) and perishable (meaning a service shall vanish when its provision is ended without any trace left). There are also authors like Gadrey (1996 referred by Gadrey 2000) who have come up with more specific definitions for a service. Ibid has defined a service to be: "a set of processing operations carried out by the service provider on a medium linked in various ways to the customers, but not leading to the production of a good able to circulate economically independently of that medium. "(referred by Djellal and Gallouj 2008, 39). As Gadrey (2000) concluded there is little doubt that a universally acceptable definition to service shall ever be found.

Similarly, to defining service in general, public services have also been defined differently in available literature. For example, amongst European Union (EU) member states that definitions vary so much that a new term services of general interest (SGI) was introduced to avoid misunderstanding (Bjørnsen et al. 2013, 16). It is important to note that even though definitions similar to Gadreys´(1996 referred by Gadrey 2000) seem to encompass also public services there are still some special characteristics to public services. Djellal and Gallouj (2008, 65-67) have noted that public services as such (a) do not have an output price, (b) are consumed (in some cases)

collectively, (c) there are both direct and indirect consumers; and (d) it adheres to principles of equality, fairness and continuity. From practitioners' perspective, public services have also been identified as services that are provisioned by the state, local municipality or a private entity fulfilling public interest to citizens based on their will (or presumed will) to fulfil its legal obligations or to make possible for the citizen to exercise their rights (MKM 2013, 6)[2]. For this thesis, the definition provided by MKM (2013) shall be used since it covers the overall goal of public services as such. The definition also brings out that the specific provider of the service can be either state institution, local municipality or a private venture fulfilling public interest.

2.2. Changing perception of public services design and delivery

Similarly, to defining public services there have been different perceptions to public services design and delivery in public administration. Hartley (2005) has argued, although from innovation perspective, that different public administration (PA) paradigms have had different perception of public services. Together with Benington, they have previously distinguished three major PA paradigms with different perceptions on governance and public management [and public services] – "Traditional" public administration, "New" Public Management (NPM) and Networked governance (NG) (Benington and Hartley 2001).

Per Hartley (2005, 29-30) the traditional public administration took a legislative, bureaucratic and rule-based approach to public service provision. The needs of the public were considered homogeneous and services are defined, standardized and provided by public sector professionals with population being the clients. The push for more standardized and pre-defined services is also evident through detailed focus on incremental budgeting as described by Hood (1991), which itself assumed public services to be more standardized and of more static nature. Kaufman (1997) described traditional public administration as being very centralized and characterized by set of strict hierarchies, which also sculpt public services delivery.

Countries influenced by the next paradigm, NPM, took a rather different approach on public services and its innovations. Hartley (2005, 30) argues that NPM was underpinned by various assumptions in neo-liberal economics and management practices. Therefore, the focus shifted towards more "efficient" and "effective" delivery of public services. Reforms of that time were

[2] Majandus- ja Kommunikatsiooniministeerium (MKM) (2013) *Avalike teenuste korraldamise roheline raamat*, accessible: https://www.mkm.ee/sites/default/files/avalike_teenuste_korraldamise_roheline_raamat.pdf

related to organizational restructuring to raise efficiency and the citizens assumed the role of the customer meaning that their voice in respect to scope and content of the service became more relevant (ibid.). Osborne (2010, 3-4) has provided additional characteristics to NPM related to public services and their delivery. For example, NPM brought with it a growth in the use of markets, competition and contracts when it came to public services – a principle that not all public services have to be delivered by public sector itself. Division of policy generation and implementation through organizational distancing can also be considered of importance when discussing public services since it separated two important parts of public service delivery – design and implementation/delivery. Performance management principles focused heavily on parts of public sector that could be measured and different indicators were set in place (mostly numeric and of monetary value) (ibid.). Hartley (2005, 30) found that innovation of public services and governance occurred mostly in relation to processes of delivery during the NPM-era.

The most recent of paradigms, referred to by Hartley (2005) as networked governance, has brought with it a view of public management as steering of the state within complex social system, network of different stakeholders and on-going changes. The policy-makers are providing large-scale innovation. The administrative institutions are rather seen as supporters of innovation [and public services delivery]. Focus is on experimenting and balancing the needs of different stakeholders. The difference from NPM when it comes to the role of the public and citizens is that the public is more and more perceived as a co-producer of public services meaning that their inclusion to the delivery process and feedback is of vital importance (ibid). Arguments from authors like Osborne (2010, 6-12) and Peters & Pierre (1998) show that irrespective of the specific public administration paradigm "ruling", the importance of interconnectivity and balancing of stakeholder interests and needs is rising. This rise of interest towards services and inclusion of citizens or the public is also evident in general management literature, where the services science has moved to the centre stage of management discussions only in the last decade (Sphorer and Maglio 2008, 238-239). As Ostrom (1972) argued there is dependency on community amongst public services organization as much as there is dependency on the service providing organizations amongst the community. Osborne et al. (2016) also noted that co-production as a concept has evolved quite in parallel with public administration paradigms, moving from a more top-down and hierarchic way of service delivery dominant to traditional PA, towards a more "consumerism" approach supported by NPM and ending up with open systems of collaboration approach predominant to networked governance (Hartley 2005) and New Public Governance (Osborne 2010). Even with some limitations and special cases, the co-operation between both providers of services (public organisations) and

citizens is in general with little doubt necessary for potentially "better" public services (for example, see conclusions by Needham 2008). For that, more adaptive management practices should be introduced to the public sector (Margetts and Dunleavy 2013).

2.3. The concept of e-government

Emergence of e-government and digital services, referred to as e-services could be considered the modern manifestation of public services delivery. The concept of e-government emerged mainly in the 1990´s together with e-commerce and was born out of the Internet boom of that time (Grönlund and Horan 2005, 714). It cannot be said that e-government is a direct result or aftermath of the NPM concept (Homburg 2004, 553-554), yet these concepts do seem to share many similar values and basis – examples being focus on efficiency, customer-centricity and lessening of bureaucratic structures to limit the citizen from engaging with the state (Torres et al 2005, 544). This can partly be attributed to the fact that e-government origins from private sector and as mentioned above is tightly connected to e-commerce which is a private sector concept.

Different authors and organizations have defined e-government in various ways (see for example World Bank 2015; UN 2016, 143). The European Union institutions have used the term e-government to describe: "the application of information and communication technologies (ICTs) to improve public services and to increase citizen participation in democratic government" (Davies 2015, 1). This somewhat general definition encompasses a multitude of aspects and in case of this thesis serves as appropriate basis since it shows necessity to think about multiple factors when implementing e-government [and more precisely electronic services].

When it comes to implementation of e-government it is necessary to take into consideration a lot of different aspects and relations between multiples parties (Tapscott 1996) and a need for substantial amount of rethinking regarding public sector and organizations relationships within it. Implementation of electronic government or electronic services is not about simple re-engineering of processes (Ndou 2004, 4).

2.3.1. Predominant management and development process for e-government projects

Pardo & Scholl (2002, 2), as the more cited authors in the field of e-government, have noted that the more popular process used in e-government development project has been linear, sequential and quite rigid in nature – referred also to as the "waterfall model". Balter (2011, 153) has also described the waterfall and linear model to be prevalent in the public sector. This model relies on consequential steps that follow each other and there is little if any possibility for change to take place regarding the requirements for the end-product or system (Wrubel and Gross 2015, 7). Royce (1970) as one of the pioneers of the software development field has described an approach to software development where program defining and analysis should be completed prior to the start of programming, software is put to operation after final testing and a substantial amount of documentation is needed to ensure a clear understanding of the solution. In Royce´s opinion this kind of process allows easier delivery of working software and less time spent on planning during the project with an assumption that the requirements are fully detailed in the beginning of the project and remain unchanged. Royce (1970) described that more intense cooperation between the developer and the customer takes place in the software requirements and [potentially] analysis phase and again more actively during testing. Thus, any change to the software could be implemented after the testing is completed. The waterfall process is visualised in Figure 1 below.

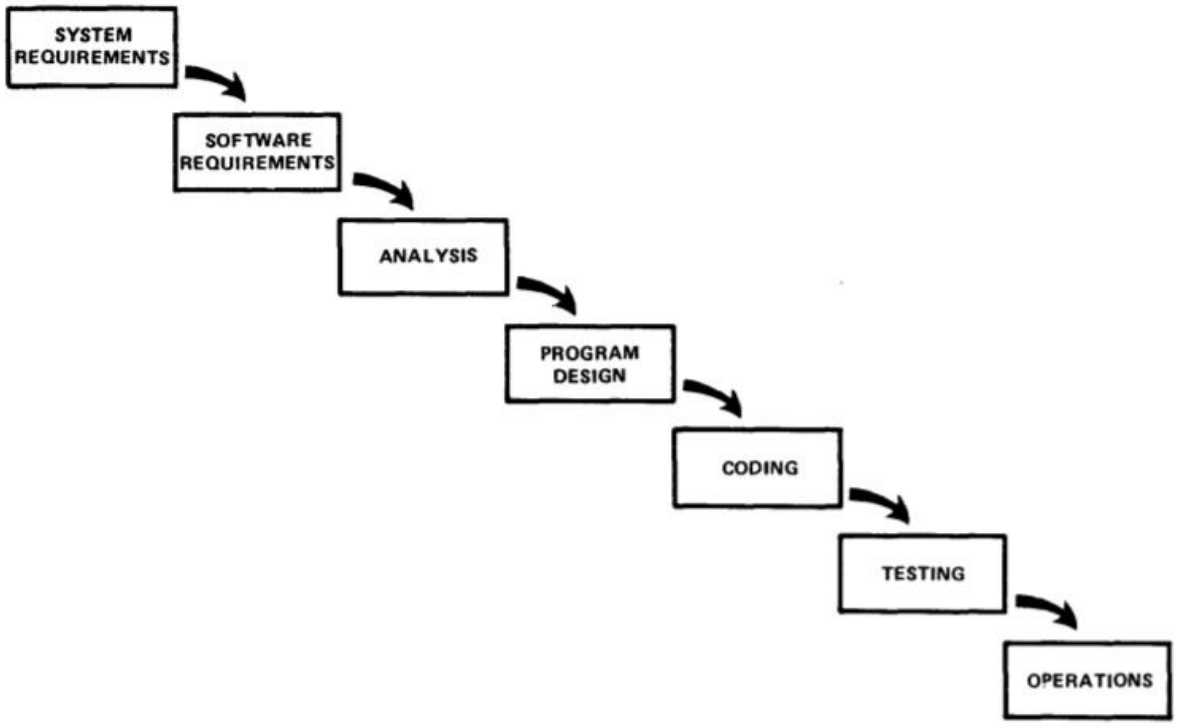

Figure 1 - Waterfall process (source: Royce 1970)

