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How New e-Services for e-Residency Project Can Be Designed: The Case of Virtual Incubation Service

Master's thesis

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Author's declaration

I confirm that I have constructed this Master's thesis individually and that the current paper has not been presented by anyone before. All resources, viewpoints, citations, and other materials from other authors that have been used in this thesis have been referred to.

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Abstract

This study discusses designing new e-services on e-Residency platform through the case of virtual incubation service. The objectives are to outline a rudimentary theoretical framework of e-Residency services, to elucidate the relevance of virtual incubation service for the platform, to suggest an appropriate methodology for modeling e-Residency services, to provide a step-by-step modeling of the virtual incubator, and to come up with generalized guidelines for modeling new services on e-Residency platform. By reaching these objectives, the author contributes to solving the practical problem of the lack of e-services designed for e-residents of Estonia. As a result of the study, e-Residency is defined as a governmental service platform oriented on providing business services to the citizens of other countries with the goal facilitating Estonian economic development. Virtual incubation service appears to be relevant for the platform because this service helps to turn startup ideas into new companies, thereby using Estonian consultancy services and possibly registering new companies in Estonia. Other background findings are that both Estonian incubators and e-residents are interested in having such service and that it has potential advantages over ordinary incubation. Two layers of virtual incubation service, namely motivational and service design ones, are modeled with the help of agent-oriented approach, thereby reflecting all ideas from the background. In order to guide modeling future services on e-Residency platform, it is demonstrated that all agent activities are tied to the business value, interactions between e-resident and mentor agents as a key feature for the service are represented in detail, and user centricity is emphasized by means of placing an e-resident at the center of interaction patterns and quality expectations.

The thesis is written in English and contains 104 pages of text, 6 chapters, 24 figures, 13 tables, and 4 appendices.

Keywords

Startup incubator, e-Residency, virtual incubation, e-services, agent-oriented models, system design, user centricity, information and communications technology

Annotatsioon

See uuring arutleb kuidas kavandada uusi e-teenuseid e-Residentsuse platvormil virtuaalse inkubatsiooni teenuse läbi. Eesmärgiks on välja tuua teoreetiline raamistik e-Residentsuse teenustele, selgitamaks virtuaalse inkubatsiooni teenuse asjakohasust e-Residentsuse platvormi jaoks, soovitada sobivat metoodikat modelleerimaks e-Residentsuse teenuseid, et pakkuda samm sammu haaval modelleerimist virtuaalse inkubaatori jaoks ja välja pakkuda üldised suunised modelleerimaks uusi teenuseid e-Residentsuse platvormi jaoks. Nende eesmärkide saavutamiseks aitab autor lahendada praktilisi probleeme e-teenuste puudulikkuse osas, mis on mõeldud Eesti e-residentidele. Selle uuringu tulemusel on e-Residentsus määratletud riikliku teenuste platvormina keskendudes pakkumaks äriteenuseid teiste riikide kodanikele, mille eesmärk on lihtsustada Eesti majandusareng. Virtuaalse inkubatsiooni teenus on vajalik e-Residentuse platvormi jaoks, sest see aitab startup ideed muuta uuteks ettevõtteteks, kasutades seejuures Eesti nõustamisteenused ja võimalusel registreerimisel uusi ettevõtteid Eestis. Lisaks selgus, et Eesti inkubaatorid ja e-residendid on huvitatud nimetatud teenusest ja sellel on potentsiaalseid eeliseid tavalise inkubaatori ees. Kahekihilist virtuaalset inkubatsiooni teenust, nn. motiveerivat ja teenuste disaini, on modelleeritud agent-orienteeritud lähenemisviisi abil tausta-ideede kontekstis. Selleks, et tulevikus suunata teenuste modelleerimist e-Residentsuse platvormil, on töös näidatud, et kõik agent-orienteeritud tegevused on seotud ettevõtte väärtusega. e-Residentide ja mentorite vahelised tegevused kui võtmefaktorid ja ühed olulisemad teenuse tunnused, on detailselt esitatud. Samuti on rõhutatud kasutajakesksust, pannes e-residendid interaktsioonimustrite ja kvaliteedi ootuste keskmesse.

Lõputöö on kirjutatud inglise keeles ja sisaldab 104 lehekülge teksti, 6 peatükki, 24 joonist, 13 tabelit ja 4 lisa.

Võtmesõnad

Startup inkubaator, e-Residentsus, virtuaalne inkubatsioon, e-teenused, agent-orienteeritud mudelid, süsteemi projekteerimine, kasutaja keskne, info- ja kommunikatsioonitehnoloogia

Abbreviations and concepts

Agent	A system able to make own decisions, oriented on meeting system goals, and perceiving and acting on its environment
Agent-oriented model	An organized representation of a socio-technical system with an orientation on agent behavior
Business Canvas	An approach to creating business models for organizations or services with a focus on business value
e-Residency	A governmental service platorm oriented on providing business services for the citizens of other countries with the goal of facilitating the economic development of Estonia
e-resident	A user of e-Residency services who has received e-ID card from the Republic of Estonia
e-service	Obtaining a certain effect as a result of interaction mediated by information and communications technology among two or more systems
ICT	Information and communications technology
PKI	Public key infrastructure
SDP model	Startup Development Phases model
Socio-technical systems	A methodology for creating systems that are based on information technology and include humans
Startup incubator	A company or organization providing services helping to turn startup ideas into new businesses
System	An integrated composite of people, products, and processes, which is aimed at

	achieving a specific function
System design	Notions and their relationships required to model and design a socio-technical system
User-centered e-service	An e-service based on an interactive information exchange with the satisfied customer
Virtual startup incubation	A service helping to turn startup ideas into new businesses remotely and using information and communications technology

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Introduction

It was an unusually hot summer day in Tallinn when technology enthusiasts, marketing specialists, mentors from e-Residency team, and other interested parties came together for the hackathon organized by Garage 48. The agenda was to create ideas for new services based on e-Residency platform (e-Estonia, 2016d). While giving an introductory speech, the organizers explained that the project had essential services that were initially developed for Estonian citizens, for instance signing documents digitally, but new services were possible to build on their basis. The potential of e-Residency as a service platform was claimed to be far from being exhausted. Among other ideas presented that day, the idea of virtual incubation service for e-residents of Estonia was introduced by the author of this study (Garage48, 2015b). The current research is called to bring this idea closer to a functioning service.

Being a service platform, the value of e-Residency project for the end user seems to be defined by the services it offers. At the moment of conducting this study, the *practical problem* is that the platform lacks virtual services designed for its end users or e-residents. It is peculiar that all existing services on the platform were initially created for a different user group – Estonian citizens. Some of these services might be universally applicable, but most of them do not seem to be particularly useful for e-residents (Krimmer, 2014). Moreover, the statistics shows that even the services where e-residents' motivation for using the platform chimes with the motivation of e-Residency creators (bringing new economic value to the country) have a limited usage (e-Residency Dashboard, 2016). The introduction of the services designed with the community of e-residents in mind seems to be a live issue. Another aspect is that the existing services could become more useful in a combination with new ones. In this light, the *research question* of the current study is how new e-services for e-Residency project can be designed: the case of virtual incubator service.

The *key objectives* of this study help to address the posed research question:

- The first objective is to provide a rudimentary theoretical framework of e-Residency project in the context of governmental and private services, institutions, and user orientation. This way, the purpose of e-Residency as a service platform is elucidated by means of applying relevant theoretical concepts to it.
- The second objective is to clarify the problems that virtual incubation service on e-Residency can solve and the demand for it. Here, the virtual incubator and its potential users are juxtaposed with the context of e-Residency.

- The third objective is to discuss how new e-Residency services can be modeled with an orientation towards all relevant human and technological constituents of the platform, such as e-residents, digital authentification, and other ones. In this case, a suitable methodology to translate theoretical ideas into service models is pursued.
- The fourth objective is to provide a step-by-step modeling of the virtual incubator for e-residents and discuss its advantages. Reaching this goal represents main findings of the case study at hand.
- The fifth objective is to define the limitations of and guidelines for service modeling on e-Residency platform. Thereby, all previous steps are reflected upon in order to provide recommendations for designing new services on the basis of e-Residency.

After covering these objectives, it is expected to achieve the following *result*: a description of the process of modeling virtual incubation service as a blueprint for modeling other new services on e-Residency platform. The main *artifact* obtained as a result of this study is a model of the virtual incubator for e-residents.

The research is structured following the defined objectives. In the first part, *Literature review and theoretical concepts,* e-Residency and the virtual incubator are discussed as a service platform and its potential service correspondingly. It is worthy to note that providing historical information on e-Residency is skipped in favor of more substantial literature review on the topic. In case the reader needs to obtain a general introduction to the project, the research papers by Tampere (2015) and Särav and Kerikmäe (2016) are recommended. Also, though no theory is favored, a number of multidisciplinary theoretical lens are applied to the case to bring as many relevant ideas for modeling the service as possible. Particularly, public administration, institutional economics, as well as service development and startup development approaches are referred to. Moreover, it is worthy to mention that the subpart *Demand from Estonian startup incubators and e-residents* contains its separate hypotheses and results, which is an unusual practice for background sections. Such structure is related to the fact that a small-scale marketing study is conducted as a part of the background analysis to complement scarce data on the demand for virtual incubation service for e-residents. The first part concludes with research hypotheses that bridge service ideas and expected modeling results.

The second part of the research is devoted to methodology. Modeling virtual incubation service is discussed from the point of view of socio-technological systems. As a result, the agent-oriented modeling approach is justified as a methodological choice that corresponds to the formed hypotheses. Coming to the third part, it is occupied by primary findings and discussion.

Motivation and service design layer models of the virtual incubator are presented. Also, main advantages of the created models are outlined, with linking service details to business value, focusing on agent interactions, and reflecting user centricity principles being in the spotlight. The study finishes with defining its limitations and drawing conclusions from it, thereby providing recommendations for designing new services on e-Residency platform from the virtual incubator case.

Literature review and theoretical concepts

The creation of virtual incubator on e-Residency requires theoretical discussion on both the service idea and platform. I would like to begin this section with the analysis of the second notion as elucidating the nature of e-Residency seems to come prior to the creation of any service on top of it. Key aspects to be discussed are governmental nature of the project, its institutional shaping, and motivation of its end users. Afterward, startup incubation and its typical problems will be addressed. I will focus on the advantages of virtual incubation versus ordinary one and its demand in the context of e-Residency. As a result, the theoretical framework of the service to be designed will be clarified.

1. The features of e-Residency as a service platform

The discussion on designing services for e-Residency begins with basic concepts that can be used to define the project. This task does not appear to be trivial because the understanding of e-Residency changes with its evolvement. The major reason for this ambiguity is that no predefined meaning existed at the beginning of the project, but rather this meaning is constantly being co-created by the involved parties. Considering the difficulty of the task at hand, this section consists of three subparts that define e-Residency in relation to certain notions that seem to apply to the initiative. It should be mentioned that there are definitely more angles to look at the project from, and the following ones are aimed at providing a tentative characterization, rather than a full description of it. Being more specific, I attempt to define e-Residency, to consider its relation to Estonian and international institutions, and to sketch its user profile.

To begin with, basic concepts that are applied to e-Residency publicly, such as ‘government’ and ‘service’, are discussed. By means of comparing the project with the initiatives that seem to be similar to it, such as Bitnation and Stripe, an understanding of how Estonian project can be characterized through the lens of these concepts is reached. The next step is to look at the institutional shaping of the project. This angle seems relevant because Estonia as a country is involved in the initiative, which means that certain public and international institutions are affected. Finally, I turn to another side of the project, without which its services would not be possible – e-residents. The intention here is to clarify general characteristics and motivation of this community of people. So, the first theoretical section is devoted to elucidating main features that characterize e-Residency, the institutional shaping of the project, and motivation of its users.

1.1. Governmental initiative for global private needs

The recent report on e-government by the United Nations maps the concept of government as a platform. Specifically, the suggested idea is that the governments should offer "a system in place to deliver services not by governments alone, but also by citizens and others.. In doing so, governments embrace collaboration with partners such as NGOs to enhance value for citizens and increase uptake; orchestrating these partnerships and acting as catalyst and facilitator" (United Nations, 2014, p. 161). In this definition, two concepts, namely 'government' and 'platform', require further discussion. The first one usually includes bureaucratic apparatus, a legal system that protects citizen and property rights, and taxation in a certain administrative unit (La Porta, et al., 1999, p. 222). It is important to distinguish this concept from governance, which is wider and denotes "steering mechanisms in a certain political unit" based on the interaction of the sectors of government, business, and society (Drechsler, 2004, p. 388). Governance might be inside a country, region, city, just like government, also it might be global, depending on where the lines of political units are drawn. So, speaking about government, one deals with certain minimum functions of a state provided to the citizens under its jurisdiction, whereas governance refers to the way three mentioned sectors arrange their co-existence inside a country or globally.

The second notion, 'platform', belongs to the realm of information and communication technologies (ICT). The concept is widely used in relation to cloud-based solutions, where it signifies providing to the end user "languages, libraries, services, and tools supported by the provider..the deployed applications and possibly configuration settings for the application - hosting environment" (Mell & Grance, 2011, p. 3). Thus, the user can go beyond managing a particular application and, instead, utilize the settings for a set of services provided together. Providing government as a platform means that the government of a country supplies certain settings required for new services to be built upon by any of the mentioned sectors. In other words, the government abolishes providing e-services on its own, each one being tied to specific governmental agency and its specific function, but rather concentrates on providing an environment for new services to be developed in collaboration with citizens and businesses.

Another important concept that has been mentioned several times in the previous paragraph is 'service. ' At the most general level, service indicates obtaining a certain effect as a result of interaction among two or more systems (Quartel, et al., 2006, p. 3). Electronic service appears when this interaction is mediated by information and telecommunication technologies (Bekkers

& Zouridis, 1999, p. 185). It is also important to draw a line between public and private services: the first ones are provided by a particular government to the citizens under its jurisdiction (Lipsky, 2010, p. 4), whereas the second ones lack this feature. In order to call a service electronic public one, it should combine both ICT and public administration features.

In the context of e-Residency, the scholars emphasize that Estonian government offers a platform to build services by third parties (Tampere, 2015, p. 56; Kotka, et al., 2015, p. 9). Thus, it is a virtual environment that can be filled with services created by citizens and businesses, which corresponds to the idea of government as a platform. However, this project is provided by Estonia to the citizens of other countries, and the latter ones remain under the jurisdiction of their governments (Kotka, et al., 2015, p. 4). For instance, e-residents have to deal with their countries in terms of receiving social benefits or submitting taxes. As a result, most public services seem to be not relevant to build on the platform of e-Residency as they would have no legal power in the countries where e-residents stay. So, the idea promoted by the United Nations is hardly met by this project. Rather, the initiative is suitable for the services that meet private needs of the citizens of other countries. In this sense, startup incubation belongs to the realm of relevant services for e-Residency due to its private-sector orientation.

Having established that e-Residency is oriented on business needs of citizens of other countries, it is worthy to compare the project with a private initiative that seems to address the same goal, Atlas service by Stripe (Stripe, 2016). Thus, Atlas allows registering a company, opening a business bank account, accepting payments, and receiving business consultancy in the USA online. A particular focus of this project is small businesses and startups that face troublesome environments in their home countries (Isaac, 2016). At the same time, the critics claim that ensuring tax compliance and dealing with possible lawsuits in the USA might be some of the future drawbacks that Stripe does not acknowledge yet (Flagtheory, 2016). In this sense, e-Residency has an advantage of being offered by the government. The status of e-resident is regulated by the Identity Documents Act of Estonia (2016). Also, the project team deals directly with different Ministries to develop legal conditions for providing remote services (e-Residency Roadmap, 2016). So, though e-Residency does not have legal power in other countries, it is important to consider that the project does have this power in Estonia. When using the virtual incubator, just like any other service that is going to be launched on the platform, the users can be certain that their activities are legal in Estonia.

It has been demonstrated that e-Residency as a platform seems to be more suitable for private-oriented services than public ones. Also, the project is compliant with governmental regulations of Estonia. But does this project have global governance elements? To address the posed question, I would like to compare e-Residency with another private initiative, Bitnation, providing "do it yourself governance services" (Bitnation, 2015a, p. 1). Bitnation has three main parts: user platform, a library of applications and application programming interfaces, and identity services. The first one consists of separate modules that can be added and withdrawn by users (Ibid, p. 3). The second one provides software and parts of the code that can be downloaded and tailored to a particular need, be it business or public one (Ibid, p. 3). The third, and most important, one provides digital identity based on blockchain (Ibid, p. 6). Though a detailed discussion of blockchain technology is beyond the scope of this study, it is worthy to conceptualize it as a technology of distributed and secure record keeping (Mougayar, 2015). The chain consists of blocks of data that can be verified and stored by any user in the network, but the personal attribution of the data is protected by public key infrastructure (PKI). This way, the data is always open, distributed, and protected. In the case of Bitnation, the aim is to use blockchain for providing services that compete with governmental ones in any country (Susanne Tarkowski Tempelhof on Bitnation and DIY Governance, 0:50). For instance, the project offers a generation of world citizenship identity that can be used to identify a person in various situations like proving employment or education.