Pardo & Scholl (2002) have argued that waterfall model does not cope with the non-linear and iterative nature of the technical development process nor with organizational and social dimensions since they focus on prescribing the solution prior to its development (Meso and Jain 2006, 20). Mergel (2016 based on Dunleavy et al. 2005) has argued that this approach has become widely spread deriving from the New Public Management movement with its focus on disaggregation, competition and outsourcing of service delivery and that the public-sector contract managers are often following a very strict performance-oriented acquisition model and trying to anticipate the result [the set of features and functionality of the e-service]. This kind of approach has proven to oftentimes lead to failures – this has been evident in cases of large-scale e-government projects such as for example healthcare.gov in the US and more in other countries (Anthopoulos et al. 2016). Authors like Margetts and Dunleavy (2013) and Janssen and van der Voort (2016) have expressed the need for more agile and adaptive management approaches to be introduced in the public sector that provide a framework which consider the needs and expectations of the citizens and helps to fulfil these needs to the highest possible extent.

2.3.2. Common management-related factors for failure for e-Government projects

A failure for an e-Government project could be defined as delivery of "[…] *a late, over budget IT systems that are not fit for purpose*" (PASC 2011). The multitude of different risks associated and factors for e-government failures have been described by various authors (see for example Rose and Grant 2010; Loukis and Charalabidis 2011; conclusions from Mkude and Wimmer 2016). Since a definitive classification of issues and factors for failure related to e-government implementation is not present (Mkude and Wimmer 2016) a literature review is conducted in this chapter to present predominant [project] management and development-related issues evident in the literature. Papers focusing on failure of IT projects in the public sector were examined for the review. Other issues, such as policy, technical, legal or organisation-related, are not described here since the purpose of the thesis is to analyse the effects of agile software development, which is a process model for conducting and managing a software development project, on a specific e-government project – and because poor project management is considered major reason for failure in e-government projects (see for example Loukis and Charalabidis 2011, Pardo and Scholl 2002, Mkude and Wimmer 2016).

Budget and time-related issues

The metrics usually applied to assess project management efficiency are whether the project was delivered on time, in budget and has the planned output/software (PASC 2011). In a recent study in the US, it was found that only 9% of IT projects were completed within the originally estimated/allocated budget and established timeframe (Fernandes et al. 2016, 5). Even though the reasons for that differ the need to carry out a project on time and in budget is important, irrelevant whether the project is carried out in the private or public sector.

Scope management-related issues

It has been stressed by numerous authors that a considerable issue for e-government projects is the management of project scope (Axelsson and Melin 2009; Pinto and Mantel 1990; Pardo and Scholl 2002; Kappelman et al. 2006). Lack of frozen requirements and changing project scope tend to affect many e-Government projects negatively and the main issue there is with the inability to handle these changes from management perspective (Loukis and Charalabidis 2010; Schmidt et al. 2001). There also tends to be a considerable number of features and functionalities described in the procurement/analysis documents that either do not fill the needs of the end-users or that are not used when the system is launched – the amount of such features and functionalities can be up to 45% when it comes to public sector ICT projects, which is partly caused by rigid procurement procedures and waterfall approach where the requirements are specified prior to development (Lee and Xia 2010, 88).

Cooperation, monitoring and measurement-related issues

e-Government projects also seem to fail because the cooperation between procurer and contractor is weak and therefore there is lack of monitoring and progress measurement taking place which manifests in critical problems being noticed too late when there is little to be done to address them. (see for example Pinto and Mantel 1990; Anthopolous et al. 2016; Pardo and Scholl 2002; Nielsen and Pedersen 2014, Axelsson and Melin 2009). This could be explained by the common adoption of waterfall approach which does not foresee tight cooperation between contractor and procurer project teams deriving from the linear process – procurer is involved in the preliminary requirements specification and again when the result/product/solution is delivered (see Balter 2011

or Royce 1970). Loukis and Charalabidis (2011) have also noted lack of communication among team members and between different departments and parties as a factor for project failure.

End-user and stakeholder involvement-related issues

Substantial number of e-government projects are characterised as having very little end-user and stakeholder involvement and this is reason for failure for many projects as the solution delivered does not fulfil the expectations of end-users (see for example Luk 2009; Pinto and Mantel 1990; Anthopolous et al 2016; Janssen et al. 2013). Luk (2009) has argued that the inclusion of all stakeholder groups proves to have considerable [positive] effect on the implementation of an e-government service. Loukis and Charalabidis (2011) and Schmidt et al. (2001) have also argued, based on experience from Hong Kong, USA, Finland and Greece, that lack of user involvement and deriving from that the failure to gain user commitment could be considered a considerable source of failure for many e-government projects. Pardo and Scholl (2002) concluded that end-user involvement is of paramount importance for a successful information system development project – allowing to design and develop a solution that provides value for the end-users and through that to the whole organization. The need for higher end-user inclusion links also with the general change in perception towards public services discussed in the previous chapter – a shift towards more inclusive and networked governance has taken place among public administration practitioners and academics (Benington and Hartley 2001).

2.4. Agile software development

Even though the approach described by Royce (1970) seems to be very promising at first due to its promise of raised efficiency, discussions regarding limitations of the more traditional software development practices sprung as more iterative approaches seemed to emerge (Cohen et al 2004, 4). The main reasons for that discussion lie in the practical pitfalls of previously prevalent traditional software development methods such as the waterfall method, which aim to anticipate the final product prior to its acquisition – a drive supported by the concept of NPM with its focus on efficiency, outsourcing, competition and performance-based acquisition (Mergel 2016, 516). A major step forward for the agile discipline took place when other fields of engineering were studied and lean management was found as a good basis for further improvement of the field in the 1980s (Cohen et al 2004, 6). The term *agile* can be considered coined in 2001, when a group of leading spokespersons in the software development field came together to discuss different software

development methods (Beck et al 2001). Thus, the *Agile Manifesto* was composed that would represent joint core principles for various methods used at that time (Ibid.).

Agility for software development in general means: "*…to strip away as much of the heaviness, commonly associated with the traditional software-development methodologies, as possible to promote quick response to changing environments, changes in user requirements, accelerated project deadlines and the like*" (Erickson et al. 2005, 89).

Balter (2011) has described agile development as a series of small waterfall development cycles focusing on specific functionality at a time and not prescribing the whole system prior to the development (see Figure 2). Wrubel and Gross (2015,8) have argued that it is the principle of agile development that the specification of specific functional requirements takes place within the framework of one iteration and in the end of the iteration the scope, objectives and functionality for the next iteration are agreed upon. In the beginning of the project, only vision is set forth of the expected result/system.

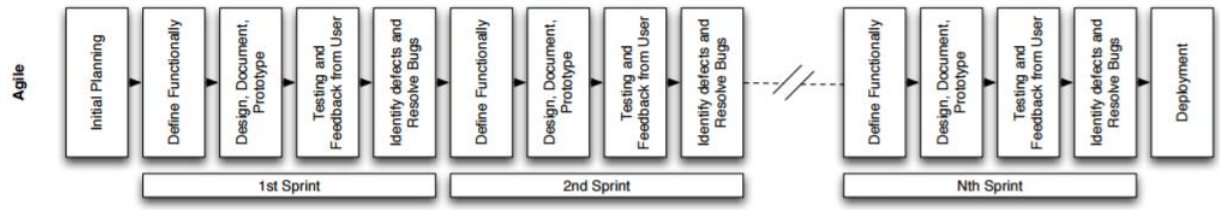

Figure 2 - Agile development process (Balter 2011)

An iteration "[…] *produces a small, tested, integrated increment of business value that is validated by customers and used as feedback for the next iteration. Iterations occur at short, regular intervals and they involve everyone: from architects to testers to the help desk staff*." (Lee and Xia 2010, 89)

Through the implementation of the practices and principles, projects carried out using agile software development have seen reduced cost and time (Bahli and Zeid 2006; Balter 2011), higher software quality due to higher and on-going motivation from the development team and overall rise in success (Moniruzzaman and Hossain 2013). Balter (2011) has argued that adoption of agile development process helps reduce the overall cost of a project through less extensive preparation

[requirements specification] required prior to the development and adaptive approach towards scope management.

Moniruzzaman & Hossain (2013, 7-17) have concluded the benefits of agile development. Practicing agile, evolutionary approach is taken to the whole project, meaning that larger targets are split into smaller sprints. This helps to keep the iterative cycles short allowing higher tolerance for requirements changes to be made during the project. Since the requirements are usually specified for one iteration (Wrubel and Gross 2015), there is capability to handle changes in the requirements and environment and quickly adapt to those changes. Another important aspect is active inclusion of end-users and/or customer, which is an important aspect for agile development (Beck et al. 2001), accompanied by short [usually between one to four weeks] implementation cycles to get feedback and set requirements for the solution. This allows fast emergence of new requirements or change requests, forces the team (procurer and contractor) to focus on highest priority functions and allows to deliver desired value to the end-user faster (ibid.). Prioritization of deliverables by the customer takes place in agile process, which provides a mechanism through which the customer can manipulate the budget and duration of the project if needed – through controlling the scope of the project (ibid.). Agile development also stresses the importance to focus on work that constitutes value for the customer and/or the end-user. Thus, agile development aims on delivery of only necessary features (ibid.). Beck et al. (2001) have also stressed that agile development focuses on the on-going communication and cooperation between team members and therefore the awareness regarding project status and goals rises among the people involved. The overall principles of agile software development as presented by Beck et al. (2001) in the prominent *Agile Manifesto* are listed in appendix C. These principles also show the expected benefits that the introduction of agile development process should bring, more notable being raised focus on value of the developed software, enhanced end-user inclusion, better governance and control of the development process and tighter cooperation and communication between the project team members [both customer and contractor side].