When compared with Bitnation, e-Residency seems to differ in two main aspects. Firstly, granting e-Residency as a service is provided by Estonian government (e-Estonia, 2016b). The data that potential e-residents need to fill in is largely similar to the one collected from ordinary residents, and the government is responsible for checking this data. It means that all e-residents have to trust Estonian government when dealing with identification of other participants in the network. Secondly, the project relies on using existing e-services provided by the country. For instance, e-residents can sign documents digitally with the help of public key infrastructure provided by Estonian company SK in collaboration with the government (SK, 2016). Overall, the government of Estonia provides both the access to the platform and essential services upon which new ones can be built. This set-up appears to be useful for virtual incubation service. For instance, the exchange of legal documents in the process of startup development can be done online with the help of Estonian digital signatures. At the same time, the virtual incubator does not seem to require global governance possibilities.

To underline the difference, Bitnation and e-Residency projects are possible to combine. This fact has been demonstrated by launching public notary service for e-residents, where documents can be notarized with the help of blockchain technology (Bitnation, 2015b). In this case, blockchain is used to corroborate the documents, whereas e-Residency provides an additional user identification. As can be seen, the two projects are not competitors regarding creating global governance. Though e-Residency also provides a set of services with open APIs (e-Estonia, 2016c), the project relies on Estonian government as a trusted party. Whereas this condition might not be beneficial for providing global governance services that compete with governmental ones in different countries, it suits well private-sector oriented initiatives like the virtual incubator.

In this subpart, a rudimentary conceptualization of e-Residency has been provided. This conceptualization is required for designing new services on the platform; otherwise, they might not correspond to the project's aim. Among most important points, e-Residency does not seem to be government as a platform in the sense of the United Nations' definition, because, though Estonia is providing the initiative, the users of this project remain under the jurisdiction of their citizenship or residence countries. However, the services launched on e-Residency are compliant with Estonian laws, which is not the case with private competitors of the platform like Stripe. At the same time, e-Residency is not a global governance initiative like Bitnation, because the government of Estonia controls the access to the platform and provides its basic services like digital identity. It seems that we deal with a governmental platform oriented on providing business services for citizens of other countries. Virtual incubation service fits this framework because it is a private initiative that can be provided across the borders. Other important aspects are that the service is oriented on creating new companies and existing Estonian governmental services like digital signature can be used for it.

1.2. Institutional adjustment of new services

In the previous section, it has been established that Estonian e-Residency offers governmental services for individual needs of citizens of other countries. Also, new services can be built upon the initial ones by third parties. In this context, it is worthy to discuss which services are suitable for the platform. The existence of a governmental group responsible for the project, which is called e-Residency team, and their understanding of the project indicate a tentative institutional set-up for new services to be developed. This subpart will offer a concise discussion of the ways

e-Residency relates to existing institutions and how developing virtual incubation service fits the picture.

To begin with, the concept of 'institution' has many interpretations. For this study, the definition offered by North – "humanly devised constraints that structure political, economic and social interaction", is adopted (1991, p. 97). Institutions are a medium that allows individuals and organizations to operate in a particular way, and, depending on which behavior is successful, the institutions are altered or preserved. The development of new projects is path dependent, meaning that public and private actors use the opportunities inherently existent in a particular institutional structure. For example, existing property rights and political rules provide "a set of structured possibilities and constraints of interaction" (North, 1994, p. 360). In order to be successful, any initiative has to be adjusted to existing institutions or should attempt to change some of them.

Coming to the next idea, institutions are not necessarily formal. They also exist as mental models of the actors of change and "shape perceptions of payoffs" (Ibid, 1994, p. 362). In this regard, path dependency is stressed concerning the fact that rules can be changed relatively fast, but norms that legitimize these rules change very slowly (Ibid, p. 367). When applying this notion to governmental e-services, the scholars claim that the adoption of ICT does not merely provide a new channel for services, but alters the relationship between government and society (Gasco, 2003, p. 7). It has been argued that, for institutional reasons, this change happens gradually (Ibid, p. 13). In some cases, the introduction of a new technology might even be used to preserve existing institutions in the interests of specific actors (Fountain, 2001, p. 90). On the bottom line, mental models of the actors that introduce a certain e-service or service platform seem to shape the way it develops.

When applying the discussed notions to e-Residency, it is worthy to mention that no author has studied institutional challenges related to providing a governmental platform with private services for citizens of other countries with the help of ICT. Probably, there is still not enough empirical data for such research as e-Residency seems to be the first project of this kind. Also, a detailed discussion of institutional aspects of the project is out of the scope of this study. However, what can be said for sure is that institutions do play a role in this development. It seems that the project might bring unpredictable transactional and reputational costs for Estonia in case it challenges international institutions like citizenship. As a result, the development of e-

Residency services appears to be guided in an acceptable direction for its creators who represent Estonian state.

The guidance seems to be conducted in two primary ways. Firstly, e-Residency team exists as a formal governmental organization responsible for project development (Vatter, 2015, sl. 3). Among its basic tasks, the group of seven members has providing support for potential e-residents, coordinating the work of Estonian state and private actors, organizing public events, and other ones. An example of their work is a series of hackathons organized in collaboration with Garage48 startup incubator (Garage48, 2015a). During these events, the members of e-Residency team served as mentors and judges for participants who developed service ideas. For new services to be given green light, they should have been approved by the team, which is an attempt of institutional adjustment. In this regard, the idea of virtual incubation service underwent the process of presenting and further brainstorming at one of the hackathons.

The second way of guidance is through informal mental models of its creators. Specifically, it is worthy to cite Taavi Kotka, Government CIO and initiator of the project, and Kaspar Korjus, Managing Director of e-Residency: the project is ‘available to anyone in the world interested in administering a location-independent business online’ (Kotka, et al., 2015, p. 4). Through this statement, the expectation that new services will be oriented on conducting business activities with the help of the virtual environment that e-Residency provides seems to be demonstrated. It is peculiar that, though the Appendix to the Estonian Identity Documents Act outlines more aims of e-Residency, for instance the advancement of Estonian culture overseas, the de-facto project development is focused on business services (Särav & Kerikmäe, 2016, p. 66). Though the details of startup incubation will be discussed in the following sections, it should be stated that virtual incubation service appears to correspond to the framework provided by the project creators. The service is aimed at startup mentoring, thereby increasing the number of e-residents who register their business in Estonia online.

The importance of e-Residency team is emphasized by the fact that various opinions on the project exist inside Estonia. Thus, the initiative creators map the network of actors whose roles influence the project (Kotka et al, 2015, p. 5). For instance, the Ministry of Justice is responsible for developing legislation concerning the business environment. In this regard, it is worth attention that the Minister of Justice, Urmas Reinsalu, considers opening companies in Estonia remotely risky due to possible offshore and money laundering operations and asks for cautious changes in the legislation (Meiessaar, 2016). His view seems to be contrary to the approach of

Taavi Kotka, who argues that the adoption of legislative changes does not take place fast enough. It is also possible that their views will alter in the future. In this case, e-Residency team is responsible for building a single project development view (e-Residency Roadmap, 2016) from shifting mental models of the main actors. Developers of new services on the platform can orient on this unified view when creating their services. Particularly, virtual incubator fits the project development direction called 'Product/services development for e-residents.'

Overall, the issue of institutional adjustment of e-Residency remains open, and this subpart indicated its importance for designing new services for the project, rather than provided ultimate answers. More generally, it remains unclear which approach to existing institutions is more appropriate to choose when building new services by third parties upon governmental ones on the platform provided for citizens of other countries. In the case of e-Residency, the tentative approach seems to be prioritizing the correspondence to international institutions, such as citizenship, rather than challenging them. Also, different opinions in the network of Estonian actors that influence the project are translated into a unified development view. This translation is achieved by having e-Residency team and their mental model as a gateway for new services. Virtual incubation service idea has undergone the development during their hackathon event and corresponds to the orientation on establishing a company in the virtual environment. Moreover, the service idea seems to fit a specific direction of project development, namely, creating new services for e-residents by third parties. In this sense, the service appears to be institutionally suitable for the project.

1.3. e-Residents as users and their motivation

Two crucial participants that should be considered when designing new services for e-Residency have been discussed in previous parts: the government of Estonia and private service providers. However, one more party is involved, e-residents, without whom the project would have no users. After fifteen months of the project, this group counted slightly over 8 800 participants from 127 countries that represent all regions of the world (see Figure 1). Their motivation for applying was also quite diverse, for instance 37% opted for running location-independent business, whereas 16% claimed to be fans of e-Residency (e-Residency Dashboard, 2016). Because of this diversity, it might seem acceptable to neglect e-residents when designing new services. Below, it will be demonstrated why this is not the case.

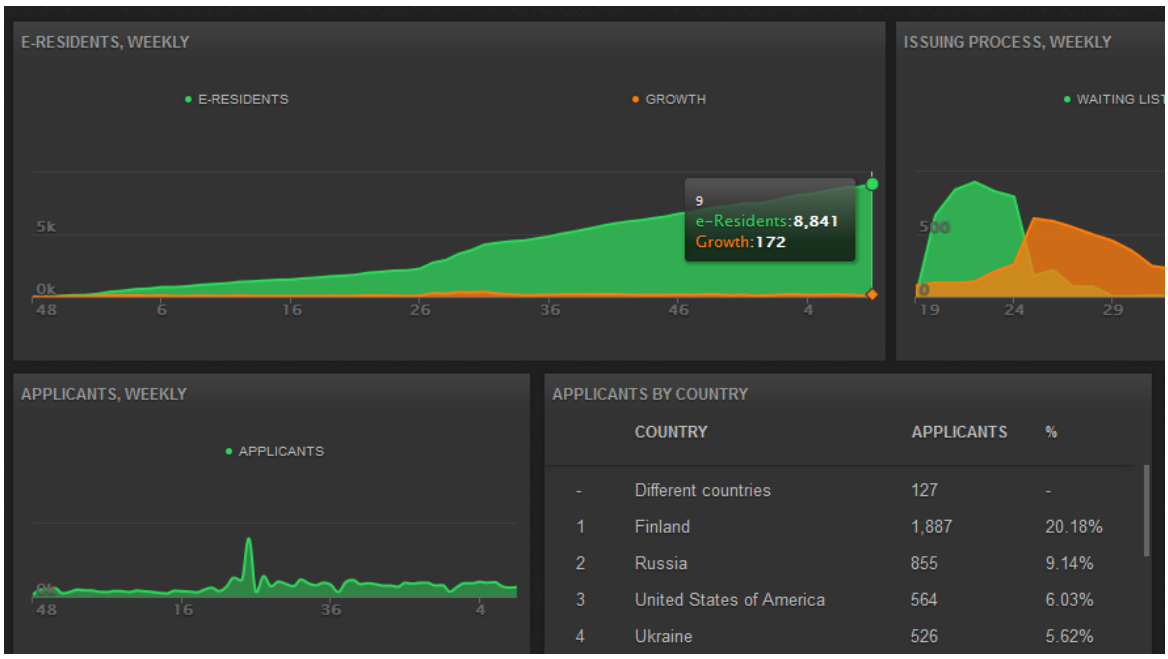

Figure 1. The number of e-residents and their countries of origin as of March, 7, 2016
Source: e-Residency Dashboard, 2016

The previously discussed definition of service emphasizes interaction between at least two parties: provider and user. As a result of this interaction, condition of the end user changes (Badja, et al., 2010, p. 620). It has been argued that e-services are not only the ones provided with the help of ICT, but also "based on an interactive information exchange with the satisfied customer (customer-centered approach)" (Lombardi, et al., 2010, p. 275). In this research, the notion of 'customer' is a synonym of 'user'. Including users into service design might help avoid unnecessary features, make services more useful, and save money (van Velsen, et al., 2009, p. 477). Another approach – service logic one, demonstrates that customer involvement in service development creates the value of e-services (Gummerus, 2010, p. 426). However, this thinking does not seem to be straightforwardly applicable in the case of e-government. Particularly, van Velsen et al. (2009, p. 478) indicate that public e-services are provided for heterogeneous citizen groups, many of these services are used incidentally, implementing regulations is a priority, competition is non-existent, interoperability inside governmental offices is difficult to achieve, and public funds usage is restricted. It seems that though taking into account user orientation is useful for e-government services, its applicability is complicated.

The situation with e-Residency services appears to be quite different from ordinary e-government ones. Among the mentioned problems, only heterogeneity of e-residents and interoperability between services are relevant for designing new services on the platform. But e-

Residency is free from implementing regulations between government and its citizens, relying on public money, and having to provide rarely used services. Moreover, the project has private competitors like Stripe Atlas. These conditions make user inclusion more important for designing new services for e-residents than for citizens in case of doing e-government as usual. At the same time, e-Residency already provides certain services that are in demand, judging by the annual growth of project users. Among most prominent ones are running location-independent businesses, having online banking, doing business administration online, and signing documents digitally (e-Estonia, 2016a). This fact might be a constraint because implementing new services does not seem to be an urgent need for the project. It appears that, in order to be viable, virtual incubation service should both address the needs of e-residents and utilize the possibilities of the services that already exist on the platform.

The first study on e-residents as users concludes that many of them lack the understanding of how e-Residency works and what they can do with their e-ID card (Tampere, 2015, p. 56). In this regard, it is worthy to consider the statistics on the motivation of e-residents to join the project. The biggest group of them, 37%, wants to create location-independent international business, 21% would like to bring their business to Estonia, 16% are fans of e-Residency, 11% are motivated by using the technology of secure authentification online, 9% want to visit or live in Estonia, and 6% have various other motivations (e-Residency Dashboard, 2016). It seems that first two groups, or 58% of users, might be potentially interested in virtual incubation service for their business ideas. This hypothesis is corroborated when one considers the number of new companies established by e-residents – 393 for 8841 users (see Figure 2). Thus, only around 4,5% of the users register at least one new company in Estonia. The ownership of established companies is also quite modest in comparison to motivation figures – 827 or about 9,4% of the users. Though the reasons for this lag between motivation and implementation might be various, it is clear that more than one-half of e-residents are interested in business-related services, more than one-third of them are considering creating new business online, and, at the same time, only around one twenty-fifth of them actually establish a new company with the help of existing e-Residency services. It seems that introducing virtual incubation service might be relevant regarding both helping e-residents turn their ideas into startup companies and increasing the use of other services on the platform.

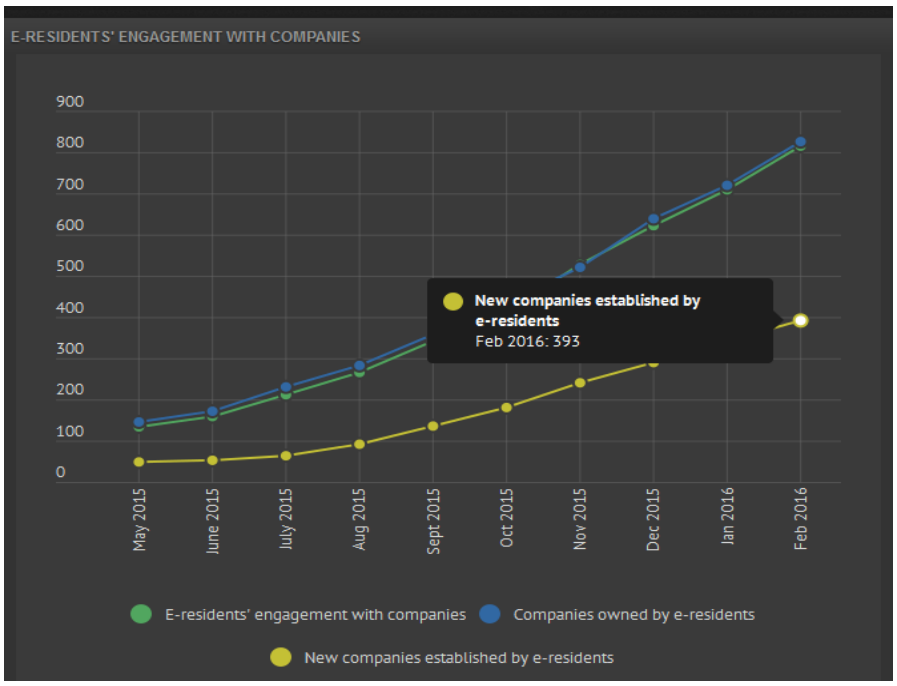

Figure 2. The number of new companies created by e-residents in Estonia as of March, 7, 2016 Source: e-Residency Dashboard, 2016

On the botttom line, e-residents appear to be more important to take into consideration when designing new services than the users of ordinary e-government services. These people voluntarily pay to access the platform, and they are not bounded by traditional relations between government and its citizens. It would be logical if new services met their needs. Still, e-Residency already provides certain features that are not only a platform for new ones, but also services on their own like digital signature. In case a newly launched service is not in demand, this is not critical for the initiative as a whole. However, the statistics demonstrates a significant lag between business motivation of e-residents and its implementation through establishing new companies or registering existing ones with the help of e-Residency. Virtual incubation service is one of possible solutions to bridge this gap. Another side of introducing the incubator is that it provides a possibility to galvanize the use of already available services.