2.5. Conceptual framework and hypothesis

Public administration literature demonstrates that there has been a general shift in the perceptions towards public services and their provisions throughout past decades. Initial public sector centric approaches where the public administrators were the designers, implementers and providers of the public services were replaced by NPM views where public sector managers were perceived as

performance and contract managers and public services were characterised by competition and performance-metrics with citizens acting as customers. With more recent paradigms of networked governance and New Public Governance the importance of adaptive and agile governance is emphasised which means that governments need to find frameworks and ways to provide their services in a manner that considers all stakeholders and is oriented towards the needs of the citizens.

Even though the overall drive for public administration is towards a more adaptive and agile governance which can better address citizens´ needs, the more modern form of public services provision, e-government, seems to be troubled in that regard. The factors for failure in e-Government projects are often associated with shortcomings in the management of these projects. The major issues described in the literature are the overall inability to carry out projects on time and in budget, more precisely the inability to cope with changing requirements and a high number of features with no value being present in the solutions, lack of cooperation and communication in the project followed by lesser control from the procurer and lack of end-user involvement which diminishes the success of e-Government initiatives. The emergence of these issues could be associated with the prevalent way e-Government projects are conducted in the public sector usually – using the waterfall approach which takes a rigid and linear approach to project management and development process.

Based on the concept, agile software development seems to address the management-related failure factors commonly described in the literature. Its introduction should therefore help avoid issues common to e-Government projects that have been identified in the literature and associate with management and development process.

Theoretical foundation dealing with agile software development in the public sector is scarce (Mergel 2016) and therefore it is important to analyse empirical cases where agile development has been introduced in public sector e-services development projects to provide theoretical findings that would support further research and provide suggestions for practitioners.

From that note, following general hypothesis with exploratory nature is posted for analysis:

1. Management-related issues common to e-government projects are addressed and potentially avoided with the introduction of agile software development [process].

3. RESEARCH METHOD AND LIMITATIONS

The chapter at hand focuses on the research method selected to answer the research questions set forth for this thesis. Topics such as unit of analysis, method of research, case selection, data gathering, limitations and avoidance of bias are covered as follow.

3.1. Unit of analysis

Even though there are multiple approaches to defining unit of analysis (see for example Grünbaum 2007, Yin 1994) it is still relevant to establish a focus for the case study. For that, Patton (2002, 229) has provided a quite holistic explanation of what a unit of analysis is by saying: *"The key issue in selecting and making decisions about appropriate unit of analysis is to decide what it is you want to be able to say something about at the end of the study ".* He has also stated that in a sense unit of analysis can be equalized with the case itself (see ibid., 447).

Deriving from this logic the unit of analysis in this thesis is the e-service development project. E-service development project is regarded in the thesis as a process with the final purpose of providing an electronic public service. The process includes different activities starting from scope definition, budget and timeframe management, process management, development of software and stakeholder inclusion.

3.2. Method of research and principles of case selection

As the conceptual framework part of the thesis showed, there is lack of theory regarding implementation of agile software development in the public sector (Mergel 2016). In cases like this, where the underlying theory [or understanding of the phenomenon] is lacking, it is reasonable to take an exploratory approach to research (Yin 1994). For this reason, the thesis at hand is also an exploratory one by nature. Based on the categorization by Yin (1994) it could also be considered an exploratory and descriptive research.

More specifically, the research for this paper is conducted as a qualitative case study. The main reason for selecting case study as an overall method for this research was the (a)construction of

the research question – the "how"-nature of it, (b)the lack of requirement to control events and (c) the contemporary nature of events under analysis (based on Yin 1994, 4-9)[3].

Deriving from the scarce theory regarding the topic and considerable novelty of the field of study, it was important to find real-life case(s) that would be relevant for the objective of the research. A single e-service development project with which the author had personal experience with, proved to be most suitable for finding relevant answers to the proposed research questions. The case selected for analysis was an e-service development project which has transitioned from a waterfall-type development process into an agile one and therefore could provide valuable insight and relevant findings. It served as rare case in the context of this research and therefore the narrowing down of the cases to one is acceptable (Yin 2011, 89). The selection of a single case is also supported by the need to gain a more in-depth understanding of a phenomenon to present more thorough analytical findings (Yin 1994). Keeping in mind the potential bias, the insight from the author can prove to be of help in conducting the analysis as the experience with the empirical case can provide valuable knowledge, potentially not accumulated by a researcher acting as an external party.

Consequently, the analysis is based on a single case with the purpose of getting detailed insight of a situation/case which then could be generalized to provide addition to existing theory to analyse similar cases in the future (*analytical generalization from case study to theory* – see ibid., 30-32) and provide potential explanation to similar occurrences in practice.

3.2.1. Methods used for information gathering

There are three main methods used for information gathering in this research – these are (a) document (procurement documents, strategy documents) analysis, (b) semi-structured interviews with relevant stakeholders, (c) analysis of the solution itself and project management environments and (d) authors insight on the case as being the contractor representative.

In the document analysis part, different documents related to the project are analysed to characterize the situation and create background and empirical framework for the case. This also includes comparison of different procurement documents, meeting minutes and other relevant

[3] The reasoning by Yin when to use case study as a research method: „...a "how" or "why" question is being asked about a contemporary set of events over which the investigator has little or no control [required] "(Yin 1994, 9)

communication related to project. The semi-structured interviews were conducted with relevant stakeholders of the project, including representatives of public sector (project and program manager level), executors team members (including input from the author) who represent the project team together with ministry representatives. Also, interested parties were interviewed to gain additional perspective of the project. The choice was made based on the need to reach stakeholders of the project under analysis – the public-sector representatives responsible for the e-service, the interested parties and delivery team. To gain more background information on the rules and principles regarding procurement and project management established in HTM, people dealing with e-services development and procurement in general were interviewed. Their insights are consciously presented less in the empirical analysis as these are less relevant in providing answers to the research question.

The reason for semi-structured interviews as opposed to fully-structured interviews or even questionnaires was the intention not to limit the interviewees approach to the research topic (Mason 2004, 1020-1021). The interviewees were chosen based on non-random sampling which supports and is found reasoned to be practiced when conducting exploratory research (Johnson 2010, 127-130). The inclusion of different stakeholders into the sample is necessary to find out if and how has application of agile management principles affected the development of the project. The list of interviewees can be found in appendix A of the thesis.

The document analysis and interviews are meant to be complementary to each other to provide diversified information regarding the case. This is additionally supported by the insight from the author who was involved in the development of the e-service.

3.3. Limitations and avoidance of bias

One could argue that when it comes to qualitative research the most profound limitation comes from the fact that the population size is small and therefore no real generalizations can be made based on that. But practitioners of the qualitative method oppose that statement by bringing out that when looking at a bigger sample or population the key relationships can be missed (Mahoney and Goertz 2006, 238).

Even though generalizability might be an issue when using case study, on the other hand it gives the researcher the opportunity to open a subject matter in a more detailed way and per Yin (1994,

10) provides an alternative generalization approach. When researchers usually refer to limitations of generalization associated with case study they refer to statistical generalization, but what case study method provides is rather an opportunity for analytical generalizations which means that case study findings are generalizable to theoretical propositions rather than populations (ibid.).
The choice of case study method for this paper is done consciously and bearing in mind the limitations described above. These limitations can be overcome with establishment of a solid theoretical framework, application of right data gathering techniques and implementation of case study design to the research (ibid., 9-11).

One could also argue that the research question does not consider all other important aspects that might affect the development of the e-service. In the opinion of the author it is of contrary to that – the case depicts both traditional development approach used and introduction of agile principles. As it was noted in the conceptual framework part of the thesis, the focus shall be set on the effects of the changed development and management approach on the e-services development project, since management failures are considered most prominent for e-government implementation. It is also necessary to set a narrower focus due to the time and format limitations to this thesis.

It must be noted here that there is a risk of bias in the thesis at hand. The reason for potential bias is that the author of the thesis has been an active participant in the project which is being analysed – on the contractor side. In many cases that could be considered negative for the case. That is not so for the thesis at hand. The reason being, that the detailed inside view of the project that the author possesses can present potentially more detailed insight to the project than an external researcher could achieve. Methods for avoiding unexplained bias have been applied by the author. These include, as Yin (2011) has suggested – (a) an established theoretical and analytical framework and format in place for information gathering and processing, (b) explanation of all findings, (c)acceptance of findings that are contrary to the preconceptions of the author and (d) usage of multiple data sources that provide a varied view of the case to minimize risk of bias input.

4. EMPIRICAL ANALYSIS OF THE CASE

The chapter at hand focuses on reviewing the case based on document analysis, interviews and complements them with insights of the author who has been involved with the project from the contractor side. The specific case that is selected for analysis is the e-Koolikott development project which has been carried out by the Estonian Ministry of Education and Research (HTM). The analysis part of this chapter follows the structure of the common management-related issues described in the conceptual framework part of the paper and analyses the effects of agile software development on the project in these regards.