To summarize the first subpart of the theoretical section, e-Residency is conceptualized as a platform providing Estonian governmental services for business needs of citizens of other countries. New services provided by third parties can be built upon the ones that are already available on the platform. Virtual incubation service fits this framework because it is a private service that can utilize the existing possibilities of e-Residency like digital authentification. Another point is that the idea of virtual incubator corresponds to the institutional framework of

the project as this idea brings e-residents closer to registering their business in the virtual environment. The statistics shows that only a minor part of e-residents create new companies using the platform, whereas at least one-third of them have motivation to do so. In this case, introducing virtual incubation of their ideas to startups might address the need. One more possible effect is that the rest of the services will be used more actively.

2. Virtual incubator as a service

In the second section of the theoretical analysis, the idea of virtual incubation will be discussed in detail. Though similar incubation services exist at the world level, virtual incubation does not seem to be widespread in Estonia. Also, such incubation has never been implemented on the basis of e-Residency. In this light, it seems useful to begin with defining startup incubation in general. My intention here is to discuss basic concepts like ‘startup’ and ‘incubator’ that will be used to develop the service idea. A particular emphasis will be made on typical startup development phases because they are applicable to any incubation process. After that, main problems of ordinary incubation will be outlined. I would like to elucidate whether virtual incubation might have some advantages in relation to ordinary one. Also, possible solutions to these problems that can be introduced with the help of virtual service will be outlined. My last point will be dedicated to the analysis of demand for the service from both Estonian startup incubators and e-residents. Looking at the service through their eyes will be useful for modeling specific service features. Overall, this section is devoted to discussing basic concepts of startup incubation, advantages and disadvantages of virtual incubation versus ordinary one, and the demand for creating virtual incubation service on e-Residency platform.

2.1. Startup incubation: helping to turn an idea into a company

At the most basic level, ‘startup’ is defined as a new business (Meriam-Webster Dictionary, 2015). If one looks more closely, this term can be characterized by ‘early stage’ of a company when moving from ‘the idea stage to securing financing, laying down the basis structure of the business, and initiating operations’ takes place (Business Dictionary, 2016). From financial perspective, such companies are often characterized by the absence of revenue and operating on their initial funding to create a product (The Free Dictionary, 2016). There also exist personal definitions from people who work with startups, for instance the one from Business Insider journalist: ‘a few-year-old tech company that could still easily fail’ (Shontell, 2014). This definition emphasizes that most of the startups are related to new technologies. Another

important point is that a fast growth of a company is claimed to be the difference between startups and other new companies (Graham, 2012). As can be seen, main features of a startup include developing an idea into a product that can be sold, establishing a company, functioning at a loss, and, from personal definitions, having technological orientation and growing fast.

As startup creation is an evolving process, there are various stages of this process. Most authors emphasize three milestones: idea, business model, and reaching customers (Glenn, 2012; Forrest, 2014). However, these landmarks seem to consider only the market side. Others pay more attention to the product side, for instance, validating an opportunity and building the product to meet this opportunity (Mitra, 2013). Coming to more advanced constructs, there is Customer Development model offered by Blank (2006, p. 16), where four phases are mentioned: customer discovery, customer validation, customer creation, and company building. This model focuses on relating to the customer at each stage of Product Development model, which was introduced by other authors: concept, product development, testing, launching (p. 2). Then, Marmer model attempts to combine the two by offering the following stages: discovery, when problem and possible customer are defined, validation, when customer profile becomes clear, refinement, when business model is adjusted to the customer, and driving, when the company pursues as many sales as possible (Lee, 2015). However, the most holistic of them seems to be Startup Development Phases (SDP) model, which is based on previously mentioned ones and includes the following stages: problem/solution, vision/founders, product/market, business model/market (Startup Commons, 2015). This construct considers various aspects of a startup like customers, funding, and other ones at each stage (see Figure 3). The model seems to be useful for designing virtual incubation service because it provides the most comprehensive overview of the stages that the service is supposed to assist in covering. Also, it is an open source material, which means that using this model does not privilege any author.

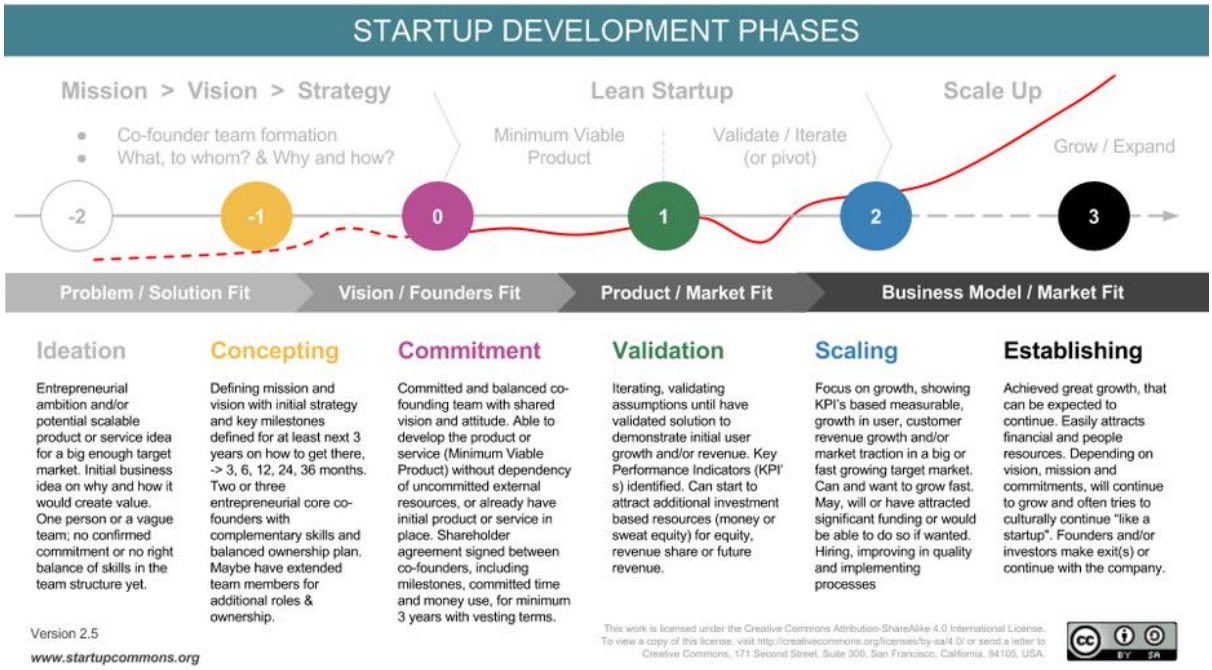

Figure 3. Startup Development Phases model
Source: Startup Commons, 2015

It is worthy to look at every stage in detail in order to understand possible service activities. To begin with, problem/solution phase is divided into ideation and concepting sub-phases. The first one is devoted to creating service idea, finding its target market, outlining revenue model, and forming a team of co-founders. The second one is about creating mission and vision, coming up with the strategy of development over next years, and stabilizing several co-founders with balanced work division and ownership. Concepting sub-phase crosses the line of the next stage, namely vision/founders. Here, commitment sub-phase is expected to bring the formation of a stable and dedicated team, development of Minimum Viable Product (MVP), and formalization of shareholder agreement where milestones and resources are specified. During product/market stage, validating the product, defining Key Performance Indicators (KPIs), and attracting investment are the main activities. Finally, the fourth stage, business model/market, consists of scaling and establishing sub-stages. The first one is about demonstrating market growth following KPIs, being able to receive additional funding, and hiring employees. The second one deals with achieving expected growth, attracting resources with ease, and redefining its identity from a startup to an established business. As can be seen, Startup Development Phases model offers specific activities that should be performed at each stage. These activities will serve as the basis for the ones during virtual incubation. The main difference with the model in this study is

that actors and roles are lacking in the SDP model; however, they can be specified for each activity in the upcoming service.

Having discussed startup stages, it is a high time to look at the concept of 'incubation.' In her seminal study, Perez (2003, p. 7) demonstrates that ICT techno-economic paradigm has two tentative stages: installation and deployment. During the first stage, the creation of startups in information technologies was relatively easy, with little competition and many financial resources being present. It is important to mention that Estonia managed to acquire competence in ICT due to its leading role in innovations in the paradigm during this period (Kalvet, 2012, p. 8). However, this stage has finished around the mid-2000s (Perez, 2003, p. 7). The second stage is characterized by a saturated market, where new companies face substantial barriers to entry and require high innovativeness. In this regard, it is peculiar that various authors demonstrate that the recent years have seen the exponential growth of 'incubators' (Glenn, 2012; Butz, 2015) - 'collaborative programs designed to help new startups succeed' (Willson, 2012). They usually provide workspace, access to early funding, mentors, training, and other possibilities that might help cover the path from an idea to an established business. An incubator might be either a company, in this case it is often a startup itself, or a non-profit organization, for instance as a part of a university or governmental program. Most incubators are oriented on information technology, but they also include other industries (Ibid, 2012). In the context of creating the virtual incubator for e-Residency, the service seems to benefit from both the global need in incubators and technological competence of Estonia.

To be more precise with the service idea, it is important to distinguish between 'incubators' and 'accelerators.' The second ones are oriented on making the growth of an already existing company faster (Forrest, 2014). They are usually characterized by being very selective, providing a small fixed investment and large mentors' network, and demanding a small equity in the company (Ibid, 2014). Another distinctive feature is that the time of residing at an accelerator is usually short and predefined (Butz, 2015). Probably, the most prominent example of an accelerator is YCombinator, which helped galvanize the development of Airbnb among others (YCombinator , 2016). In contrast, an incubator deals with turning ideas into companies. Incubation programs begin earlier than acceleration ones and provide more time and investment opportunities (Forrest, 2014). They are also more flexible, for instance governmental and private incubators might have quite different rules of participation. An example of Estonian incubator is Tallinn Business Incubators, which is a governmentally supported organization that nurtured Lingvist among others (Tallinn Business Incubators, 2016). When it comes to e-residents, the

second notion seems to be more relevant, because the aim of the programme is to engage world citizens into establishing new companies in the country by means of using the provided services. That is, the primary focus is on running business operations with the help of e-Residency, rather than on facilitating the growth of already existing companies worldwide. Another point is that accelerators are more demanding in terms of resources and business returns, which might prove problematic in the virtual environment. At the same time, it should be acknowledged that virtual acceleration service is also conceivable to run on the platform.

Overall, startups turn ideas into new companies. Previous studies outline certain stages that most startups cover. The most recent and widely used model is Startup Development Phases, which defines specific team building, funding, product building, and marketing activities at each of four typical stages: problem/solution, vision/founders, product/market, business model/market. These stages and corresponding activities will form the basis for virtual incubation service design. Another important point is that using the assistance of startup incubators is a common trend nowadays, particularly related to the saturation of information technologies market. In this regard, it might be relevant for e-residents with startup ideas to draw from Estonian expertise. Last but not least, incubators should be differentiated from accelerators, as the latter ones are oriented on facilitating the existing businesses and impose more strict business requirements. In contrast, incubators have fewer business demands, which provides room for experimenting with a virtual service. Also, an incubator is more appropriate to create on top of e-Residency with the goal to make its users establish new companies online with the help of platform services.

2.2. Problems of incubation services

Despite the surge in the number of startup incubators, their effectiveness remains an open question. It is hard to measure the usefulness of incubators because most startups are very unstable and prone to disappear with or without incubation. At the same time, one or two successful cases might alter the perception of an incubator. In this subpart, I will generalize problems that ordinary incubators face. It must be admitted that a virtual service can hardly solve all the problems. However, some of them are expected to provide ideas for the solutions that can be included in service design.

To begin with, many authors claim that incubators fail to focus on business services. Mitra (2013) states that, in many cases, validation of a market opportunity and creation of a product are not prioritized over providing physical space or financial resources. In a similar vein, it is

mentioned that moving from an idea to a viable business model gets diluted in incubators (Glenn, 2012). The latter ones are claimed to provide too many collateral services and support weak ideas. Another argument is that early exposure to investors often makes startups orient on reaching quick returns instead of developing a long-term business model (Hough, 2012). Considering these issues, virtual incubation service will be designed for moving from one development phase to another. The system will guide both e-residents and mentors through these phases by means of prioritizing crucial milestones. For instance, creating a business model or reaching market research goals will be required for opening next stages in the system.

The second problem that is often mentioned is distractions. Thus, several reviewers claim that coworking space might be distractive for startup founders (Mitra 2013; Forrest 2014). Particularly, working in a common area with many other groups might be problematic for large teams. Also, short-period relocation for a startup incubation programme is claimed to bring too much stress (Hough, 2012). It might happen that finding a place to stay, traveling, and meeting new people prevent startup founders from focusing on developing their idea. In this regard, virtual service seems to be quite useful, because all work is supposed to take place online. Such set-up will limit the range of distractions that the founders encounter. For instance, the service will provide only required communication possibilities at every startup stage. For general communication, eResNetwork service (eResNetwork, 2016) is already available on the platform, where the startup enthusiasts can perform additional networking activities.

One more issue is an inefficient use of limited time with relevant mentors. It is argued that enough time and enough experience on mentor's side are required for incubation to be useful (Relan, 2014). Quite often, mentees do not receive a relevant feedback because these conditions are lacking. Howerton (2012) even argues that the decision to join an incubator should be based on the knowledge about how easy it is to access the mentors. In my opinion, it might also be that the mentees do not know how to use the time with their mentor efficiently. For example, they might pose the questions of less importance. Though virtual incubation cannot help with the previous experience of the mentors, the service will help the sides save their time and match in terms of expertise. This idea will be implemented through an intelligent mediation feature, which remembers all questions and answers in the process of incubation and guides new participants when they want to contact a mentor. As a result, less general questions will be posed, less time will be spent on direct interaction, and more targeted advice will be received.

Coming to the limitations, it must be said that some incubation problems seem difficult to solve with the help of a virtual service. For instance, immediate investments are often taken as a measure of startup success, but not a long-term business strategy (Mitra, 2013). Also, country and market contexts are unique, and there is no one-size-fits-all solution for company development (Butz, 2015). These issues are present in any incubator, be it ordinary or virtual one. Another set of limitations is specifically related to operating in the virtual environment. Among most important ones, communication with a mentor might be less dynamic than in a live setting. Also, it might take more time to solve problems for a team. However, these limitations seem to vary for each case; for instance, it might be that the whole team of founders is located in one place, they hire coworking space, which is a service available separately from incubators nowadays, and interact with a mentor via e-Residency platform.

To summarize, startup incubation faces various issues. Some of them can be improved with the help of a virtual service. Failing to focus on business services will be solved by following startup phases in the system. In case the participants do not fulfill the required activities at a certain stage, the system will guide them. Most distractions related to ordinary incubators, such as sharing space with many teams or moving to a new place for a short-term period, will be absent due to the virtuality of the service. Also, communication possibilities will be limited as e-residents already have the service for networking purposes. Coming to the next point, the service will mediate between mentors and mentees, making their communication more efficient and targeted. An intelligent mediation feature seems to be particularly useful in this regard. Finally, it should be acknowledged that the virtual incubator for e-residents will not be an exempt from the vices related to startup incubation in general, such as the dependency on investors, and that the virtual environment might pose some inconveniences in terms of problem solving and communication.

2.3. Demand from Estonian startup incubators and e-residents

Having clarified the principles and problems of startup incubation, it is a high time to look at the demand for virtual incubation service. Though the business model of the service will be explained in detail in the practical part, it should be mentioned that Estonian startup incubators and e-residents are defined as service users. From previous theoretical discussion, it is assumed that the first ones will use the service to access people with startup ideas from the whole world and the second ones will benefit from Estonian expertise in developing startups. Also, the methodology of collecting and analyzing data from these two groups will be presented in detail

in the corresponding part. It is enough to state that online survey was used in both cases in order to access respondents remotely and receive comparable data. The survey is not intended to be representative, but rather informative about user ideas for the service. Below, I will concentrate on main findings and their usefulness for designing virtual incubator.

To begin with the incubation side, my hypotheses based on the literature review were (see Appendix Three):

H1. Estonian incubators have expertise mostly in IT startups.
H2. The incubators are not completely satisfied with the choice of applicants in Estonia.
H3. The incubators are willing to expand to online incubation services via e-Residency.

Also, two open-ended questions were posed in order to collect ideas for service design:

Q1. What are your main expectations from such service? What would make you join?
Q2. Could you name 3 main features you would offer during virtual incubation if you had an unlimited budget?

To begin with, five Estonian organizations expressed their interest in the service. Among them, there are three traditional incubators, one accelerator, and one startup laboratory. Their expertise is focused on technology, particularly IT. Thus, all organizations mentioned some technology as their key expertise: ‘green-tech,’ ‘FinTech,’ ‘technology,’ etc. Three of them declared information technologies as their focus: ‘IT,’ ‘ICT,’ and ‘SaaS.’ As can be seen, their key startup profile is indeed in information technologies. Such situation indicates that Estonian expertise seems to be relevant for a typical startup globally.

Coming to their satisfaction with the choice of incubation applicants in Estonia, four organizations mentioned that they were not completely satisfied (see Figure 4). Only one organization claimed to be satisfied in full. Though these results might have various explanations, there seems to be room for expanding incubation activities outside of Estonia. The studied incubators appear to be open for more diverse applicants.

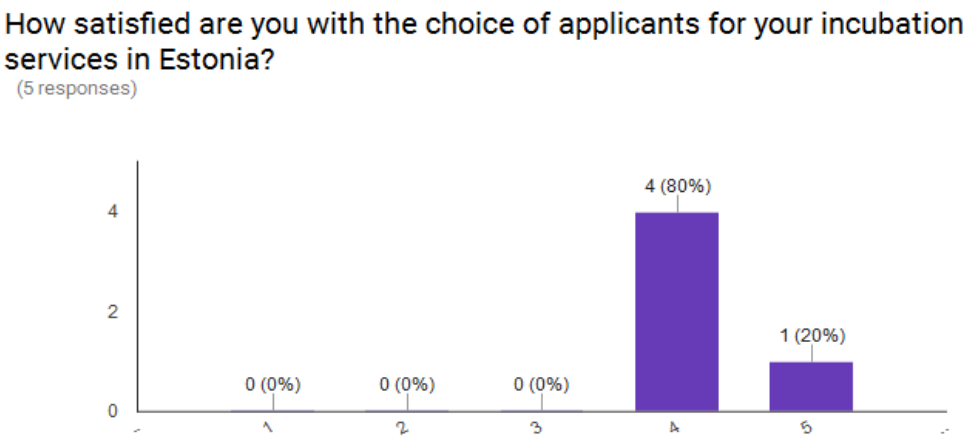

Figure 4. The level of satisfaction of Estonian startup incubators with their applicants

Similar results are obtained regarding willingness for expansion to online incubation services. Four organizations replied that they were willing to offer such services. To provide a couple of examples of their responses, 'it is a good idea to expand' and 'I would certainly test it'. Only one incubator expressed their uncertainty. The response emphasizes their orientation on physical services: 'the basic incubation service we have is connected to rooms and support.' So, four organizations are willing to go for virtual incubation.

To join the service, Estonian incubators expect to have a better choice of applicants and ideas. Four organizations provided such answers: 'the choice of applicants,' 'I'm up as long as e-Residents apply,' 'better business ideas and more teams,' etc. One respondent had a different demand, namely 'early visibility of high potential founders' and 'brand visibility.' It might be that they expect both an easier access to promising startup creators and a better coverage of their work with such people. On the bottom line, it seems that the choice of applicants and ideas defines the interest of startup incubators to participate.

Regarding the features to offer, online work with a mentor was mentioned in four answers. For instance, 'one on one coaching (virtual)' and 'world-wide mentor network'. Three organizations emphasized the implementation of various activities of startup development: 'business modeling, sales, marketing,' 'idea validation,' 'proper business plan,' 'strong approach to export markets,' etc. Moreover, two answers prioritized connections: 'connections' and 'connections with world-wide mentor network.' Also, one organization promised video calls, which seems to be strongly related to communication and mentoring. In total, connecting e-residents and mentors, meeting startup needs at different development phases, and using technology to communicate remotely seem to be most important to implement.

Coming to the e-residents side, my hypotheses from the literature review were (see Appendix Four):

H1. e-Residents have startup ideas.
H2. e-Residents find Estonian startup expertise relevant for their needs.
H3. e-Residents are interested in using virtual startup incubation via e-Residency.

Also, two open-ended inquiries were added in order to collect ideas for service design:

Q1. What are your main expectations from such service? What would make you join?
Q2. Could you name 3 main features you would like to have in virtual incubator?

The answers to the survey were collected from twelve e-residents. Among them, ten persons claimed to have a startup idea at the moment. Only two said they did not have one. This result matches statistical information about business orientedness of e-residents as a group, namely 37% of them would like to create a location-independent international business. Creating startups seems to be a part of this general orientation.

Coming to the relevance of Estonian startup experience, eight respondents answered positively to this question. One more person claimed that the relevance depends on specific business needs. This result also corresponds to the hypothesis that information technologies competence in Estonia is useful for global needs. Most respondents want to benefit from this experience.

In terms of willingness to use virtual startup incubation via e-Residency, ten respondents provided positive answers (see Figure 5). One more participant mentioned that their decision would depend on the price. So, e-residents are interested in trying the service, but it might be that not all of them are ready to pay for it.

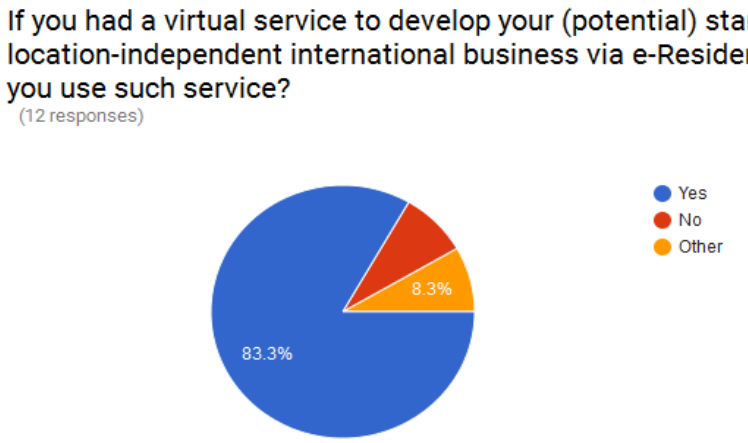

Figure 5. The willingness to use virtual incubation service by e-residents

User expectations from the service are quite diverse. Six persons made an emphasis on connections and networking: ‘connecting to potential execution partners’, ‘tied to eResNetwork’, ‘well-recommended within community’, etc. Four persons declared that they would need different kinds of assistance: ‘help me to find partners,’ ‘advice, development support,’ ‘basic financing access,’ and ‘high quality business admin.’ Three persons mentioned a fast and easy-to-use service: ‘ease of entry,’ ‘prompt service,’ and ‘easy to establish startup.’ Two respondents expect a specific focus on e-Residency possibilities: ‘something that has never existed before and will only be achievable with the use of e-Residency’ and ‘make it natural to e-Residency.’ Finally, one person hopes to receive ‘tax residence.’ Overall, the inquired users expect to build valuable connections to develop their startups, to get mentoring that is tied to their needs, to have an easy-to-use service, and to utilize other e-Residency possibilities.

When asked about three main features to have in the virtual incubator, the respondents provided more specific demands. The biggest group, six persons, wants easy connectivity and mentoring, for instance ‘easy access to mentoring,’ ‘virtual option for feedback,’ ‘real networking with potential partners,’ etc. Five persons ask for accounting, tax, and legal support: ‘easy access to legal services,’ ‘legal and accounting support (basically compliance),’ ‘accounting/tax/solicitor services,’ etc. Four people hope to get different kinds of technical support: ‘virtual hosting,’ ‘help desk to enterprise development,’ and others. It is peculiar that three respondents expect to enter the European Union market easier, for example ‘Europe connection’ and ‘access to market of the EU’. An unexpected interpretation is provided by two persons who want to get residency in Estonia this way: ‘visa waiver’ and ‘ideal actual residence’. In total, the majority of participants would like to have easy access to mentors and partners, to receive relevant pieces of advice, such as legal and technical support, and to adjust their startup to entering the EU market.

As can be seen, the demand from Estonian incubators and e-residents is complementary. The first ones have technical expertise, would like to access startup creators worldwide, and are ready to join a virtual service. Their main interest is the choice of founders and ideas. Key features to offer are mentoring, helping to cover startup development phases, and communicating remotely. Coming to e-residents, creating startups belongs to their interests, Estonian expertise in this field is relevant for them, and they are willing to try virtual incubation, though they might be not ready to pay for it. Their main expectations from the service are connectivity, relevant mentoring, and utilization of other e-Residency possibilities. Among more specific features, they would like to easily access mentors and partners, to receive pieces of advice that would cover various startup needs, such as legal and development support, and that would make their new company profitable in the European market. These ideas form the basis of the business model of virtual incubator that will open the practical section.

Overall, in the second subpart of the theoretical section, startup was conceptualized as a process of turning an idea into a company. Its main stages were defined in accordance with Startup Development Phases model: problem/solution, vision/founders, product/market, business model/market. At each stage, market, product, financing, and team creation activities were outlined. These activities will form the basis for the ones in the service to be developed. The relevance of virtual incubation during the mentioned stages was put in the context of IT market saturation and Estonian expertise in the field. Also, incubation was given priority over acceleration in the context of the goals of e-Residency project. Concerning possible advantages of a virtual service over an ordinary one, it was argued that the first one could be designed to provide more focus on business services like market research, less distractive demands like relocation, and more efficient communication between the parties due to an intelligent mediation in the system. These features will be translated into service models. Finally, it was clarified that both Estonian startup incubators and e-residents are interested in trying the service. The first ones are motivated by the access to global startup founders and ideas, whereas the second ones hope to receive convenient and relevant mentoring and support services. The main user ideas will be included into service models.

3. Research hypotheses

On the basis of the provided background information, the following research hypotheses were formed. My zero hypothesis is that *it is not possible to translate the discussed ideas for virtual*

incubation service on e-Residency platform into service models. The methodology and practice of this study are devoted to refuting this hypothesis. This refutation is successful when each and every of the following ideas is reflected in service models:

- The service helps to reach the primary goal of e-Residency: to facilitate economic development of Estonia;
- The service includes e-residents as users;
- The service is based on the existing services on e-Residency platform, e.g. digital authentification;
- The service covers four Startup Development Phases and key activities at each stage;
- The service includes Estonian startup incubators as customers;
- The service is oriented on developing a startup from an idea;
- The service guides the users between Startup Development Phases by means of checking the completion of key activities at each stage;
- The service is oriented on making communication between e-residents and startup mentors more efficient through providing an intelligent search feature;
- The service provides the access to idea owners for Estonian startup incubators;
- The service provides the access to mentoring for idea owners;
- The service provides the access to other relevant services on e-Residency platform, e.g. networking service.

Another hypothesis is that *agent-oriented modeling approach is appropriate to translate the mentioned ideas into service models*. The verification is performed by employing the agent-oriented modeling approach for creating service models. If at least one of the ideas is not reflected in the models, the hypothesis is refuted.

Research Methodology

The methodology of this study is divided into two general categories: problem overview collection and analysis methods and modelling and notation methods. Such division emanates from the necessity to analyze background information before service models can be created. Since researching the context requires quite different methods from the ones suitable for modeling activities, they are placed into separate subparts. In the first subpart, I outline main methods that are used for clarifying the background of providing virtual incubation on e-Residency. These methods are divided into data collection, such as an online survey of Estonian incubators, and data analysis methods, such as statistical analysis of e-residents' motivations. Afterwards, primary methods to create service models are presented. I begin with general concepts for modeling electronic services, such as 'system'. Then, the agent-oriented approach is presented and justified as the modeling framework of choice. Finally, basic notation of future service models is explained, for instance domain model notation.

1. Problem overview collection and analysis methods

1.1. Data collection methods

Both qualitative and quantitative methods are used for data collection. To begin with, a literature review is carried out in order to scrutinize the context e-Residency and startup incubators. Also, I apply theoretical concepts that seem to be relevant to the topic. For instance, the focus of e-Residency is clarified by means of providing a comparison with Bitnation and Atlas Stripe projects through the concept of governance. It should be separately mentioned that statistics on e-residents is accessed via e-Residency dashboard, bringing quantitative perspective on user motivations to the study. Except of that, informal discussions on the service idea are carried out with relevant parties during public events and via e-mail communication. This complementary approach allows verifying other data sources and looking at the problem from new angles. As an example, the goals of e-Residency project are corroborated during their public events. So, literature review and statistical review are used to collect the secondary data, and informal communication complements them.

Primary data on service demand is collected via an online survey of Estonian startup incubators and e-residents. This method is chosen to receive comparable service ideas. For instance, both

groups of users are asked the following open question: ‘Could you name 3 main features you would like to offer/to have in virtual incubator?’. This way, it is possible to compare what e-residents would like to have and what the incubators are ready to provide. Another reason for choosing this method is that e-residents can be accessed only remotely since they are not located in Estonia. In total, 17 Estonian startup incubators, accelerators, and laboratories are contacted (see Appendix One). Their list was formed on the basis of both unofficial information (StartSmart, 2016) and official data on Estonian startup ecossytem (Enterprise Estonia, 2016). The number of responses is 5, the rate of reply being around 30%, which is higher than average for online surveys (Jansen, Corley & Jansen, 2007, p. 3). Coming to e-residents, 12 respondents provide their ideas (see Appendix Two). Half of them were recruited through personal connections, and another half came from e-Residency forum (eResNetwork, 2016), where the survey was posted. It is important to note that the questionnaire was made visible to e-residents only, and not to the general public, so the confidence in obtaining answers from relevant persons is high. Overall, surveying e-residents and Estonian incubators provides useful insights into service demand and complements representative statistics on e-residents.

1.2. Data analysis methods

Coming to data analysis, simple statistical operations are performed on the data about e-residents. Mainly, distribution analysis and percentage calculation are employed. For instance, the number of newly established companies is divided by the number of e-residents to obtain an approximate evaluation of the fraction of the users who venture for new businesses with the help of the platform. In the case of online surveys, theoretical reading and content analysis are employed. Firstly, the answers are read in search for specific data of theoretical interest (Kvale, 2007, p. 117). For instance, it is expected that Estonian expertise in startup development is relevant for e-residents. Secondly, the answers are analyzed with the help of inductive content analysis (Mayring, 2000). Particularly, I define codes and group them into categories. For example, ‘connecting to potential execution partners’ and ‘well-recommended within community’ codes belong to ‘connections and networking’ category. Finally, an inductive content analysis is also used to analyze the articles on startup incubators in order to define incubation problems. Each of these articles is written in different style and language, so I identify relevant codes, such as ‘little coworking space’ and ‘relocation’, and form overall categories out of them, for instance ‘distractions.’ As can be seen, statistical data analysis, theoretical reading, and inductive content analysis are employed to analyze the collected data.

As can be seen, my primary data from the surveys and informal conversations is combined with the secondary data from the statistical source and literature review. Correspondingly, a combination of analytical methods is required to process the data. Qualitative analytical methods, such as inductive content analysis, are combined with the quantitative ones, such as statistical analysis. This approach allows me to capture various aspects of the problem in an appropriate way. For instance, e-residents form a large group of potential users, so statistics is appropriate to scrutinize their general motivations, whereas Estonian startup incubators are few possible customers for the service, so their demand requires an in-depth understanding. As a result, verified ideas for service design are obtained.

2. Modeling and notation methods

In the second subpart of the methodological section, modeling methodology is presented. To begin with, key concepts are outlined, such as system and agent. Their relevance for modeling the virtual incubator is explained. These definitions are incorporated into particular modeling principles, for instance goals and interaction, which form the basis of agent-oriented methodology. On the basis of these principles, viewpoint framework for modeling is defined. My activities concentrate on domain and platform-independent modeling in order to allow their implementation in any programming environment. At the next step, the differences between agent-oriented methodologies are discussed more specifically. In this study, the elements from various methodologies are combined to create most accurate models. The subpart finishes with outlining notation methods that will be used in the practical section.

2.1. Key concepts and framework for modeling an e-service

The most basic concept that I adopt for modeling an e-service is ‘system’. In accordance with Lightsey (2001), a system means “an integrated composite of people, products, and processes” (p. 3). Blanchard (2004, p. 1) adds to this definition that each system has a specific function to achieve. The scholar emphasizes that there are various kinds of the systems like natural, human-made, conceptual, and other ones. Coming to developing information technologies, Tsai (2005, p. 1) introduces the concept of a service-oriented enterprise as a multi-layered system. Such system consists of configurable business logic, e-business service-oriented architecture, service-oriented management, service-oriented infrastructure, and hardware (see Figure 6). When modeling an e-service, one deals with the second layer as a part of an overall enterprise system. At the same time, each service has its internal structure, where, as was mentioned in the

theoretical part, an interaction between systems to acquire a certain effect takes place. Considering that each service is also aimed at meeting a particular need, it can be said that an e-service has three possible perspectives: a part of larger enterprise system, an interaction between systems, and a system on its own. The latter notion is employed in this section.