4.1. E-Koolikott – description of the project and different phases

e-Koolikott is "a single web environment comprising digital learning material arranged by keywords on the basis of the [national] curriculum… The primary purpose of e-Koolikott is to allow accessing digital learning materials from a single point - the user no longer needs to search for materials in different portals." (e-Koolikott 2016). The origin of such centralized web environment for digital learning materials to be provided as an e-service by HTM goes back to the Lifelong Learning Strategy 2020[4]. As part of the strategy, a digital focus was set for lifelong learning with the objective to "*…apply modern digital technology in learning and teaching in a more efficient way and with better results, to improve the digital skills of the general population and to guarantee access to the new generation of digital infrastructure.* "[5] Digital focus became a separate program under which the e-Koolikott as a solution and a public e-service has been created and is developed further. Even though the project could formally be connected to the digital focus program, the major initiating force for the development of e-Koolikott was a supplement to the Basic School and Upper Secondary Schools Act[6] that came into force in 01.09.2013 and which stated that all learning materials published after 01 May 2015 must be made available digitally through a digital environment provided by the ministry (interview A). Some interviewees noted that the origin of e-Koolikott even dates back prior to the formalization of Lifelong Learning Strategy 2020 (Interview C).

[4] The Estonian Lifelong Learning Startegy 2020, accessible: https://www.hm.ee/sites/default/files/estonian_lifelong_strategy.pdf
[5] Ibid.
[6] Basic Schools and Upper Secondary Schools Act, §100[5], RT I 2010, 41, 240

Pre-analysis phase

In July 2014 HTM signed a contract with Tallinn University to conduct a pre-analysis for the e-Koolikott solution[7] (referred to as pre-phase or pre-analysis). The purpose of the pre-analysis was to describe functional and technical requirements for the platform that would be used for sharing of learning resources (Interview A and C). The pre-analysis stage of the project included interviews with more than 30 different stakeholders from different institutions – examples being HTM representatives, publishers, teachers, educational technologists, IT-entrepreneurs, open-data experts, learning management system providers (e.g. eKool), universities (Laanpere et al 2014). During these interviews the requirements from and expectations of different interest groups were gathered, analysed and common requirements were composed based on the needs (Interview C). It was also noted that some of the requirements were discarded as these did not fit to the overall purpose of the solution (Ibid.). The result of the pre-analysis was a document describing the requirements for the new environment to be developed (Laanpere et al 2014). The pre-analysis phase was conducted in a timeframe of 4 months[8].

It is evident from the e-Procurement Estonia portal that the approach within the administrative field of HTM regarding development of new e-services and solutions has in recent years been towards conducting prior pre-analyses project and launching new projects with first phase having specification in place prior to development[9]. It was noted by the ministry also that for new e-services, regarding which the ministry has less technical and in-depth process knowledge, a pre-analysis is preferably conducted (interview D). This could also be associated with the fact that for the past six years or more, new (from scratch) e-services have not been procured by the ministry (interview B), which shows that experience in this field might be scarce (referred to in interview C and G).

[7] Ministry of Education and Research, Public Document Registry, mark: 10.6-5/14/788
[8] Acceptance letter dated November 2014 – Ministry of Education and Research, Public Document Registry, mark: 10.6-5/14/788
[9] E.g. The new learning information system (ÕIS) – separate procurement for detailed analysis of user requirements (https://riigihanked.riik.ee/register/hange/154765) and after that procurement for the development of phase 1 based on the user requirements was conducted (https://riigihanked.riik.ee/register/hange/176011). Also, other pre-analysis procurements have been conducted by the ministry itself.

First development phase

The pre-analysis was followed by drafting of procurement documents and alterations to requirements document (where needed) and internal confirmation process which took about 3 months and included multiple departments within the ministry who are responsible for the subject (interview A). After the internal confirmation process the procurement notice and relevant documents were published under an open procurement procedure on 08 January 2015[10] (referred to as the first phase). The open procurement procedure means that all interested persons who fulfil the economic and technical capacity criteria set forth in the procurement notice may submit a tender for the procurement[11]. For this procurement, the technical specification (scope of the project) and completion date were defined within the procurement document. It was stated in the procurement documents that the tenderer was expected to deliver the solution that meets the requirements within specific timeframe and based on a predetermined budget set forth based on the price offer made by the tenderer. The procurement evaluation criteria did include, in addition to price component (40% weight), a quality criterion (60% weight) in the form of project delivery method, timeframe and project plan that would describe the roles of the procurer and contractor. Also, the level of detail of the risk management method described by the tenderer was assessed.

Three tenderers presented a price proposal for the procurement. The winning proposal was from company Net Group OÜ (NG), whose proposal got the highest score in regards to quality criterion and thus highest overall evaluation score in the procurement, even though their price proposal was not the lowest one amongst the presented proposals.[12]

The first development phase started with a detailed analysis and visual prototyping of the e-Koolikott solution based on the scope requirements set forth in the procurement documents. The detailed analysis described the technical details regarding different features and functionalities of the solution and based on the preliminary project plan, the detailed analysis would have been followed by development of the solution itself based on the agreed details[13].

[10] E-procurement Estonia portal, procurement no 158786, accessible: https://riigihanked.riik.ee/register/hange/158786

[11] Public Procurement Act, §25, clause 1.
[12] See procurement reports for procurement 158786 (https://riigihanked.riik.ee/register/hange/158786)
[13] Net Group tender documents, process description. Governed by business confidentiality and potentially available through separate request.

It is important to note that one considerable change was introduced to the first development phase in its very beginning which required response regarding how the project was conducted further on. This was the development and implementation of a transition solution to fulfil the legal requirement by HTM. Development of such solution was not foreseen in the initial project plan but it was necessary to maintain legal compliance. The transition solution was developed as a minimum viable product that would support the cause stated in the Basic School and Upper Secondary Schools Act. The transition solution was in use until the launch of e-Koolikott portal in the end of first development phase.

On a contrary to the plan, the detailed analysis revealed for HTM that there had been functionalities described in the pre-analysis and requirements document that promised little value for the end-users in their pre-defined form or were very expensive to develop as opposed to received value and therefore the decision was made to change the development process and focus more on functionalities that provide higher value to end-users (interview A and G). The switch to a more agile development process was made in July 2016[14] – concepts like backlog[15], backlog grooming[16] and task prioritization[17] were introduced and sprint and iteration-based approach was taken towards the delivery of features and functional modules. All the functionalities were approached on a sprint-basis, detailing their specific features and re-assessing the tasks. The concepts and approaches evident in the case of e-Koolikott at this phase of the project are inherent to agile software development (see Beck et al 2001; Moniruzzaman and Hoissan 2013).

The change in the process also manifested in a way that regular (weekly or even more frequent) meetings were set in place between the contractor team and ministry project manager to compose backlog, review the results of work done during previous sprint, plan for the next sprint and conduct retrospectives to improve the process and eliminate obstacles in the project. The team also held extensive internal estimation and planning workshops to remain within the agreed budget while delivering as much of the desired value as possible. The dedicated systems analyst was

[14] Evident from project management environment for phase one, accessible: https://www.pivotaltracker.com/n/projects/1350786

[15] "*A backlog is a list of features or technical tasks which the team maintains and which, at a given moment, are known to be necessary and sufficient to complete a project or a release*.", Agile Alliance, accessible: https://www.agilealliance.org/glossary/backlog/

[16] A review of the backlog in order to remove features and technical tasks which are irrelevant to the project goal (Author).

[17] Decision process together with customer and team, which functionality/feature is more important from value perspective and positioning of the task to either top of the backlog (higher priority) or bottom of the backlog (lower priority). (Author)

removed from the team (Interview E) and the team itself and NG project manager together with HTM project manager took on the responsibility to specify the needs into small increments and organize tasks based on that.

Second development phase

After the fulfilment of the first procurement agreement, a second procurement was published. The procurement was titled to be for the maintenance and additional development of the previously created platform[18] (referred to as second phase). The procurement was again conducted as an open procurement and procurement notice was published on 04 May 2016. It was expected by the tenderers to provide a test assignment solution and hourly rate for the service as part of the tender proposal – these two parts of the tender were also used for the evaluation. The procurement was intended for the purchasing of development service within the framework of pre-determined budget and/or within specified timeframe of 24 months starting from the signing of the procurement agreement. A framework agreement structure was used as the basis for the procurement agreement. No specific pre-determined scope was described in the procurement and it was stated that development shall be carried out based on real needs of the customer. The only and therefore winning proposal for the second procurement was submitted again by NG.[19]

The development process in the second phase of the project seems to follow similar agile development process pattern as it did in the second part of first phase, after the changes in development process had taken place. Analysing the project management environment for the second phase[20] the work is carried out based on a backlog which comprises of different customer needs which are then translated (specified) into smaller tasks with clear outcomes, the tasks are then estimated regarding the amount of work, the estimations confirmed by the customer, tasks included into a planned iteration and then delivered for acceptance testing by the customer. The customer has the right to decide to prolong the development of some backlog items (features) and (re)prioritize others. Regular meetings are held to specify the tasks and expected results, estimate the working hours necessary for the delivery of functionality and compose sprints and iterations from defined backlog items to be delivered. If some tasks take longer than estimated and

[18] E-procurement Estonia portal, procurement no 173684, accessible: https://riigihanked.riik.ee/register/hange/173684
[19] See procurement reports for procurement 173684, accessible: https://riigihanked.riik.ee/register/hange/173684
[20] Project management environment for phase two, accessible: https://github.com/hariduspilv/koolikott

functionality cannot therefore be delivered during one sprint or iteration the tasks can be transposed to next iteration. The second phase is on-going at the time of writing this thesis.

The project timeline has been presented also on Figure 3 (see next page). The specific aspects of the project are analysed in the next sub-paragraphs based on the common management-related issues discussed in the conceptual framework part of the thesis.