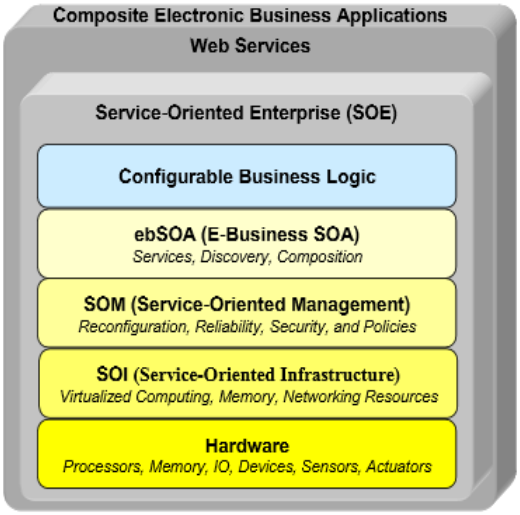

Figure 6. A system of service-oriented enterprise
Source: Tsai, 2005

When modeling e-services that are used by humans, both technological and social elements are combined. Most modeling approaches fail to include this focus on human-technology interaction. For instance, object-oriented methodologies allow to model object states, but not who manipulates the objects and with which logic (Booch, 1986, p. 211). Since the interaction of e-residents and startup mentors with the system is my primary focus, a more refined modeling methodology is required. In this regard, it is important to note that the concept 'socio-technical system' has various definitions. For instance, Geels (2005, p. 1) assumes that such systems comprise artifacts, human agency, social structures, and organizations. An example he provides is road transportation. His approach is rather a theory of society and technology, which is much wider than the scope of my study. The socio-technical systems concept provided by Sterling and Taveter (2009, p. 27) is quite different from this macro perspective. The authors conceptualize such system as the one that consists of agents manipulating conceptual objects. Particularly, they mention that both software and human users are considered when designing a system. As can be seen, this is a methodology for creating systems that are based on information technology and include humans. For modeling purposes of this study, the latter definition of socio-technical systems is adopted.

An important concept was mentioned when defining the system - 'agent.' Historically, there were many understandings of this notion, and Wooldridge (1996) even calls it "a kind of Rorschach test for computing: everyone sees something different" (p. 47). When it comes to generally agreed attributes, the term signifies a "system capable of autonomous action in some environment in order to meet design objectives" (Wooldridge & Weiss, 1999, p. 32). Thus, such system makes various decisions on what action to take to meet its goals. This is the primary quality that is lacking in 'object' – "state information as a collection of data values" (Kinny & Georgeff, 1996, p. 2). An object cannot make decisions for its behavior. Instead, object-oriented methodologies put object classes and their relations with other classes in the heart of modeling. Also, it is worthy to emphasize that agents are modeled in a certain environment. In this regard, Franklin and Gaesser (1996) mention that an agent "senses that environment and acts on it" (p. 25). Overall, an ability to make own decisions, an orientedness on meeting system goals, and perceiving and acting on its environment characterize agents. These properties seem useful to implement the desired features of virtual incubation service, for instance guiding the user through startup incubation stages.

To model agent behavior, agent-oriented approaches rely on several central principles. To start with, 'goal' means an "obligation to be accomplished or satisfied" (Chung, et al., 2012, p. 7). For instance, to define a business model might be a goal in virtual incubation. This concept is closely related to functional and non-functional requirements, which are usually modeled for information systems. If an agent achieves its goals in an appropriate way, the system meets its requirements (Dardenne, Lamsweerde & Fickas, 1993). In agent-oriented methodologies, it is advised to consider quality and emotional goals as corresponding to non-functional requirements (Chung, et al., 2012, p. 6). The researchers claim that, though these goals are difficult to measure, they are specifically relevant to include when humans and non-humans interact (Sterling & Taveter, 2009, p. 138). An example of such goal is the feeling that completing a stage in virtual incubation is supposed to evoke in an agent. So, in the models for this study, both operational goals, as well as quality and emotional goals, are taken into consideration.

At the next level, agents perform actions to achieve their goals. This behavior is modeled through 'roles' (Kendall, 1998, p. 1). It is worthy to mention that roles are not present in object-oriented methodologies because objects cannot behave on their own. In agent-oriented methodologies, role model serves to describe the roles and organization model serves to demonstrate relationships between these roles (Sterling & Taveter, 2009, p. 114). Conserning role model, each role has responsibilities, emanating from achieving goals, and constraints,

proceeding from appropriate ways to reach these goals. Also, an agent cannot complete its role solely, but rather needs to "interact" with other agents, "exchange knowledge", and "coordinate" (Zambonelli, Jennings & Wooldridge, 2001, p. 238). These processes can be modeled through relationships between roles, or organization model. Main types of role relationships are: control, when one agent delegates some responsibilities to other ones, benevolence, when self-interested agents fulfill mutually beneficial responsibilities, and peer, when roles are equal (Sterling & Taveter, 2009, p. 33). For example, a mentor is supposed to provide a service to an e-resident during virtual incubation, which is a relationship to model. Overall, role and organization models are useful to demonstrate how system goals are achieved.

One more important aspect of a socio-technological system is its 'environment'. Whereas modeling the whole environment might be quite complex, domain models exist to represent knowledge about the medium where agents perform their roles (Juan, Pearce & Sterling, 2002, p. 7). Such knowledge is necessary to fulfill agent roles, and the latter ones can be revised when the environment alters. Thus, Taveter and Wagner (2005, p. 294) stress that agents interact not only with each other, but also with their environment. In the case of the virtual incubator, e-resident and mentor exchange their ideas through the virtual medium. These environmental interactions and required resources are important to model to specify the context of performing the roles.

Coming to the next notion, 'interaction' belongs to system design layer. In this case, acquaintance models, which represent communication principles between agent types (Wooldridge, Jennings & Kinny, 2000, p. 297), interaction-frame diagrams, which demonstrate possible interactions among two types of agents (Taveter & Wagner, 2005, p. 293), and interaction-sequence diargrams, which model prototypical instances of real action processes (Ibid, p. 293), are key artefacts to create. For instance, a diagram of mentee-artificial agent interaction to find answers to typical questions can be provided. Another point is that goals are translated into 'behaviour' models, where activity diagrams and state diagrams can be used (Sterling & Taveter, 2009, p. 116). Additionally, rules are specified for activity diagrams to define the limits of agent behavior (Taveter & Wagner, 2005, p. 278). An example here is a diagram specifying the condition of a mentee at different stages of idea development. Finally, domain models turn into 'knowledge' ones at the level of system design. These models demonstrate relevant objects that an agent knows in the environment. To provide an example for virtual incubation, e-resident has a startup idea and knows about the portal for e-Residency services.

To sum up the discussed concepts, modeling framework can be defined. There exist various frameworks for modeling information systems. One of the first ones is offered by Zachman (1999, p. 463), who introduces owner, designer, and builder views, with data, processes, and networks being outlined for each view. This framework is comprehensive, but it is also very generalized and difficult to translate into models. Model-driven architecture by Open Management Group (2003, p. 6) is focused more specifically on platform-independent and platform-dependent modeling features. However, it does not take into account agent-orientedness. In their article, Taveter and Sterling (2007) adopt the principles of model-driven architecture and Zachman framework, but also make agent-oriented aspects more prominent (see Table 1). Their viewpoint framework offers three layers, namely domain analysis, computational design, and platform specific design. These layers are penetrated by three agent-oriented modeling aspects, namely organization/interaction, information, and motivation/behavior. This way, goal models can be translated into behavior ones, domain models – into information ones, and roles models – into interaction ones. This framework is adopted for modeling purposes of the current study.

Viewpoint models	***Viewpoint aspect***		
Abstraction layer	*Organisation/ Interaction*	*Information*	*Motivation/ Behaviour*
Computation independent domain analysis (CIM)	Role Models (ROADMAP)	Domain Model (ROADMAP)	Goal Models (ROADMAP)
Platform independent computational design (PIM)	Interaction Models (RAP/AOR)	Information Model (RAP/AOR)	Behaviour Models (RAP/AOR)
Platform specific design and implementation (PSM)	Class and Sequence Diagrams (UML)	Class Diagrams (UML)	Class and Sequence Diagrams (UML)

Table 1. Viewpoint framework for modeling an e-service
Source: Taveter and Sterling, 2007

2.2. Agent-oriented modeling methodologies and notation methods

There exist a variety of agent-oriented methodologies. The scholars claim that they lack consensus (Cernuzzi & Rossi, 2002, p. 2) and that none of them is significantly better than other ones (Sterling & Taveter, 2009, p. 191). Each methodology seems to have its strong and weak points. However, they all are based on object-oriented and knowledge engineering

methodologies to some extent (Iglesias, Garijo & Gonzalez, 1998, p. 317). For instance, they share the division into abstraction layers – from organizational context to platform-specific implementation. Considering this situation, it has been decided not to follow one specific methodology in this study, but rather to borrow useful elements from different ones.

To begin with, Gaia methodology suggests separating system requirements into roles and interactions (Wooldridge, Jennings & Kenny, 2000, p. 287). This way, agents can be modeled more precisely. MaSE methodology introduces the notions of environment and agent-environment interaction (DeLoach & Valenzuela, 2006, p. 5). Thus, not only agent capabilities, but also environmental factors play a role. At the same time, both Gaia and MaSE are characterized by the scholars as lacking dynamic elements. Tropos legitimizes abstract modeling to capture mentalistic notions of the agents (Bresciani, et al., 2004, p. 205). Thus, an abstract notation is useful to employ before coming to a programming-oriented one. For instance, operational and quality goals should be modeled before classes. Prometheus emphasizes that system modeling is an iterative process of system specification, architectural design, and detailed design (Padgham & Winikoff, 2003, p. 176). In other words, when new information is available about the system, it will be possible to remodel each abstraction layer accordingly. To continue, ROADMAP provides tools to model open environments and agents that adapt to these environments (Juan & Sterling, 2004, p. 55). The importance of modeling quality requirements is stressed when the environment is changing. Finally, RAP/OR introduces mental state structure modeling elements (Taveter & Wagner, 2005, p. 286). The examples are message type and action event type (see Figure 7). Overall, virtual incubation service will be modeled through agent roles and interactions; system environment will be included in the models, mental notions and quality goals will be represented, the ability of agents to adapt to changing conditions will be emphasized, and mental state structure elements will be used.

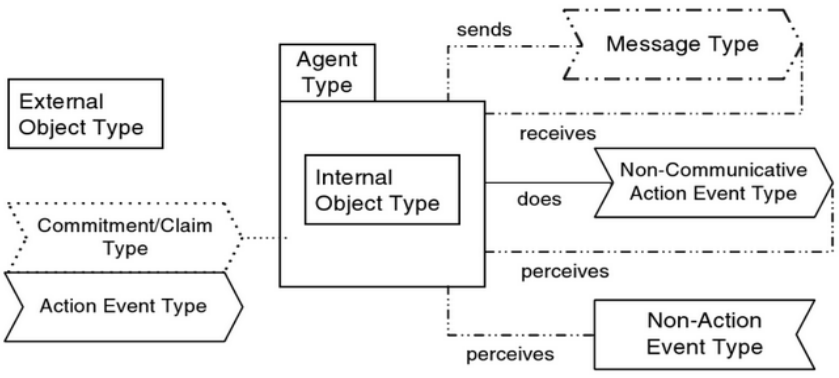

Figure 7. Mental state structure elements from RAR/OR mehtodology
Source: Taveter and Wagner, 2005

Coming to specific notation elements, the approach of Sterling and Taveter (2009) is adopted. These researchers combine various agent-oriented methodologies in order to utilize the strongest points from each of them. Also, they emphasize that a holistic framework should be developed on the basis of these approaches. At the layer of domain analysis, or motivation one as they call it, goals, quality goals, emotional goals, roles, and domain entities are modeled (Ibid, p. 67). Notation for these elements is represented below (see Table 2). Then, description, responsibilities, and constraints are specified for each role (Ibid, p. 74). Conclusively, resources and environments are defined for domain model. These elements will be used to model the most abstract architecture of virtual incubation service.

Symbol	Meaning
	Goal
	Quality goal
	Emotional goal
	Role
	Relationship between goals
	Relationship between goals and quality goals

Table 2. Domain analysis notation
Source: Sterling and Taveter, 2009

At the layer of system design, activities are modeled on the basis of goals; rules – on the basis of goals, quality goals, and roles; perceptions – from quality goals; agents – from roles and domain entities; and knowledge items – from goals and domain entities (Ibid, p. 45). Basic Universal Modeling Language (UML) notation is used here (see Table 3). To begin with, agent types are defined for agent model, and their relationships are specified for acquaintance model. When it comes to interaction, object, message, and event types are represented in accordance with Image 6. For knowledge model, attribute types are introduced, such as string, integer, and real (Ibid, p. 90). It is worthy to note that cardinalities are also specified for this kind of models: one-to-many, one-to-one, and many-to-many. When it comes to scenarios for achieving goals, agent roles,

activities, steps, and, sometimes, resources and quality goals are provided. Finally, behavior models are based on interaction ones, but they use additional notation elements like rule, activity type, start event, control flow, alternative control flow, condition, join, and epistemic action (Ibid, p. 102). Rules in these models consist of triggering event, condition, action if this condition is true, and action if it is false. With the help of this toolset, it will be possible to move from abstract models to service design ones.

Symbol	Meaning
	Generalization
	Aggregation
	Relationship

Table 3. The UML notation used for system design
Source: Sterling and Taveter, 2009

To delineate the boundaries of the system to be modeled, it is worthy to mention that the third layer, platform specific design, is not included into models. This fact is related to the aim to build abstract models that can be implemented in any programming environment. This way, a system architect will be able to tailor the model to their specific implementation possibilities. For this study, I define platform specific design as the one containing object classes, relations between them, and their characteristics. When the virtual incubator reaches implementation, these elements will be defined. In this regard, it is important that the entire service is modeled using AOM4STS Tool developed at Tallinn University of Technology (2016). This tool provides possibilities to add the third layer and export the model in XML format for further implementation. Also, the programme is online and freely available, thus my results can be verified and complemented by any interested party.

Summing up the abovementioned, a mix of agent-oriented methodologies is employed for modeling virtual incubation service. The purpose is to take most useful ideas from each of them. For instance, roles and interactions are specified by Gaia methodology and mental state modeling elements are taken from RAP/OR. Specific notation elements are used for modeling domain analysis and system design layers. These elements combine both abstract notions, such as goal and quality goal, and basic UML ones, such as object and relationship. The layer of platform specific design is intentionally omitted so that the system remains independent in terms of implementation environment. Finally, AOM4STS Tool serves as a primary instrument to create models, which makes possible complement them in the future.

In the second subpart of the methodological section, the virtual incubator modeling was specified from the level of general concepts to the level of specific notation elements. The service is going to be modeled as a socio-technological system, with a particular attention to non-human agency. A service agent can manipulate objects, act on the environment, and interact with human sides. To specify the system, it will be divided into three layers, two of them – domain analysis and platform-independent design – being the focus of modeling, and three modeling aspects, namely interaction, information, and behavior ones. Such division allows moving from general viewpoints to specific ones, thereby emphasizing the idea of the service prior to its implementation details. A combination of agent-oriented methodologies will be used to represent these viewpoints, as the intention of this study is to create the most appropriate models rather than to benefit a certain methodology. As a result, both agent-oriented and standard UML notation elements will be employed to represent service models. The online software will provide an opportunity to complement and alter each system layer for future applications.

Results and Discussion

Having clarified the background of introducing virtual incubator on e-Residency platform, I proceed with modeling the service. It is worthy to reiterate the notion from the introduction that creating service models is inseparably related to business development activities. To introduce specific features in these models, it is necessary to consider a business perspective on the whole. Therefore, the practical part begins with a business model for the virtual incubator. The model serves as a bridge between the ideas from the background research and specific service features. After that, service models are created at two layers: domain analysis and platform-independent design. It should be mentioned that the models provide an overview of essential service features, rather than include all aspects of a real-life service. The latter ones should be specified after conducting a more extensive market research and choosing a particular development platform to create the service.

1. Business model for virtual incubator

In order to create a business model for virtual incubation service, the Business Model Canvas (Osterwalder, 2010) is used in this study. Though the Canvas has been initially designed for analyzing for-profit services, it is applicable to both private and governmental ones (Ibid, p. 15). Taking into account that the discussed service is for-profit, but based on a governmental platform, the Canvas seems appropriate to use. The approach combines nine building blocks, namely value proposition, customer relationships, customer segments, channels, key activities, key resources, key partnerships, cost structure, and revenue streams, which comprehensively describe the service at hand (Ibid, p. 16-17). Also, a general description of the business and product idea is added to these particular characteristics. Each feature is provided on the basis of the background research.

Business and product idea. Estonian startup incubators are not completely satisfied with the choice of applicants in Estonia and would like to offer their services virtually. e-Residents have ideas for new businesses and find Estonian expertise in startup incubation relevant for their needs. So, the business idea is to develop startup ideas of e-residents into new companies, employing the mentorship from Estonian incubators, offering auxiliary services on e-Residency platform, and, possibly, registering new location-independent businesses in

Estonia. This way, the service both fits the framework of e-Residency and can bring profit to its owner. The more specific product idea is to connect Estonian incubators and users of e-Residency platform via online service. At the beginning, an e-resident submits his or her idea, and the incubators select the ones they are interested in. The incubators access a community of business-oriented people from the whole world in a secure way. The users receive an opportunity to develop their business ideas regardless of the resources available at their place of residence, with a possibility to pilot reaching the EU market. Also, the service utilizes the advantages of the virtual environment to avoid common problems of incubation services. Particularly, it guides participants through startup phases, allows reducing the number of distractions and expenses, and makes communication between mentors and mentees more efficient with the help of ICT.