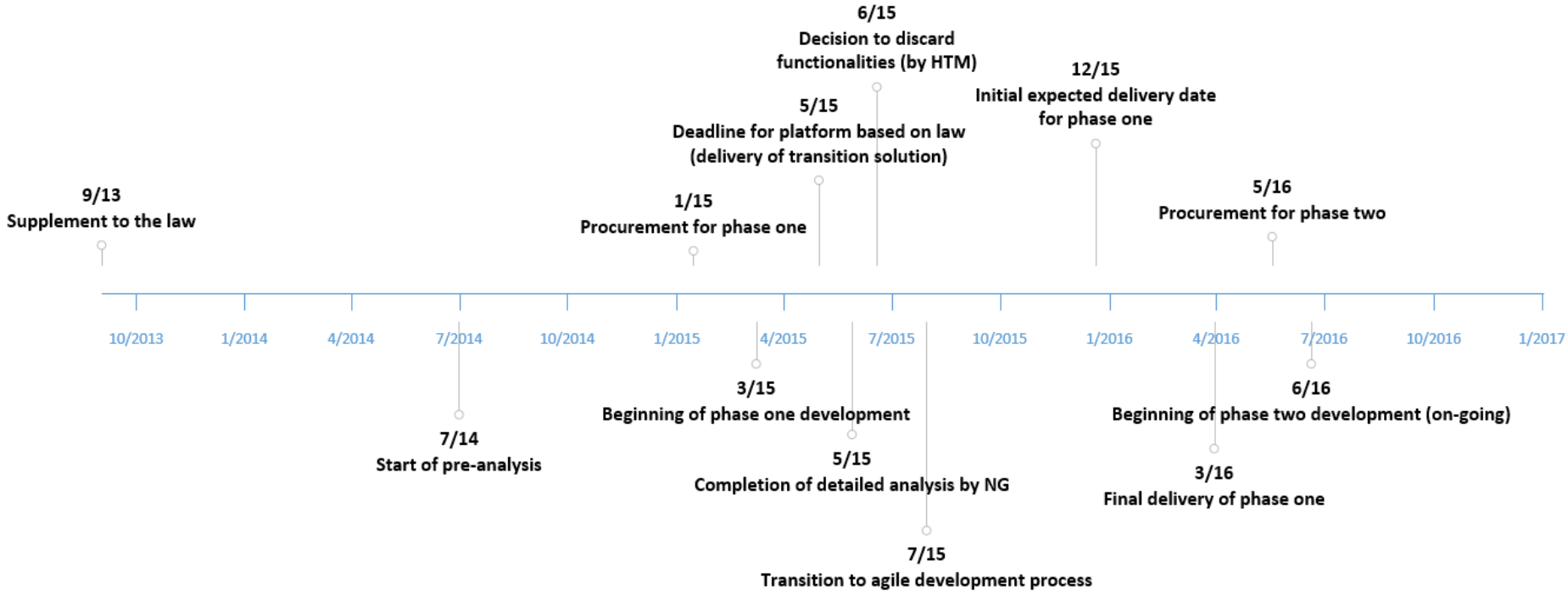

Figure 3 - Timeline of the project (Author)

4.2. Budget and time management

Both budget and timeframe were set for both development phases. The initially allocated budget for the first development phase based on the procurement agreement was 174 900 euros, excluding value added tax. In the initial procurement notice it was expected that a solution that fulfils the pre-defined requirements should be delivered within 9 calendar months starting from March 2016 and the due date being December 2016. The procurement agreement was signed in the end of April 2016 by both parties. In the agreement, the project plan still foresaw the delivery date to remain within the proposed 9 calendar months, with the delivery of the solution taking place in December 2016.

The procurement agreement foresaw potential enlargement of the budget in the amount of 20% if additional work was carried out or there was unforeseeable rise in the complexity of the to-be delivered solution. Regarding scope, it was stated in the agreement that the scope can be changed if the discarded functionality is either replaced with another functionality with the same amount of work required or the budget is reduced in the amount of the remunerational value of the functionality to be discarded.[21]

The first development phase was finally conducted with a budget of 209 880 euros and final delivery act was signed between parties in March 2016. The project management environment used for the first development phase reveals that some additional bud fixes were delivered under warranty after that. This means that the budget allocated for the first phase was exceeded by 20%, which was the maximum potential deviation from the initial budget allowed in the procurement agreement and with final delivery date 3 months after the passing of estimated delivery date in the procurement notice and procurement agreement signed between HTM and NG.[22]

Based on the work delivery acts and project documentation, the budget increase was induced by the changing needs and scope of the solution and one critical aspect was changing requirement from HTM regarding technical framework used for the development of user interface part of the

[21] Procurement agreement – first development phase, accessible: https://dok.hm.ee/et/document.html?id=7ae1b44f-531b-4ca0-901b-f4d3f9a1e966

[22] Comparison of phase one procurement agreement and information/reports from e-Procurement Register.

solution in the last part of the project[23] (mentioned explicitly in Interview E). The reasons behind the change in the technical framework remain unclear from the documents and were not specifically addressed by the project parties during interviews.

The second development phase has a budget of 130 000 euros, excluding taxes, allocated for a period of 24 calendar months. The budget is spent based on real needs and budgetary resources of HTM. The procurement agreement is a framework agreement which, upon reaching maximum budget or end of the 24-month period, shall be considered fulfilled/terminated and a new procurement must be conducted and agreement signed for further development.[24] Therefore, the budget usage analysis similarly to first development phase could not be conducted. What project communication and regular reports[25] show, though, is that the budget expenditure pace is faster than might have been expected in the procurement – meaning that the budget maximum shall probably be reached well before the 24-month period ends.

Time aspect is interesting for the second development phase. The project management environment for the second development phase reveals that there have been delays in the delivery of some milestones where there seem to be debates regarding the specific solution delivered by the development team[26].

HTM representatives (interview A and G) brought out that there are budget restrictions present for every project but budget overrun was not stressed as a critical factor for e-Koolikott with the note that the solution was new and it was to some extent expected that the final solution might end up more expensive than originally estimated (Interview G). What was brought out was that there are tasks in the backlog which have not yet been delivered and have seemed to "drop out" of milestones and iterations in the process of planning (Interview A and G). This aspect could be considered delay in the delivery of the software, even though it does not manifest in a form of any missed deadline.

[23] Comparing initial procurement agreement and Addendum signed in October 2015. The Addendum is accessible upon request for information. Reference accessible: https://dok.hm.ee/et/document.html?id=92a5d51f-eb13-4200-8d96-24a95a610005

[24] Procurement agreement between HTM and NG for the second development phase. Available upon request for information from HTM.

[25] Documents confidential between NG and HTM. Available upon separate request either to NG or HTM.

[26] Examples: https://github.com/hariduspilv/koolikott/issues/90 and https://github.com/hariduspilv/koolikott/issues/149

4.1. Scope management

The scope of the first development phase was roughly pre-defined based on the functionalities in the procurement documents and technical description of the solution. The scope and requirements document was put together based on the pre-analysis described above and first development phase was carried out considering the initially described requirements. The procurement agreement of the first phase described scope management to take place either by dismissing required functionalities, exchange of required functionalities to new ones or addition of functionalities in accordance with the maximum enlargement of the budget by 20%. As it was described in the project overview, the detailed analysis revealed for HTM that several functionalities initially required turned out to provide very little value for their price and therefore it was decided that focus would be set on value-creating functionalities (interview A and G). Features such as the school manager dashboard and in-depth learning analytics module were discarded entirely for example. During the first phase the exchange of different functionalities was conducted and some of the functionalities were simplified. It was characterized by interviewees that the agile approach allowed more flexibility to be introduced in what features would be included in the product and which ones would be not (interview A and E) and it provided more control and better management of the scope. It was also expressed that the project approach was focused on not delivering features with no real use or value for end-users (interview A and G). Deriving from the agreement format, it seemed for NG team that unnecessary trade-offs and "horse trading" had to be carried out by project managers to maintain the desired agility for the development (interview E). It was even said that even though the contract did not fully support the changes in the scope but "it was made to fit with the process." (interview E) This fact is supported by the addendums signed between parties which described changes in the scope.

In the second development phase the scope management is easier, since the work orders are composed based on real needs and broken down into small tasks that are specified in detail prior to inclusion to the sprint or iteration. Therefore, the second phase has "provided even more flexibility" (interview A) and possibility to manage changes better since "The tasks are so small that there is no need for changes once the task has been specified." (interview E). As it is evident from the project management environment for the second development phase, tasks have been left on-hold and changes managed without disproportionate effort. This is also evident from product

change log which shows the evolution of many features[27] – with changes occurring regularly based on better understanding what works best for users.

There were some negative effects related to scope management brought out by different parties. Both HTM and NG representatives (interview E and G) expressed concern regarding lack of "joint direction" and understanding of the result of the development which seems to be evident for the second development phase. So, there is uncertainty for HTM, whether they are getting expected result from the sprints and milestones carried out in the project. Another problem that was expressed in the interviews by HTM was that "maybe the process has become too agile" (interview G). This could be explained with the fact that all the desired results have not been achieved still, even during phase two. This concern was expressed by both the contractor and procurer representatives in the interviews (interview G and E).

4.2. Cooperation, monitoring and progress control

The cooperation between NG development team and HTM has also seen change throughout the project. From the formal aspect, cooperation between NG and HTM teams should have taken place in the form of meetings, e-mail, Skype chats, phone, etc. The agreement itself did not specify in very much detail how the cooperation should be carried out. It has been stated in the procurement agreement, that the party responsible for the carrying out of specific work must choose the [cooperation] method to do the work with optimal resources and keeping in mind the desired result.

In the beginning of the first development phase, the cooperation between HTM and NG was quite intense due to analysis and prototyping (interview G). The part of phase one between the detailed analysis and switch to agile development process has been described by both HTM and NG as a stand-still moment, where there seemed to lack understanding from both sides how to proceed (interview E and A). The switch to agile development process brought with it a change in the cooperation – meetings were held amongst team members regularly and quite often[28] to keep the parties aware of what is developed, what is planned and how the process is going and therefore all the project team members from both side got a better understanding of where the project is steering (interview E). This means that HTM as a procurer was involved with the project more actively and was given the opportunity to control the outcome of the project – the weekly planning and

[27] Product change log, accessible: https://github.com/hariduspilv/koolikott/blob/master/CHANGELOG.md
[28] As much as three times a week in some cases.

retrospective meetings were set in place that provided operative overview of the progress and supported on-going monitoring of the project.