*Value proposition***.** Five main customer and partner groups are provided with different value propositions (see Figure 8). For Estonian startup incubators, the service gives an opportunity to securely access a business-oriented community that is interested in Estonia, to have a choice of global startup ideas, and to work in a more efficient incubation environment. For e-residents with startup ideas, the service is useful due to receiving location-independent incubation, accessing Estonian expertise in startup development, benefitting from collateral services on the platform, such as consultancy and networking, and piloting the reaching of the EU market. Coming to the partners, for other service owners on e-Residency platform, it is an opportunity to galvanize the use of their services. For e-Residency team, it is a possibility to attract more applicants. Finally, startup investors will access a new pool of startup ideas from the whole world.

Customer relationships. To begin with, the assistance with frequently asked questions and general issues will be provided for all users by the service owner. Personal assistance through feedback for specific ideas of e-residents will be provided by mentors from the incubators. After selecting a particular idea, co-creation activities will take place between e-residents and mentors. Finally, collateral services available on e-Residency platform will be utilized. For instance, eResNetwork could be used for finding team members among e-residents.

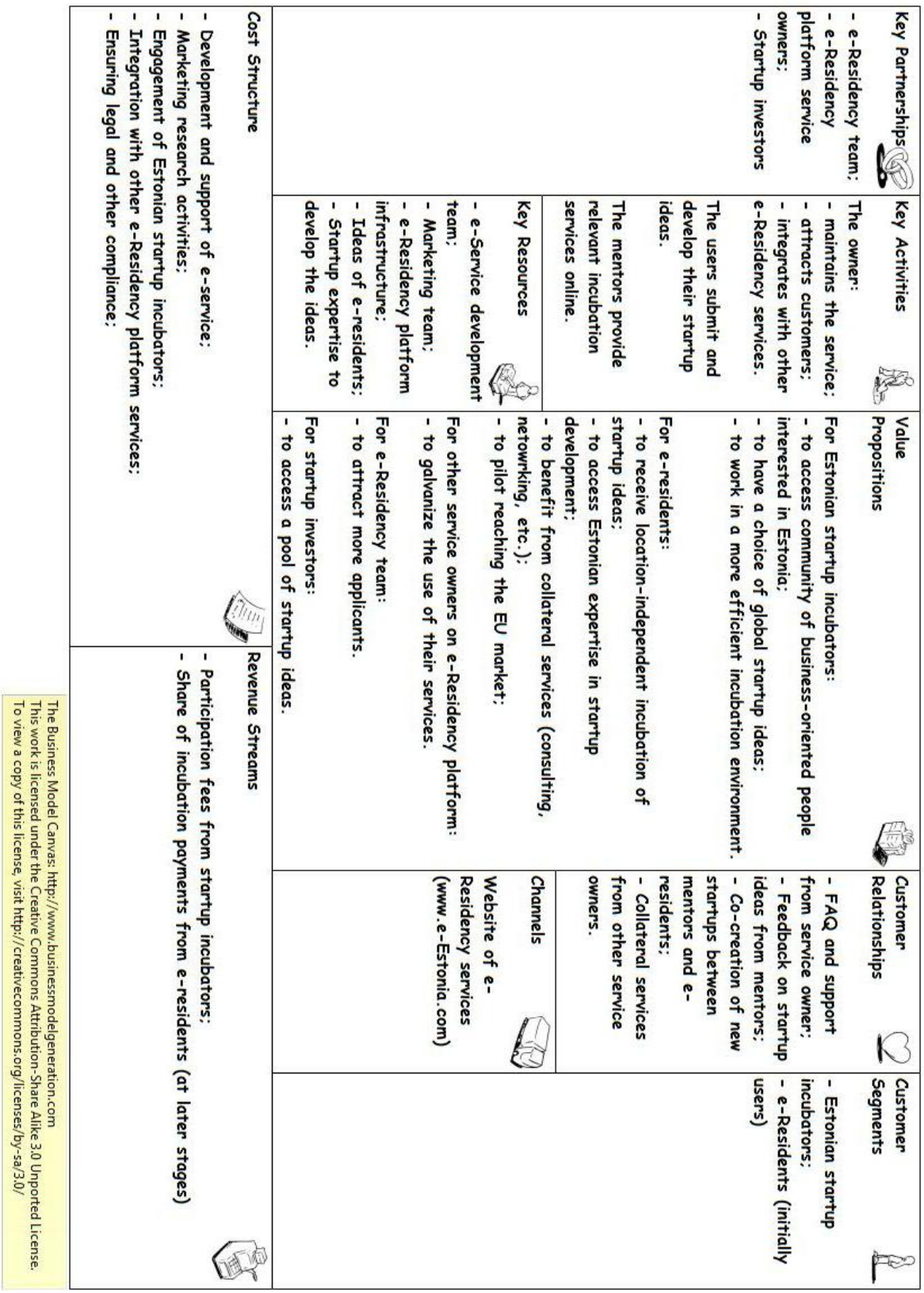

Figure 8. Visual representation of the business model for virtual incubation service

Customer segments. Primary customers of the service are Estonian startup incubators. They are assumed to pay a participation fee for using this service as a channel to access e-residents with ideas. After the service becomes popular, e-residents will become customers as well. A certain part of their payment for mentorship is expected to belong to the service owner. Such decision was made on the basis of the market research, where some e-residents indicated their unwillingness to pay, and the fact that e-residents already pay the fee of 100 € for getting access to the infrastructure (e-Estonia, 2016b). Regarding user segments, two primary groups are expected to use the service - e-residents and startup mentors.

Channels. Website of e-Residency (e-Estonia, 2016d) will be used as a channel for virtual incubation. The primary reason is that it is a one-stop shop to becoming an e-resident of Estonia. Besides, the underlying ID-card infrastructure and other services are present there.

Key activities. Several key activities are necessary to take place for virtual incubation service to work. First of all, the owner develops and maintains the service, attracts customers to the service, and integrates the virtual incubator with other e-Residency platform services. On their part, the users are expected to submit and proceed with developing their startup ideas. Finally, the mentors are supposed to provide relevant incubation services online.

Key resources. Concerning the resources to perform the mentioned activities, e-service development and support team and marketing team are required. Another essential resource is e-Residency platform infrastructure. Finally, startup ideas and expertise to develop these ideas are necessary.

Key partnerships. Among the major partners, e-Residency team is defined the first one, because their platform is used to provide the service. Then, e-Residency platform service owners are important to include with the goal of integrating virtual incubation with their tools. In addition, startup investors seem to be crucial to involve in mentorship activities.

Cost structure. Primary expenses will be related to developing and supporting an e-service. Also, marketing research activities on e-residents might involve some costs as their community is expected to count at least tens of thousands. Another source of expenses is the engagement of Estonian startup incubators because personal collaboration is required in this case. For the same reason, some expenses will be related to the integration with other e-

Residency platform services. Last but not least, maintaining the service in accordance with local regulations will involve certain costs.

Revenue streams. At the beginning, revenue will be generated through participation fees from startup incubators. After the service gains popularity, e-residents will pay for mentorship, with a certain share of this payment belonging to the service owner.

As a result of outlining the business model, main features for the virtual incubator to possess are emphasized. To begin with, the service will deal with connecting two primary parties - mentors and users, looking to capitalize on the willingness of Estonian incubators to access global startup ideas and the interest of e-residents to Estonian expertise. The virtual incubator will be focused on assisting the sides to cover main startup phases in a more efficient way than they could do with ordinary incubators. The service is also supposed to utilize the possibilities of relevant services on e-Residency platform. For instance, digital authentification seems useful to prove the identity of participants. In addition, the initiative is supposed to be aligned with the goals of e-Residency team, meaning that it will be focused on linking Estonian startup expertise with global ideas. To provide an example, customer engagement will be limited to Estonian startup incubators. This way, virtual incubation on e-Residency is expected to combine both for-profit and governmental considerations.

2. Motivation analysis

The models for virtual incubation service begin with motivation analysis. This layer is devoted to the most general overview of the system to be designed. In other words, it connects business model and service design. The primary notion here is business requirements that define actors, goals, and dependencies between them. Afterward, I model roles and domain entities, where description, responsibilities, and constraints are specified. Also, the relationship between roles is shown in organization model. Finally, resources and environment of the service are specified in domain model.

2.1. Goal model

Having defined the business model for e-Residency virtual incubator, it is possible to outline business requirements for the system. Such requirements provide "a "strategic" description of the different actors in the business domain with their goals and needs and with their mutual dependencies" (Pistore, Roveri & Busetta, 2004, p. 96). Thus, actors, goals, including both operational and quality ones, and connections between them are defined below. Thereby, a business model becomes connected to the needs of its service applications, and the two can be developed coherently (Kazhamiakin, Pistore & Roveri, 2004, p. 1). In the case of the virtual incubator, I seek to clarify what the service is supposed to achieve for its primary users: e-residents and startup mentors. Another value is that defining business requirements allows connecting new services easier, since "the strategic aspects underlying the organizational setting within which the software system will eventually function" (Ibid, p. 3) can be shared with other service owners. This feature seems to be particularly useful for integrating the virtual incubator with other emerging services on e-Residency. So, the modeling begins with the goal model in order to define system motivation and to provide for easier integration in the future.

The primary operational goal of the system is to develop startup ideas into companies (see Figure 9). The quality goals that are related to it are "Easy-to-use service" and "Unique virtual features," which are based on main expectations of e-residents. This operational goal is also attributed to the role of e-Resident as an idea owner. e-Resident is responsible for submitting startup ideas and develops them further. The emotional goal in this regard is to "Feel empowered" in terms of implementing startup ideas regardless of the country of residence. Moreover, to achieve the primary operational goal, it is necessary to guide the development of startup companies. This goal is attributed to the role of Mentor from incubation organizations as a guide for the development. The emotional goal here is to "Feel unleashing global potential" of startups with the help of e-Residency. As can be seen, two primary goals, namely to develop a startup and to guide this development, and two main roles, namely e-Resident and Mentor, are defined in the system.

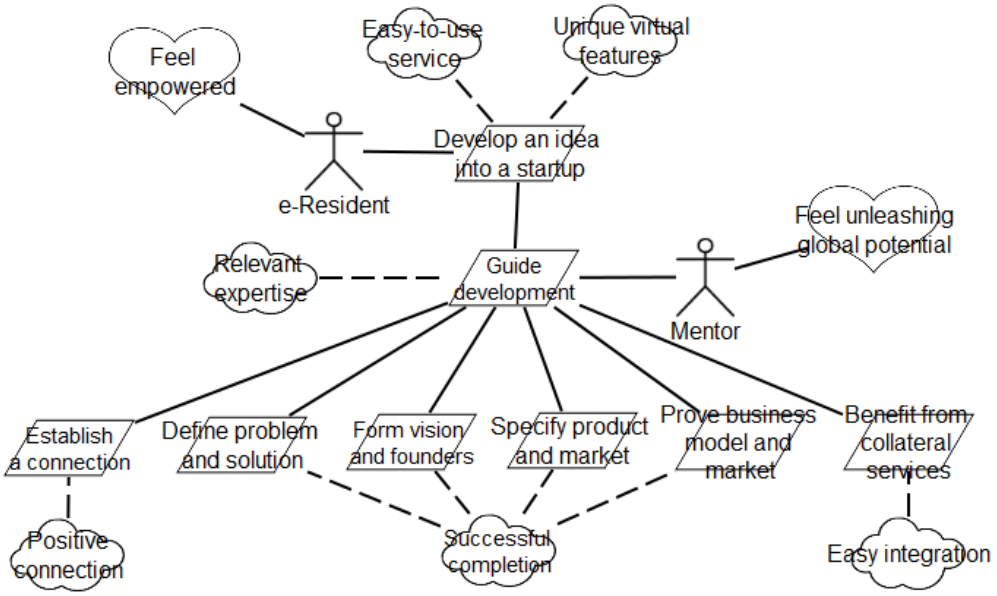

Figure 9. The main goal model for the virtual incubation system

More specific goals begin with “Establish a connection”, where the quality goal is to create a positive connection between the actors. After that, four operational goals are provided following the discussed startup development phases: “Define problem and solution,” “Form vision and founders,” “Specify product and market,” and “Prove business model and market.” Since the service is oriented on covering the whole path from an idea to a company, one quality goal is related to all four mentioned ones, namely “Successful completion.” Finally, “Benefit from collateral services” is outlined as a separate operational goal, since e-residents need various kinds of consulting. The related quality goal is “Easy integration,” meaning that the service should be compatible with other ones on e-Residency platform. Overall, the system has six operational goals, one of which is related to establishing a connection between e-Resident and Mentor, four ones deal with covering the path from an idea to an operating company, and one addresses the need for complementary services.

The fist goal, “Establish a connection,” contains several subgoals (see Figure 10). The first one is “Offer and idea,” where the quality goal is to have a wide choice of startup ideas, reflecting the interest of Estonian incubators. Then, “Receive feedback” comes, which is expected to be useful for e-Resident. The third subgoal is “Initiate collaboration,” and it is achieved through two subgoals: “Submit a request to continue” by e-Resident and “Receive a confirmation” from Mentor. As can be seen, choosing an idea to develop is a collaborative

process between e-Resident and Mentor. Performing this goal is expected to establish a positive connection between the parties.

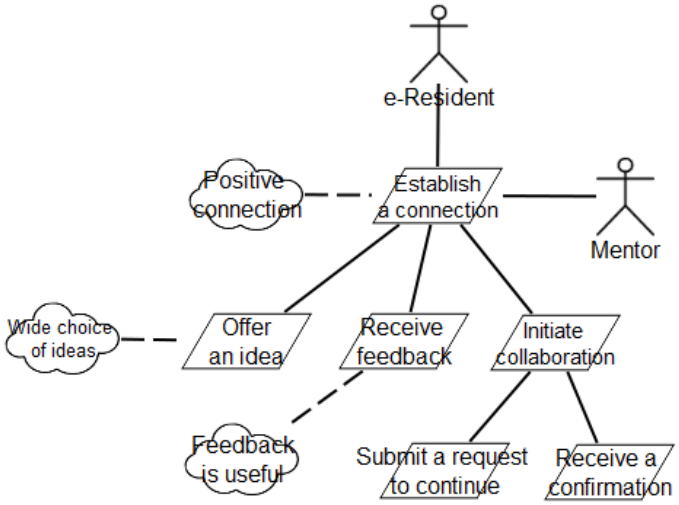

Figure 10. The subgoals of establishing a connection

The second goal is “Define problem and solution,” with related quality goal “Successful completion” (see Figure 11). For this goal, a new role is introduced – Startapo, an intelligent non-human assistant in the system. Thus, Startapo helps with goal “Learn from previous projects” before proceeding with the subgoals. Anytime e-Resident contacts Mentor, the assistant searches the questions that e-Resident had to Mentor when performing a similar goal during previous projects. The more projects go through the system, the richer its knowledge base becomes. Concerning quality, it is important that the advice of Startapo is relevant for the parties. This advice might be related to any of the subgoals, namely “Clarify service idea,” “Find target market,” “Outline revenue model,” “Form the team,” and “Proceed with the next step.” The latter subgoal can be performed only when previous subgoals are checked. Here, Startapo helps again by ensuring that e-Resident has reviewed all required steps. This action is performed through completing the following subgoals: “Ask Startapo to proceed” and “Receive a confirmation.” Overall, e-Resident and Mentor shape an idea into a project at this stage. Startapo, just like during the following stages, makes e-Resident learn from previous projects before collaborating with Mentor and ensures that e-Resident checked all subgoals before proceeding.

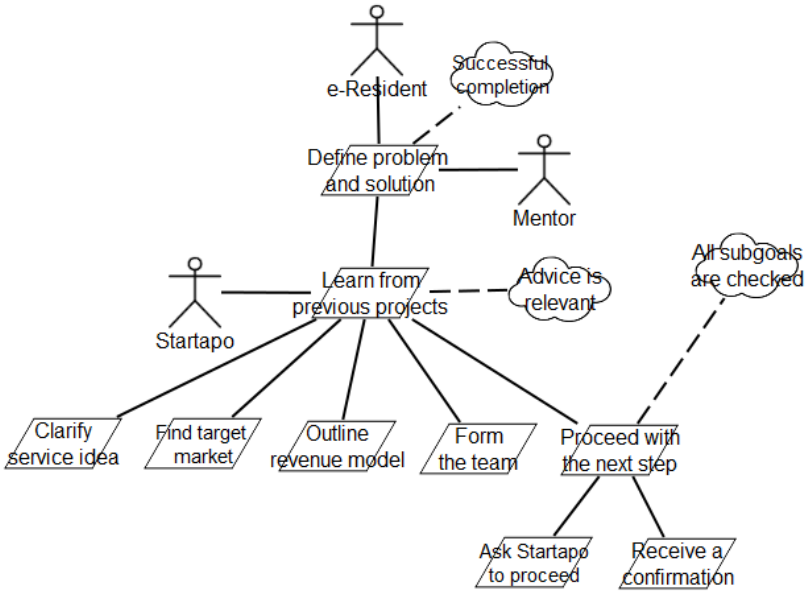

Figure 11. The subgoals of defining problem and solution

The next goal is called “Form vision and founders” (see Figure 12). As can be seen from the figure, the role and goals related to Startapo remain the same. Among new subgoals, there are “Create vision and mission,” “Offer development strategy,” “Develop MVP,” “Formalize shareholder agreement,” and “Stabilize the team.” The latter one has two important quality goals, namely “Balanced work division” and “Defined ownership,” in accordance with the emphasis made in Startup Development Phases model. So, forming vision and team of founders marks proceeding from the initiation to the development of a startup.