Deriving from the format of the first procurement contract, the parties had to consider bureaucracy while cooperating – meaning that amendments had to be formalized as amendments to the procurement agreement and separately signed to maintain legal compliance with the national procurement legislation. It was considered somewhat cumbersome from the contractor perspective (interview E).

However, it was noted by HTM that during the first phase NG seemed to be more rigid regarding cooperation, which manifested in quite strict approach to certain functionalities and features (Interview A). This could be explained by the formal arrangement, according to which the needs of HTM had to be fulfilled within a specified budget and timeframe – that required a more rigid approach to some features and functionalities with less rooms for changes to take place.

For the second development phase, the cooperation has formally continued using the same channels as in the first development phase. Deriving also from contractual changes that have occurred, the cooperation manifests in weekly meetings to discuss the needs of the customer and translate the needs into tasks for the development team. In the beginning of the second phase, developers were directly involved with HTM more and discussed the tasks. It was expressed by interviewee E that this kind of tight communication has changed with the addition of new team members and the push to deliver more functionalities. By the time of writing this thesis the project has again a separate dedicate analyst who specifies the needs of the customer. It has created a situation where the cooperation seems to work from process perspective but it remains unclear whether the result is envisioned similarly by members of both teams – a lack of shared vision and strong product ownership was mentioned (interview E and G). A substantial effort regarding product ownership was expected by HTM (interview G) which was not explicitly stated in the procurement document and/or agreement.

For the second phase, overall, the use of agile software development process combined with supportive agreement format have increased HTM ability to control and monitor the progress of the project and receive regular overviews of the project status. Weekly reports have also been

implemented by NG to keep HTM informed of ongoing progress, risks, arrangements agreed and use of budget funds.[29]

4.3. Stakeholder inclusion

Inclusion of different external parties and stakeholders relevant to the e-Koolikott project and solution initially took place already during the pre-analysis. As it was mentioned in the project overview sub-paragraph, over 30 interviews were conducted as part of the pre-analysis and the input was used to set requirements for the e-Koolikott solution. There were very many different interest groups included in the pre-analysis phase – teachers, schools, publishers, ICT companies, academics, etc. The needs expressed by the groups were gathered, synthesized and general functional requirements were composed based on the needs (interview A; Laanpere et al 2014).

During the first phase of the development there was a limited group of external parties (besides HTM and NG) included in the process (interview C, interview E, interview F, interview G). The inclusion of stakeholders was not formalized as such (interview E, A and G) meaning that there were stakeholders present who were active themselves and who had the potential to provide additional results for the project. From the interviews (A and G) it turned out that majority of the inclusion took place in the pre-analysis phase. During the first phase of the development project the reliance was more on personal contacts and feedback was gathered from project team family members who happened to be representatives of the stakeholder groups (interview A, G). One expressed reason for that seemed to be lack of time from the end-users' side (interview A) and lack of financial instruments to pay the end-users (interview G). A methodical inclusion of stakeholders seemed to drop as the first phase of the development project seemed to progress (Interview C, Interview F, interview G). The opinions why it was so, vary among different parties (Interview C, Interview E, Interview F). For example, there is lack of knowledge among project stakeholders whether end-user testing and feedback was implemented or not (Interview C and Interview E), even though these were suggested during the first phase – meaning that formally the different parties were unaware of the situation. Another comment has been made that the inclusion seemed to take place only when there was a stand-still in the development (Interview F) or the focus was narrowed for topics regarding which external party was included (Interview C). On the other hand, the inclusion of HTM departments and sub-units of the ministry seemed to proceed – internal feedback was asked for different functionalities and more regarding user experience that

[29] The weekly reports are accessible through request for information to either HTM or NG.

was to be implemented, since the functionalities themselves were determined in the analysis and part of the agreement (Interview A).

During the second phase, there are different inclusion and feedback channels used by the ministry. These include events for subject experts twice a year which also encompass discussion of information systems, feedback from e-Koolikott feedback e-mail and user support and through HTM Facebook page (interview A). The parties admit that there still seems to be deficit in the inclusion of real end-users (interview C, interview E and interview F, interview G) so there is still a risk to develop an e-service which does not fully derive from the needs of the end users (Interview E). The decisions regarding changes and additional development seem to have been made and are being made within the ministry (Interview C, Interview F). It was expressed by the ministry that they are aware of the end-user needs and expectations based on the pre-analysis and that the e-service does not fulfil "minimum expectations" yet, to gather end-user feedback (interview G). Suggestions for stakeholder council was made during an interview that should argue on the topics of end user needs and should devise a strategic look for the project and carry the sense of ownership (interview C and interview E). This council should comprise of representatives of target groups interviewed during the pre-analysis.

5. MAIN FINDINGS

The findings from the case are discussed and analysed in this chapter. Also, suggestions for practitioners and further research topics are given deriving from the findings of this thesis.

5.1. Agile development process and project budget and time

The budget and time management of e-Koolikott project was analysed in the previous chapter. It can be said that the agile development process influenced the overall budget and time management. Even though the development and planning process seemed to support management of scope and decisions to be made during the project which should have made keeping the project on time and within the allocated budget, the project analysis showed that the initially allocated budget was exceeded. The first development phase of the project was completed with 20% budget overrun, which even though it was supported by the agreement, was more than initially estimated. Even though the agile development process provides mechanisms that should support keeping the project in time, it seemed from e-Koolikott case that the possibility to change the scope of the project brought with it an increase in the budget since there were changes that were fundamental for the technical solution and affected the amount of work needed for delivery in the final part of phase one.

Deriving from these same changes that were possible through the adoption of agile development process the first development phase was not delivered on time. The first phase of the project was 3 months late as compared to the initial deadline.

For the second phase, it seems that agile development process has helped to maintain delivery timeline compliance. This means that on-time delivery seems to be prevalent with some minor exceptions. There seems to be another tendency though – there are features that have not made to any planned milestones or iterations, which could be considered a delay in delivery of value for end-users. This shows that even though agile development process is followed, the value for end-user seems to be delayed in some cases, which is contrary to usual benefit described regarding agile software development.

So, in the case of e-Koolikott, it cannot be said that agile development process helped maintain the budget and timeframe of the project better or more efficiently. It did provide the necessary

tools to do so but on the other hand it seemed that the agility was accompanied by many changes to the scope that caused additional work and therefore budget overrun and delivery delay compared to initially established goals. The overrun of the budget in the first development phase and the velocity of development in the second phase compared to initial budget allocation time perspective also shows that agile development process seems to induce inclusion of new features easier and therefore spending of the budget faster than initially meant.

5.2. Agile development process and scope management

The analysis of how project scope was managed in e-Koolikott project, reveals that it was affected by the agile development process. The introduction of agile development process provided potential to discard unnecessary features from the scope and therefore development of unnecessary features or features with little value for end-users seemed to be avoided, which has been noted as an issue for many e-government projects. Also, the process allowed more flexibility for the ministry regarding decisions, what needs to be developed and what not. Changes were handled with little extra effort and the changes to the scope did not shut down the project or brought it to a standstill. Overall, change management was possible and evident in both phases of the project. The second development phase seemed to be even more in favour of simplified change management – the agile development process has help deconstruct the needs and requirements to such small pieces (tasks) that little change is needed during the development and changes in the legislation or requirements can be implemented in matter of iterations.

There is another aspect to scope management that became evident analysing the e-Koolikott project. Namely, the agile development process has created a problem for both the contractor and the ministry to maintain the same understanding of the expected result and therefore insecurity has risen regarding what is it that is going to be achieved through the development of specific features (interview E and G). A so-called “bigger picture” seems to be missing which was to some extent present in the first phase, even though manifested as the requirements document. Another finding with a negative connotation was that partly due to the agile development process, there were features of the solution that were needed but left out of the scope in the first phase and some have not even been implemented during the second phase (interview E and G). This could be partly due to the need to manage scope, time and budget, which requires prioritization of features – at least more in cases where the agile process is introduced in fixed-budget-fixed-time frameworks. When the functionalities and features are not prioritized during

the agile development process there is a threat that these functionalities might be left un-implemented.

5.3. Agile development process and cooperation, monitoring and control

In the case of e-Koolikott, the introduction of agile development process brought with it more active cooperation between the procurer and the contractor and allowed the procurer to have more control of the project. Regular meetings, scope discussions and debates regarding functionalities as methods strengthened the cooperation between the teams and allowed the procurer to control the outputs of the project. From monitoring perspective, the agile process has proved to allow better overview of the project status and more operative response to be taken when the project seems to steer off to the wrong direction.

Due to agreement format for the first phase, bureaucratic overhead had to be dealt with by the project managers. Scope changes had to be documented and agreed upon separately which meant that the team could not fully focus on delivery of working software, which is important for agile development approach in theory. As seen from the case, these contractual changes were also changed without disproportionate effort.

In the case of e-Koolikott, it turned out that the introduction of agile process in the first phase helped the team understand the requirements and needs better and be included in finding the best solution. It is interesting to note that addition of new team members and heightened expectations towards the number of deliverables in a single sprint has seemed to distance the team from the procurer (HTM) meaning that a separate analyst has been included to specify the needs – this in turn has made the procurer more distant for the team which lessens the understanding of what are the different goals for the project (interview E, G). It has to be noted though that from meeting minutes it shows that majority of the meetings between the customer and contractor are attended by practically all team members – so the latter finding could rather represent an emotional statement from a team member which should not be considered the absolute truth.