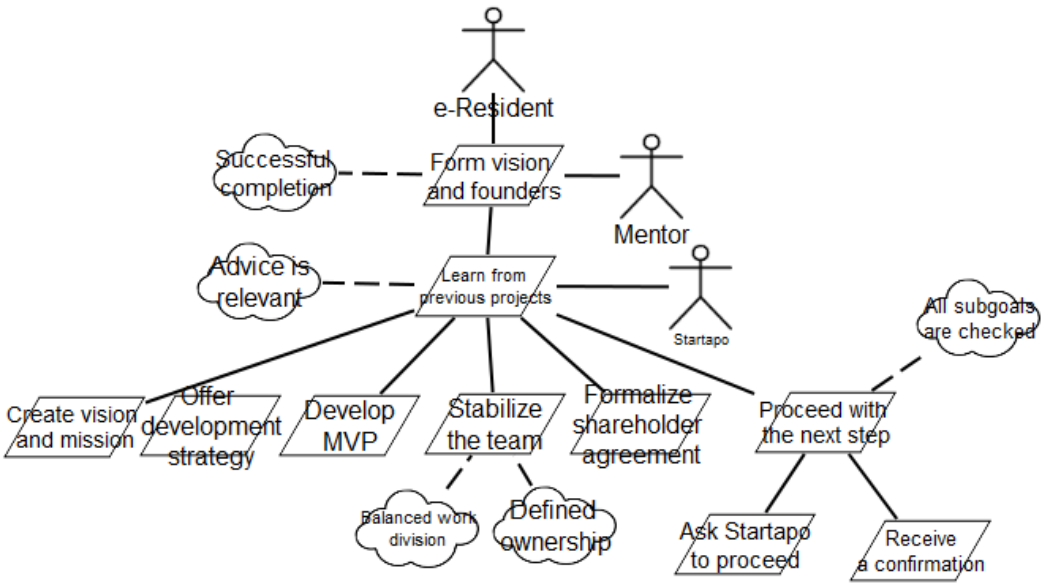

Figure 12. The subgoals of forming vision and founders

Proceeding with the next goal, it is “Specify product and market” (see Figure 13). It consists of the following subgoals: “Validate the product,” “Define KPIs,” and “Attract investment.” The most important quality goal is related to the first subgoal because the product should be convincing in terms of potential user growth and revenue. Also, KPIs should be relevant to the case. In total, it seems that meeting this goal is an essential step to establishing a business.

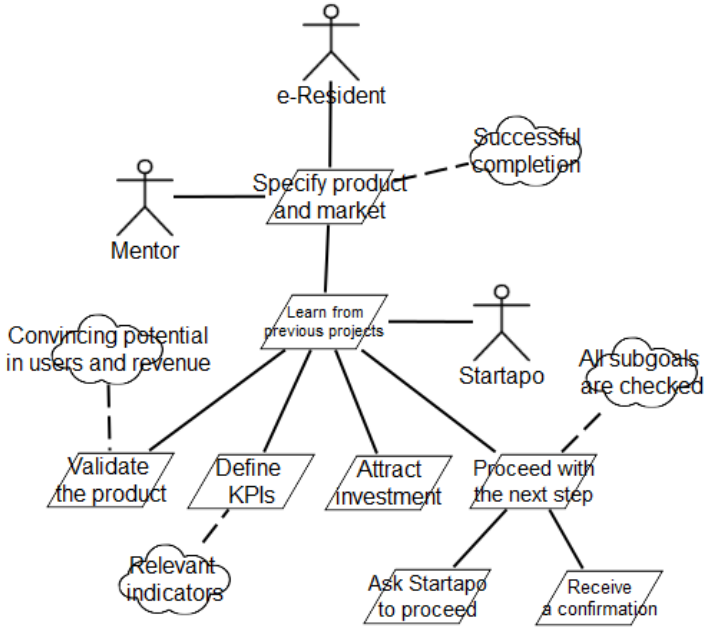

Figure 13. The subgoals of specifying product and market

Coming to the final goal of four main ones, “Prove business model and market” goal is to be covered (see Figure 14). The first subgoal here is “Have market growth,” with related quality goals “Measurable by KPIs” and “Relatively fast.” Another subgoal is “Attract resources.” It consists of several subgoals in its turn: “Hire employees,” “Receive additional funding,” and “Access other resources.” For all of them, it is expected to have an easy completion. Also, “Meet expectations” subgoal is defined, with a startup showing “Great future potential.” The final subgoal is “Redefine an identity,” when a full-scale company is formed.

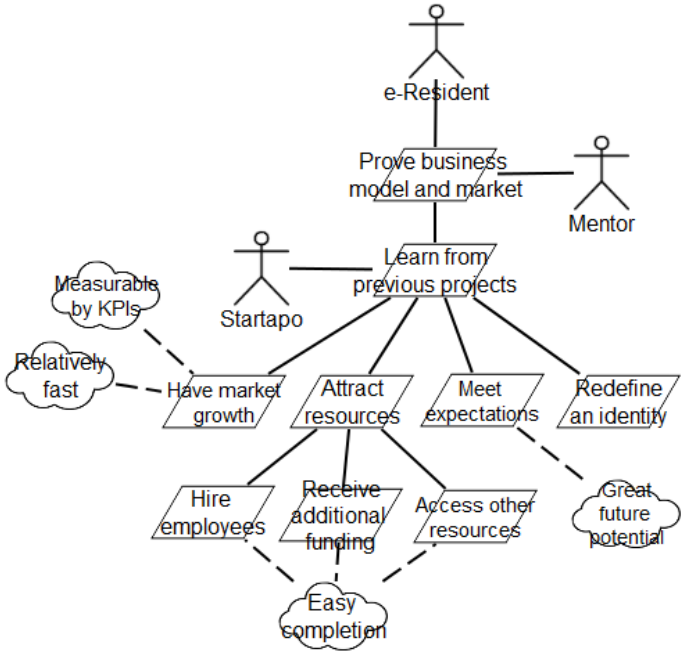

Figure 14. The subgoals of proving business model and market

One more goal is “Benefit from collateral services” (see Figure 15). The role of Another Service Provider is introduced to complete this goal. Though other services remain black boxes for my system, it is important to ensure a smooth integration with them. Specifically, this is achieved through the following subgoals: “Choose from service list,” “Submit a request,” “Receive service.” More detailed models of other services are possible to integrate with the current one in the future.

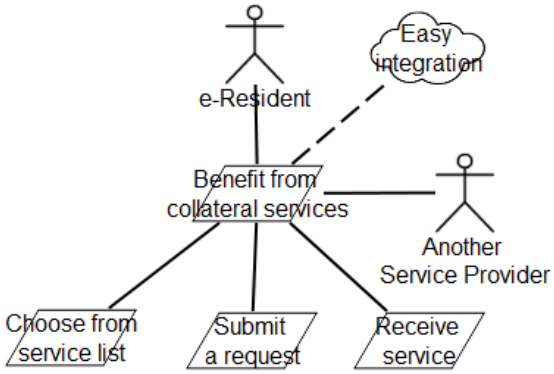

Figure 15. The subgoals of benefitting from collateral services

Finally, “Join the service” is the operational goal that is modeled separately from the main goal model (see Figure 16). The reason is that this goal involves only Mentor as a customer of the service. To enter the system, Mentor has the following subgoals: “Submit a request,”

"Receive a confirmation," "Fill in the profile," "Pay the fee," and "Access ideas." The paying process is associated with several subgoals: "Go to bank page," "Confirm the details," "Receive e-mail invoice." Accessing the ideas has two subgoals: "Check current ideas" and "Receive new ideas" that are submitted by e-Resident. Overall, this goal is dedicated to accessing startup ideas, which is the primary motivation for Estonian incubators to join the service.

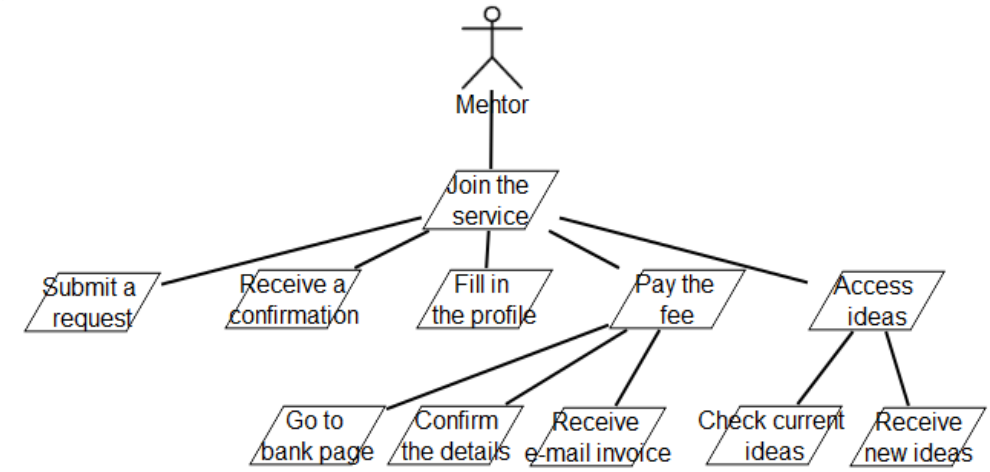

Figure 16. The subgoals of joining the service for Mentor

Overall, e-Resident and Mentor perform six common operational goals to develop a startup: they connect, cover four phases of startup development, and utilize collateral services that are relevant. Separately, Mentor joins the service as a customer to access startup ideas. Startapo enters the stage during four core phases, where its role is to help the sides to learn from previous projects and to ensure that all development activities are checked during each phase. Finally, Another Service Provider participates in providing collateral services. The modeled goals include all main ideas for the service that were collected through the surveys, literature review, and statistical data.

2.2. Role and organization models

Several roles were introduced when describing goal model. These roles are required to achieve system goals and quality goals. In order to make the roles perform the required functions, their responsibilities and constraints need to be described. Sterling and Taveter (2009, p. 75) claim that such descriptions are particularly valuable because they correspond to the division of labor to reach goals in real organizations. Below, the roles of principal actors in virtual incubation

system, namely e-Resident, Mentor, Startapo, and Another Service Provider, are presented. After describing them, their relations are specified through organization model.

The first role is e-Resident, or a startup idea owner (see Table 4). Its main responsibility is "Develop an idea into a registered company." This responsibility includes "Present startup idea," "Apply for collaboration with Mentor," "Complete actions during Startup Development Phases," "Read instructions from Startapo," "Ask Startapo to proceed between steps," "Consult with Mentor during Startup Development Phases," "Read the list of collateral services," and "Apply for collateral services". Coming to the constraints, the main one is that e-Resident must be interested in Estonian experience with startups. Also, the role has the following constraints: "Must be positive when communicating with Mentor," "Must follow the advice of Startapo and Mentor," "Must strive to complete all actions during startup development," "Must be ready to use other e-Residency services," "Needs a functioning e-Residency card and USB card reader or proper computer," and "Needs a computer with Internet connection". As can be seen, e-Resident role is primarily responsible for developing a company with the help of the system. This condition requires orientation on Estonia and collaboration with the system agents.

Role name	e-Resident
Description	The role of an idea owner
Responsibilities	• Develop an idea into a registered company • Present startup idea • Apply for collaboration with Mentor • Complete actions during Startup Development Phases • Read instructions from Startapo • Ask Startapo to proceed between steps • Consult with Mentor during Startup Development Phases • Read the list of collateral services from Another Service Provider • Apply for collateral services
Constraints	• Must be interested in Estonian experience with startups • Must be positive when communicating with Mentor • Must follow the advice of Startapo and Mentor • Must strive to complete all actions during startup development • Must be ready to use other e-Residency services • Needs a functioning e-Residency card and USB card reader or proper computer • Needs a computer with Internet connection

Table 4. The role model for e-Resident

The second role to discuss is Mentor, or a guide of startup development (see Table 5). The overarching responsibility of this role is to assist with the development of e-Resident's startup idea. To reach the system's goals, Mentor performs the following responsibilities "Apply for joining the service," "Check ideas' feed," "Provide feedback for an idea," "Confirm

collaboration with e-Resident," "Assist e-Resident to complete actions during Startup Development Phases," and "Advise e-Resident on collateral services." The main constraint here is that Mentor is supposed to be oriented on establishing global startup companies. Other constraints are "Must be competent in the area of an idea," "Must be encouraging with e-Resident," "Must provide an appropriate support to cover all aspects of startup development," "Must pay attention to Startapo's notifications," "Needs a functioning e-Residency or Estonian ID card and USB card reader or proper computer," and "Needs a computer with Internet connection." Overall, Mentor's main responsibility is to help turn an idea into a company through virtual incubation. This condition requires orientation on e-residents of Estonia and competence in the area of an idea.

Role name	Mentor
Description	The role of a guide of the development
Responsibilities	• Help with the development e-Resident's startap idea • Apply for joining the service • Check ideas' feed • Provide feedback for an idea • Confirm collaboration with e-Resident • Assist e-Resident to complete actions during Startup Development Phases • Advise e-Resident on collateral services
Constraints	• Must be oriented on developing global startup companies • Must be competent in the area of an idea • Must be encouraging with e-Resident • Must provide an appropriate support to cover all aspects of startup development • Must pay attention to Startapo's notifications • Needs a functioning e-Residency or Estonian ID card and USB card reader or proper computer • Needs a computer with Internet connection

Table 5. The role model for Mentor

Coming to the most innovative role, Startapo is an intelligent non-human assistant (see Table 6). The primary responsibilities of this role include: "Record the questions by e-Resident and the answers by Mentor," "Search previous information by keywords and typical questions each time e-Resident has a question," "Provide e-Resident with advice," "Revise completion of all actions during each development phase," and "Notify e-Resident and Mentor about unchecked actions." In terms of the constraints, Startapo's pieces of advice are expected to become increasingly more appropriate with new information entering the system. Among other limitations, "Must be able to sort various kinds of information," "Must be able to decide which information is relevant to the development phase," "Must be useful to e-Resident," and "Must serve as a reminder for e-Resident and Mentor." In total, Startapo is called to advise e-

Resident on typical questions and notify e-Resident and Mentor about skipped actions. The agent performing this role is expected to learn and adapt to e-Resident's needs.

Role name	Startapo
Description	The role of an intelligent non-human assistant
Responsibilities	• Record the questions by e-Resident and the answers by Mentor • Search previous information by key words and typical questions each time e-Resident has a question • Provide e-Resident with advise • Revise completion of all actions during each development phase • Notify e-Resident and Mentor about unchecked actions
Constraints	• The more information in the system, the more appropriate is advise • Must be able to sort various kinds of information • Must be able to decide which information is relevant to the development phase • Must be useful to e-Resident • Must serve as a reminder for e-Resident and Mentor

Table 6. The role model for Startapo

The final role is Another Service Provider (see Table 7). Detailed responsibilities and constraints of this role belong to other service systems. For virtual incubator, it is enough to mention the following responsibilities: “Provide the description of the service,” “Answer e-Resident's application,” and “Perform other service actions.” Also, the following constraints are relevant: “Must react to the messages from the system” and “Must be oriented on solving the needs of e-Resident.” So, this role supports the integration of other services with the system by making them available and possible to access when needed for e-Resident.

Role name	Another Service Provider
Description	The role of a provider of another service
Responsibilities	• Provide the description of the service • Answer e-Resident's application • Perform other service actions
Constraints	• Must react to the messages from the system • Must be oriented on solving the needs of e-Resident

Table 7. The role model for Another Service Provider

Having outlined all system roles in virtual incubation, it is possible to define their relationships (see Figure 17). To begin with, e-Resident is the main role in the system, because the service is called to help the agent performing this role develop an idea into a startup. Mentor and Another Service Provider are benevolent to e-Resident, because they provide the required help to cover startup development process. The agents performing these roles can make independent decisions, for instance when they have better knowledge than the agent performing e-Resident’s role, but they are bounded by providing services to e-Resident. This fact is also the reason for having peer relationship between Mentor and Another Service

Provider. Finally, Startapo is controlled by e-Resident, since this role is entirely dependent on user's actions. As can be seen, the organization of roles in the system is user-centered, with Mentor, Startapo, and Another Service Provider assisting e-Resident in different ways.