5.4. Agile development process and stakeholder inclusion

The findings regarding stakeholder inclusion have been quite interesting in the case of e-Koolikott. It seems that introduction of agile development process has not resulted in higher inclusion of stakeholders as it is described in the theory of agile software development. Interviews (A, C, F, E,

G) seemed to show contrary effect for e-Koolikott project – the further the project has evolved the less stakeholders seem to have been involved. Stakeholders seem to have been included more thoroughly during the pre-analysis and requirements gathering for the first phase. In the beginning of the first development phase stakeholders seemed to have bigger role in the project but as the project progressed they were included in cases of very specific topics (Interview C) and it seemed for the stakeholders that their input was needed when the project was lagging or faced with a challenge that the stakeholder could help resolve (Interview F). The inclusion of stakeholders took place mostly during the pre-analysis and during the project, through personal contacts with people representing end-user group based on information from HTM (interview A and G). More and more channels are set in place for user feedback but there seem to be no separate format included in the development process for stakeholder inclusion.

The reasons for not including the end-users or stakeholders more actively were different. Low quality of the feedback and capacity to provide it, lack of financial resources and "insufficient" readiness of the solution were brought out mainly (interview A and G). Based on the pre-analysis it seemed to the ministry representatives that they have good enough understanding of end-user requirements in order not to actively include end-user representatives more actively to the development process (interview G, F and C).

5.5. Additional findings

Some additional analytical findings are discussed here. These were not the focus of this research paper but became evident during the research and are worth to be noted.

First, it became from the e-Koolikott project that agile development process is not a sole factor to help address the management related issues. It must be accompanied by relevant legislative, planning and budgeting frameworks. It was noted in many interviews (A, G, E) that to make full use of the agile process, the legislation, procurement rules and budgeting should become more flexible, less output-based and more outcome oriented. The case of e-Koolikott in this sense is a good example, since HTM is one of the first ministries to have implemented program-based budgeting as opposed to performance budgeting[30] (interview G). This means that overall the

[30] Education commission notes, accessible : http://f.ell.ee/failid/protokollid/labiraakimised/haridus_noorsoo/2014/2014-10-09_valdkondliku_koosoleku_protokoll_09.10.14.pdf

procurements and budget allocations are made based on expected outcomes, not based on output (interview B, D, G). This accompanied with supportive agreement format allowed agility to be introduced to the project (interview A, G)[31]. It is also important that there is acceptance of new project management practices in the organization, as seems to be for HTM with their less strict approach to project management practices (interview D) and availability of suitable procurement rules and potential openness for change in that regard (interview B).

Another general finding from the e-Koolikott case was that introduction of agile development process requires strong product ownership to be defined and vision-drafting to constantly take place. As the lack of vision was expressed by both parties, this could be considered a challenge that needs to be addressed. The overall comment from many interviewees was that agile development requires talented and experienced people to work well (interview A, E). The reason for that could be in the fact that agile development helps to address some critical issues for e-government project but on the other hand brings new complexity by supporting change to take place.

It is important to note as a general finding, that agile development is not a "cure for all disease" and if practiced wrong can bring the same undesired results as the more traditional approaches – some of these potentially undesired results were evident in the case of e-Koolikott also, such as budget overspending, lack of long-term planning and stakeholder and end-user inclusion. However, agile development process seems to introduce several tools for both procurers and contractors to address the management related issues evident from the research on e-Government failures.

5.6. Suggestions for practitioners and further research topics

Some suggestions to practitioners and further research topics could be made based on the case of e-Koolikott.

The first suggestion would be that introduction of agile development process requires wider approach than just defining a new way the development process is conducted. The legal framework and contractual arrangements must be reviewed and compliance sought with the desired agile process. It is also important that there is a solid vision of what the expected results of the project

[31] HTM used a new agreement format, designed in cooperation with public and private institutions. More information: https://itpraktikud.eesti.ee/dokuwiki/doku.php?id=itari:toogrupid:erasektor:start

are and ownership is taken from the procurer side. Otherwise there is a risk of confusion among the team which might result in budget and time overrun, as it was for the first phase of e-Koolikott project.

Another suggestion for practitioners would be to emphasize end-user inclusion together with the introduction of agile development process. In the e-Koolikott project the end-user inclusion part seemed to be lacking and therefore there remains uncertainty whether the end-user experience of the e-service is as they expect it to be (interview E, C, F). Even if real end-users cannot be included in the everyday project activities, they should be included for end-user tests at some regular interval and feedback process should be incorporated. Also, requirements gathering should be done during the development regarding specific functionality to be implemented in the e-service. The latter should be done in addition to initial requirements gathering that sets the overall goal for the project.

Third suggestion for practitioners deriving from the e-Koolikott case would be not to get "carried away" by the possibility for changes and inclusion of new features that agile development process provides. This means that the change requests regarding the software developed must be made with solid reasoning behind them. Otherwise there remains the risk of ending up with a solution that is not exactly what was expected, with much re-engineering and re-doing of the functionalities and with overdue delivery time and budget overrun.

The size of the development team should be considered also. From the case of e-Koolikott it seemed that the direct cooperation between the procurer team and all members of the contractor team seemed to lessen as the expectations for the volume of work and features to-be delivered rose – at least it seemed so for the team member interviewed. This needs to be researched further to provide concrete suggestions but it is an aspect to consider nevertheless.

This thesis has also brought out some interesting findings that could spark new research topics. For example, it would be interesting to conduct a wider research on how stakeholder inclusion has taken place in other public sector projects where agile development process has been implemented and with which results. It would also be interesting to see whether lessening of long-term planning regarding the e-service developed is also evident in other projects as it was noted in the case of e-Koolikott project. More research could also be conducted to analyse the links between budgeting models and their supportiveness of agile development process in the public sector.

Since the nature of this research is exploratory it would be interesting to see, what the results are for other public e-services projects to potentially formulate more statistical generalizations.

One more philosophical research question comes to mind when researching agile software development in public sector: “How much agility is possible in the public sector?”. The final question should be researched considering the context of the state, legal environment, etc. Based on the e-Koolikott project, widening this research question to Estonian setting could potentially provide interesting and characteristic results.

The field of research regarding more modern and agile management practices for e-government initiatives and software development is most certainly promising since it is an interest of both public administration and e-government researchers and practitioners.

6. CONCLUSION

The subject of agile management has risen to the focus of public administration and e-government discourse very actively in the past few years. The historic shifts in public sector management paradigms and negative lessons from practice have made academics and practitioners in various fields, both public administration and e-government, discuss how could more adaptive, flexible and agile management be introduced in the public sector. The research conducted so far regarding agile development of public e-services is lacking. Therefore, it is important to analyse cases where this kind of agile approach has been introduced – more specifically regarding IT projects and e-government initiatives since agile software development has been around for more than a decade already and more traditional and linear approaches have resulted in failures.

The objective of this thesis was to provide exploratory insight to an e-service development project and detect potential areas where the introduction of agile software development seemed to influence the project, more precisely in areas related to management. The findings of this research could then be used by academics whose interest is agile development in the public sector and practitioners planning to introduce agile development process in their organisation. To conduct such an exploratory research, a single case was chosen for review and analysis – the development project of e-Koolikott. It was seen that during the process, which started off as quite linear, there was a turning point in which an agile approach was taken to the development process. The reason why this case was selected was because it represents a very graphic example of the introduction of agile software development process in the public sector. The data was collected through document analysis, semi-structured interviews, the analysis of the e-Koolikott software solution itself and complemented with the insights of the author who was part of the contractor team in the project.

The analysis of e-Koolikott project showed some interesting findings from both theoretical and practical perspective. First, the analysis showed that introduction of agile development process did not help avoid budget overrun and delay in the delivery time which is different from what could be expected based on existing knowledge of agile development projects. The agile nature of the scope seemed to spark several changes that resulted in additional work which in turn manifested as delayed delivery and budget overrun compared to what was initially estimated.

Secondly, from the scope management perspective, the agile development process helped to avoid development of unnecessary features and functionalities. Also, changes in the requirements seemed to have been handled with little disproportionate effort needed. On the other hand, the agile nature and small tasks made it harder for the teams to share a common vision of the expected result and finished e-service and there seemed to be a decrease in long-term planning of the e-service.

Thirdly, the analysis of e-Koolikott project revealed that agile development process provided tools for better cooperation, control and monitoring of progress of the project. Since the process allowed on-going decisions to be made by the procurer regarding the project, more control was achieved. The cooperation seemed to be challenged in the eyes of the contractor team with the enlargement of the team and higher expectations regarding the volumes of work to be done. This last finding should be researched further to provide more solid evidence whether this kind of causality was present in the project.

Fourthly, the analysis of stakeholder inclusion was conducted. This revealed probably one of the more interesting findings – the stakeholder inclusion seemed to drop in the case of e-Koolikott as the project progressed. This was evident, which is contrary to common agile development process and benefits perceived from this kind of process. The reasons were different for the lack of inclusion.

More general findings from the research were that agile development process solely on its own will not help resolve the issues common to e-Government projects. This means that agile process should be accompanied by supportive legal and procurement framework. Also, it is important that planning and budgeting process supports agile development. Another general finding from the case analysis was that agile software development process requires strong vision and product ownership from the public-sector side – otherwise, there is risk of confusion and deriving undesired results.

Based on the e-Koolikott case there rose some suggestions for practitioners and researchers. It was suggested that practitioners must analyse the legal, procurement and planning framework prior to implementation of agile process, plan methods for end-user inclusion and compose a strong vision of the desired outcome (expected value). This should be accompanied with self-control not to “get

carried away" by the possibility for continuous changes to be implemented, which is supported by the agile process.

For further research, it would be interesting to conduct similar research regarding other public sector projects to raise statistical generalizability, analyse links between budgeting models and their supportiveness of the agile development process. It would also be interesting to discuss a more philosophical question: "How much agility is possible in the public sector?".

A lesson to learn from the case of e-Koolikott is that simply implementing agile development process should not be considered "a cure for all disease" regarding management-related issues evident for e-Government projects. The agile process provides tools to address the common issues but if not practiced right can cause totally new and different issues which were discussed in the analysis of e-Koolikott project.

Overall, the field of agile software development and agile management in more general is an interesting field of research and based on the interest from both public administration and e-government academics seems to be a promising field too.

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APPENDIX A: LIST OF INTERVIEWS

List of interviews that were conducted by the author for this thesis[32]:

- Interview A. Employee (1) of the Ministry of Education and Research – directly involved with e-Koolikott project. Interview notes. 28.11.2016
- Interview B. Employee (2) of the Ministry of Education and Research – responsible for procurement. Audio recording. 28.11.2016
- Interview C. Representative of external party/stakeholder (1) involved with e-Koolikott project. Audio recording. 29.11.2016
- Interview D. Employee (3) of the Ministry of Education and Research – responsible for e-services development in general. Interview notes. 01.12.2016
- Interview E. Employee (1) of the contractor responsible for e-Koolikott development. Audio recording. 01.12.2016
- Interview F. Representative of external party/stakeholder (2) involved with e-Koolikott project. Audio recording. 02.12.2016
- Interview G. Employee (4) of the Ministry of Education and Research – directly involved with e-Koolikott project. Audio recording/interview notes. 06.12.2016

Note: The thoughts and ideas presented in the interviews are supported in the case review part of the thesis by authors own knowledge and direct experience with the project – author was part of the contractor team and acted as a steering group member for the project. The input from the author to the analysis part of the thesis is left without separate reference.

[32] Note that some interviews have audio recordings and some have interview notes associated to the. This depends on whether recording was permited by the interview partner or not.

APPENDIX B: INTERVIEW TOPICS/OPEN QUESTIONS

The semi-structured interviews were carried out and planned to cover different topics and reveal different views on the project to find common topics. Therefore, the somewhat different planned structure for the interviews was used. The interview topics and open questions are presented below based on what aspect was analysed.

1. Interview topics/open questions to cover different aspects:
    a. <u>General practices for e-service development in the ministry (interview D)</u>
        i. How are e-services development projects planned in the ministry? Please describe from your perspective.
            1. Goal setting
            2. Specification
            3. Budgeting
        ii. How is acquisition/procurement of e-services carried out? Describe based on your experience.
        iii. How does ministry manage e-services development projects in general/usually?
            1. Please describe a lifecycle of a solution and what kind of management approaches are practiced during this time?
        iv. Potential guiding questions:
            1. What parties are involved and how?
            2. What roles are there in place from the ministry side?
            3. How is the cooperation with contractor teams?
            4. How are changes handled in the projects?
        v. What is your knowledge of the e-Koolikott project?
    b. <u>E-services procurement background (interview B)</u>
        i. How is acquisition (procurement) usually conducted for e-services development in the ministry?
            1. How are procurements prepared for? What is the process like?
            2. What type of tenders are used (e.g. lump-sum, hourly rate or other models)?
            3. How is procurement/acquisition carried out during an e-service lifecycle?
        ii. What do you know of e-Koolikott project?
        iii. How has the procurement of e-Koolikott been carried out? Please describe the process from your perspective.
            1. How does procurement of e-Koolikott compare to procurement of other e-services?
    c. <u>Ministry perspective of e-Koolikott project (interview A and interview G)</u>
        i. How long have you been involved with the e-Koolikott project? At what stage did you get involved?
        ii. How e-Koolikott as a project came to be? Please describe the process based on your knowledge.

1. What were the pre-activities prior to the software development and how were they carried out?
2. Goal setting, specification and budgeting.

iii. What has the development process of e-Koolikott been like starting from the beginning of the project?
1. How have requirements setting, development and acceptance been related to each other?
2. Have there been any changes of any magnitude in the development process and management practices during the project? If yes, what kind of changes and why were they introduced? How have they affected the development in your opinion?
3. How e-Koolikott project management and development process compares to other e-service development projects carried out in the ministry based on your knowledge?
4. What role have external parties (besides the contractor) had in the project and at what steps?

iv. What has the procurement/acquisition of the development been like throughout the project?

d. Contractor view (interview E)
i. How long have you been involved in the e-Koolikott project?
ii. What has been your role in the e-Koolikott project?
iii. Please describe the development process of e-Koolikott project in your own words, starting from when you got involved with it.
iv. Has there been any change in the way the project is carried out? If yes, what kind and how have these changes affected the project and results?
v. What kind of role have external parties (besides Net Group and ministry) had throughout the project?

e. External parties (interview C and interview F)
i. What do you know of the e-Koolikott project?
ii. What has been your role regarding the project?
iii. How would you describe the development process of e-Koolikott from your perspective and your participation in the process?
iv. Have you noticed any change to the e-Koolikott project and/or your role in it? If yes, what kind of changes?
v. Have you participated in any other public sector software development projects? If yes, what kind and in which role?

APPENDIX C: PRINCIPLES OF AGILE SOFTWARE DEVELOPMENT

Principles behind the Agile Manifesto:

- Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
- Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
- Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
- Business people and developers must work together daily throughout the project.
- Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
- The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
- Working software is the primary measure of progress.
- Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.
- Continuous attention to technical excellence and good design enhances agility.
- Simplicity--the art of maximizing the amount of work not done--is essential.
- The best architectures, requirements, and designs emerge from self-organizing teams.
- At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behaviour accordingly.

(Source: Beck et al. 2001)

APPENDIX D: SUMMARY IN ESTONIAN

Agiilne tarkvaraarendus avalikus sektoris - digitaalse õppevara portaali e-Koolikott juhtumi analüüs.

Käesoleva magistritöö eesmärgiks on uurida agiilse tarkvaraarenduse mõjusid avaliku sektori e-teenuse arendamise projektile. Agiilne (*agile*) ning kohanduv (*adaptive*) juhtimine on avaliku halduse akadeemilises debatis ning praktikute seas järjest enam päevakorda kerkinud. Sellest hoolimata näib, et ühe kaasaegseima valitsemise vormi, e-valitsemise, puhul on endiselt populaarne lineaarne juhtimispraktika mis toob endaga kaasa mitmeid probleeme ja ebaõnnestumisi. Käesoleva töö peamine, avastava iseloomuga, uurimisküsimus on: (1) Kuidas mõjutab agiilse tarkvaraarenduse protsessi kasutuselevõtt avaliku e-teenuse arendusprojekti? Töö fookuse raamistamiseks on püstitatud ka järgmine alamküsimus: (2) Kas agiilse tarkvaraarenduse kasutuselevõtt aitab adresseerida juhtimisalaseid probleeme, mida on seostatud e-valitsemise (*e-Government*) projektidega?

Töö kontseptuaalne raamistik koosneb avalike teenuste üldisest teoreetilisest käsitlusest, peamiste juhtimisalaste probleemide ülevaatest olemasoleva e-valitsemise kirjanduse kontekstis (*literature review*) ning agiilse tarkvaraarenduse kontseptsioonist mis kontseptuaalselt näib pakkuvat võimalusi eelmainitud probleemide vältimiseks või minimeerimiseks.

Uurimisküsimustele vastuste leidmiseks on valitud kvalitatiivne, olemuselt avastav, juhtumianalüüsi metoodika. Uurimismeetodi valik tuleneb olemasoleva kirjanduse vähesusest nimetatud teemal ja vajadusest tuvastada esmaseid mõjusid mida agiilne tarkvaraarendus omab. Analüüsi objektiks valiti üks e-teenuse arendusprojekt, mille olemus võimaldas otsida vastuseid püsitatud uurimisküsimusele. Valik üksikjuhtumi analüüsimiseks tehti eesmärgiga tagada põhjalikum ülevaade ja sügavuti uurida projektiga toimunud muutusi ning agiilse tarkvaraarenduse kasutuselevõtu tulemusi. Andmete kogumine viidi läbi, kasutades dokumendianalüüsi, pool-struktureeritud intervjuusid, projekti halduskeskkondade ja projekti tulemi (tarkvara) analüüsi ning autori enda teadmisi projektist, olles töövõtja meeskonna liige. Tööst tulenevate üldistuste piiratus on teadvustatud ning erapoolikuse (*bias*) vältimiseks rakendati erinevaid meetmeid.

Empiiriline analüüs keskendus digitaalse õppevara portaali e-Koolikott projektile. Analüüsis käsitleti projekti erinevaid etappe ning uuriti kitsamalt teemasid, mida on problemaatilistena välja toodud e-valitsemise projektide puhul. Empiirilise analüüsi eesmärgiks oli uurimisküsimustest tulenevalt tuvastada võimalikke mõjusid, mida agiilse tarkvaraarenduse kasutuselevõtt projektile omas ning analüüsida detailsemalt, kas e-Koolikoti projekti puhul on enamlevinud juhtimisalaseid probleeme välditud, tulenevalt agiilse tarkvaraarenduse protsessi kasutuselevõtust.

Empiirilise analüüsi tulemusena leidis töö, et e-Koolikoti kaasuse puhul pakkus agiilse tarkvaraarenduse kasutuselevõtt vahendid enamlevinud juhtimisalaste probleemide vältimiseks ning mõjutas projekti mitmes aspektis, kuid puhtalt arendusprotsessi muutusest kõigi juhtimisalaste probleemide vältimiseks ei piisa. Tähelepanu tuleb agiilse tarkvaraarenduse kasutuselevõtmise puhul pöörata ka seadusandlusele, hankimise põhimõtetele ja eelarvestamisele. Lisaks võib agiilse tarkvaraarenduse kasutuselevõtmine tuua endaga kaasa uusi ja seni vähemesinenud riske ning probleeme. Empiiriliste leidude tulemusena tehti ettepanekud edasiste uurimuste tarbeks ning anti soovitusi praktikutele, kes plaanivad agiilset tarkvaraarendust avalikus sektoris kasutusele võtta.

APPENDIX E: LIST OF ABBREVIATIONS

HTM – Ministry of Education and Research (also referred to as customer and procurer)

MKM – Ministry of Economic Affairs and Communications

NG – Net Group OÜ (also referred to as contractor)

NPM – New-Public Management

PA – public administration