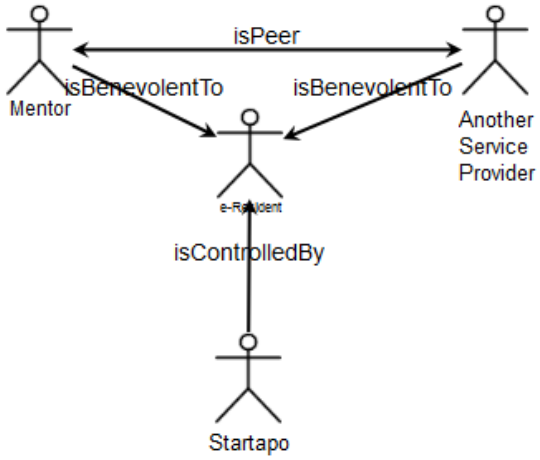

Figure 17. The organization model for the virtual incubation system

In total, the virtual incubator on e-Residency platform has four roles: e-Resident, Mentor, Startapo, and Another Service Provider. The first role, e-Resident, achieves the system goal to develop a startup. Main constraints of this role are being interested in Estonian startup expertise and being ready to collaborate with other system agents. Mentor helps to turn an idea into a company under the following constraints: being oriented on bringing global startups to life and being competent in the area of an idea. Startapo serves to tackle common questions and notify about development phases. The agent performing this role needs to learn and adapt to the user. Another Service Provider provides other relevant services during startup development. Main constraint here is being oriented on solving e-Resident's needs. The organization model underlines the central position of an agent performing e-Resident role, because the system goal is achievable only through this role. Mentor and Another Service Provider roles are benevolent to it, whereas Startapo is controlled by it.

2.3. Domain model

As it was mentioned in methodology part, system roles are always performed in a certain environment. It is useful to model system domain in order to delineate the boundaries of the system, resources it needs, and relations between roles, resources, and environments (Sterling & Taveter, 2009, p. 78). This way, knowledge about the system is more complete. In the case

of the virtual incubator, the service takes place through the website of e-Residency. Also, the service is supposed to be virtual. Below, its domain model is specified through idea submission case.

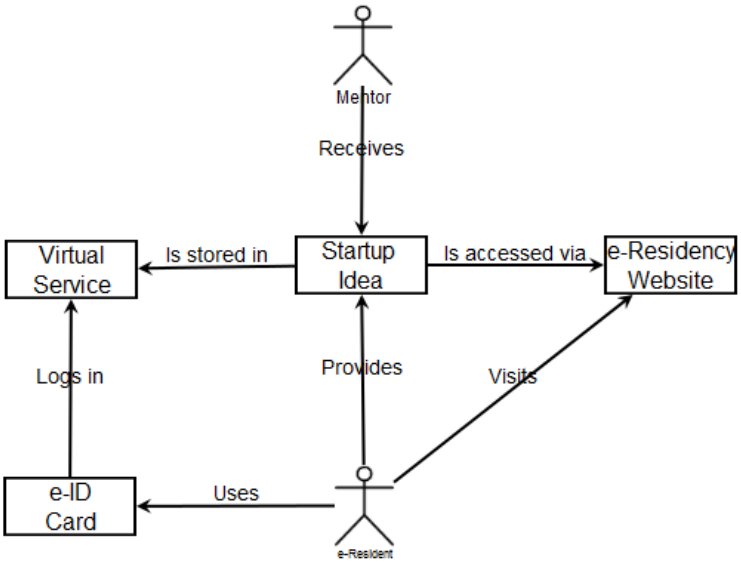

Figure 18. The domain model for the virtual incubator

To begin with, submitting an idea was chosen as the case to demonstrate domain model. It is worthy to mention that other goals can also be modeled for this purpose. However, the environments and roles remain similar for all of them. Another important notion is that Startapo role is required for some other goals, but this role is not present when offering an idea. So, the system has two environments - e-Residency Website and Virtual Service (see Figure 18). An agent performing e-Resident role can visit the website and enter the service. To complete the latter action, e-Resident uses e-ID Card type of objects to log in to Virtual Service. Upon logging in, e-Resident provides an object of Startap Idea type, which is received by Mentor. It is worthy to mention that other types of objects might be required for performing other goals. All of them, just like Startup Idea, are stored in Virtual Service and are accessed via e-Residency Website.

As can be seen, the system domain includes two environments: Virtual Service and e-Residency Website. Through them, the system resources of various types are stored and accessed by agents performing the system roles. The system agents, for instance the one performing the role of e-Resident, visit e-Residency Website and log into Virtual Service with the help of e-ID Card type of resource. Also, other object types are used when interacting inside the system, for instance Startup Idea type.

3. System design analysis

Having outlined the motivation for virtual incubation service, it is possible to proceed with designing the system. This layer begins with defining agent types and their interaction principles, which is the purpose of agent and acquaintance models. Also, I demonstrate knowledge that a certain agent type possesses. Then, typical examples of agent interaction and behavior are discussed, where rules and actions are fundamental notions. As a result, the link between motivating and implementing the system is provided.

3.1. Agent and acquaintance models

The analysis of system design starts with agent and acquaintance models. They serve to identify agent types and their interaction patterns (Sterling & Taveter, 2009, p. 79). The scholars claim that no definite rules exist for this identification; however they provide some tips. For instance, peer roles usually belong to the same agent type, whereas benevolence and control ones belong to different types (Ibid, p. 80). Acquaintance model complements agent one by means of specifying interaction between the types. Due to this model, it becomes clear how agent types collaborate. The two models are applied to the virtual incubator in this section.

In the theoretical background part, it was clarified that each service has two parties that interact. On this basis, generalized agent types for virtual incubation service - Provider and Receiver, can be delineated (see Table 8). The first type corresponds to a party providing a service, whereas the second one indicates a party that receives a service. When connecting them to the roles in virtual incubation system, it seems that Mentor and Another Service Provider can be mapped to Provider agent type. The main reason is that both of them have responsibilities that help e-Resident agent achieve the system goal. Also, they are connected by peer relationship, which indicates performing similar functions in the system, namely providing supporting services. Correspondingly, Receiver agent type includes only e-Resident role. The activities of an agent performing this role are crucial for reaching the system goal. At the same time, an e-Resident agent does not provide services to agents that function as Mentor and Another Service Provider. Their connection is benevolence or market exchange.

Agent name	Provider
Description	The agent type of a party providing a service
Roles	Mentor, Another Service Provider
Responsibilities	

Agent name	Receiver
Description	The agent type of a party receiving a service
Roles	e-Resident
Responsibilities	

Table 8. The agent models for Provider and Receiver

The third proposed agent type in the system is Assistant, which includes only Startapo role (see Table 9). The responsibilities of this role are close to the ones of Mentor and Another Service Provider; however an agent performing it has less freedom. Startapo agent is controlled by e-Resident one, who is free to take into account or disregard its actions. Besides, an agent performing Startapo role is non-human one, so its role seems to be unique in the system.

Agent name	Assistant
Description	The agent type of an intelligent non-human assistant
Roles	Startapo
Responsibilities	

Table 9. The agent model for Assistant

Coming to acquaintance models, Receiver and Provider agent types interact, because the roles that belong to these agent types contain many mutual responsibilities (see Figure 19). For instance, an agent acting as e-Resident applies for collaboration with an agent performing Mentor role and the latter one provides feedback to an idea of the first one. In its turn, Assistant agent type interacts only with Receiver. Providing an example, an agent acting as e-Resident asks the one with Startapo role to proceed to the next startup development step and receives a confirmation. It should be mentioned that though Startapo agent notifies both e-Resident and Mentor agents about unchecked startup activities, only e-Resident one can perform actions in response. So, Receiver agent type interacts with both Provider and Assistant types, but the latter ones do not communicate with each other.

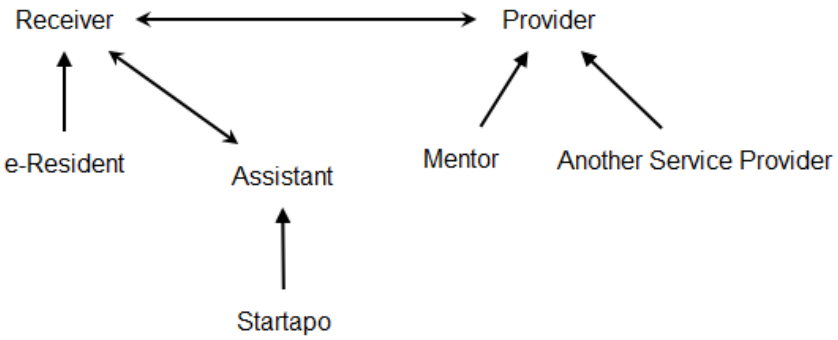

Figure 19. The acquaintance model for the virtual incubator

Overall, three agent types are identified in the system: Receiver, Provider, and Assistant. The second one combines the roles of agents providing supporting services, whereas the latter one deals with non-human assistance to Receiver agent type. Such agent structure corresponds to the general idea of the virtual incubator as a service, and it also considers artificial intelligence integration, reflecting on a subordination of an agent performing Startapo role. User centricity in the service is emphasized through interaction patterns, as Receiver is connected to both Provider and Assistant agent types, but the latter two do not exchange without the principal agent.

3.2. Knowledge model

After outlining agent types, their knowledge can be mapped in knowledge model. The main concepts here are knowledge attributes, or certain quality dimensions of agents, objects, and their environment, and conceptual objects, which stand for resources that are consumed by an agent (Sterling & Taveter, 2009, p. 90-91). Knowledge attributes can be of various types, for instance ‘integer’ is used for numbers without fractional components. Conceptual objects can have different relationships, for example ‘generalization’ is employed to represent the connection between general and specific objects. Below, a partial knowledge model for agents of the Receiver type is outlined, including the connections between an agent and knowledge items.

The knowledge model begins with demonstrating the agent type – Receiver (see Figure 20[1]). Agents of this type perform e-Resident role or main user of the service. To begin with, an agent knows about environmental objects Virtual Service and e-Residency Website. In order to use the system, an agent possesses knowledge about conceptual objects of types e-ID Card and Password. Objects of the first type possess the following knowledge attributes: 'Name' of String type, 'Date of Expiry' of Date type, 'Document Number' of Integer type, and 'Personal Code' of Integer type. In its turn, Password type conceptual objects generalize two specific object types: 'PIN1' and 'PIN2.' These object types correspond to two passwords in Estonian e-ID documents – one for authentification and another one for digital signature. Their knowledge attributes have Integer type, because they can include only four full digits. In total, Receiver type agents know two main environmental objects, namely Virtual Service and e-Residency Website, and two main conceptual objects to operate in the environment: e-ID Card and Password. One Receiver agent can have only one e-ID card object, but several passwords. Also, there might be many agents of Receiver type in Virtual Service and e-Residency Website, but these environmental objects are common for all of them.

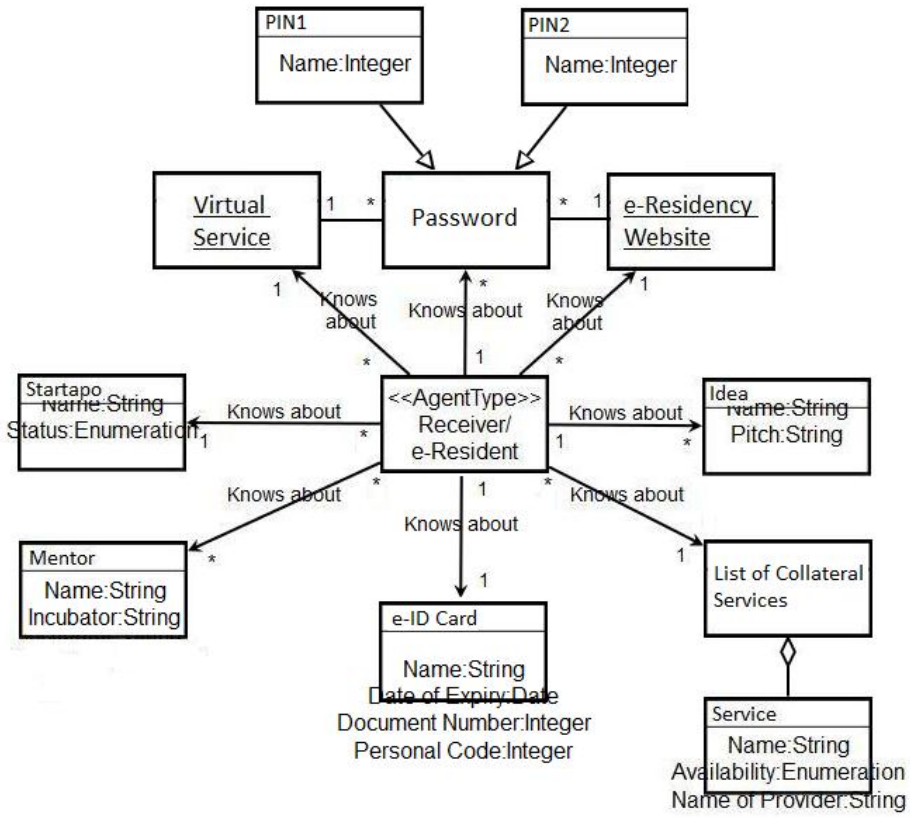

Figure 20. A partial knowledge model for agents of the Receiver type

[1] This figure has been edited as a static image, because AOM4STS tool does not have all required elements for representing a knowledge model at the moment of conducting this study

Another part of the knowledge of agents belonging to the Receiver type concerns other agents in the system. In this regard, Startapo knowledge item represents knowledge about Startapo agent. Its main attributes are ‘Name’ of String type and ‘Status’ of Enumeration type. By the latter, it is meant that Startapo agent can be either active or inactive. Coming to Mentor knowledge item, agents of Receiver type are supposed to know the following basic attributes of Mentor agents: ‘Name’ of String type and ‘Incubator’ of String type. It is worthy to emphasize that one Receiver agent might have many Mentor agents and vice versa. In other words, several agents acting as Mentor might provide support to one Receiver agent and one Mentor agent might have many agents belonging to Receiver type. In contrast, Startapo type agent is unique, and this agent is supposed to work with many Receiver type agents.

The model also features typical conceptual object types in startup development process, namely Idea and List of Collateral Servies. Thus, agents of the Receiver type know about startup ideas, for which ‘Name’ of String type and ‘Pitch’ of String type are main attributes. Thereby, Receiver agent can submit a startup idea. In its turn, List of Collateral Services object type includes Service object type, so they are connected with the help of aggregation relationship. Service knowledge attributes are the following: ‘Name’ of String type, ‘Availability’ of Enumeration type, and ‘Name of Provider’ of String type. This way, Receiver agent can choose other relevant services. Coming to the connections, an agent mapped to the Receiver type might have many ideas, but each item of Idea type belongs only to one agent. The situation with List of Collateral Services object type is the opposite: the list of services is common for many agents of the Receiver type.

As can be seen, knowledge model for agents of the Receiver type consists of three main knowledge areas: environment (e.g. e-Residency Website), other agents in the system (e.g. Startapo), and typical conceptual objects in the system (e.g. Idea). Most common knowledge attributes in these areas are of type String and Integer. Also, some conceptual object types consist of other types, for instance List of Collateral Services and Service object types are connected via aggregation relationship. Finally, Receiver type agents have various connections with the mentioned knowledge items, such as one-to-one with e-ID Card type objects and many-to-one with Startapo ones.

3.3. Interaction model

The acquaintance model demonstrates that certain agent types interact in the virtual incubation system. Particularly, Receiver and Provider, and Receiver and Assistant agents types engage in communication. Also, the role model specifies responsibilities for each agent performing a particular role, where for instance e-Resident role belongs to Receiver type. From these two models, it is possible to create interaction models, which show interaction patterns in detail (Sterling & Taveter, 2009, p. 82). These models include the following elements: actions events or the ones caused by agents, including communicative action events or messages between agents, nonaction events or the ones taking place in the environment, and actions on environment or the ones without particular agent as an addressee (Ibid, p. 89). There are several diagram types for modeling interactions, and I choose an interaction-frame diagram because it demonstrates all possible options of interaction between agent types. More specific interactions can be derived from the model presented below.

The first diagram represents the interaction between Receiver and Provider agent types when establishing a connection (see Figure 21). Thus, Receiver agent submits a startup idea into the system. At this point, no agent is affected by the action, so it is an action on the environment. At some point, an agent of Provider type receives a list of startup ideas. These ideas are aggregated and no specific agent causes the event, so this is a nonaction event. Provider agent sends a message to Receiver agent with the feedback on a specific idea. In response, Receiver agent expresses gratitude and, in certain cases, applies to continue the collaboration. Provider agent has two options for response: to agree or to decline this offer. In case an agent of Provider type agrees, the first startup development phase begins. As can be seen, the interaction frame includes alternative options for interaction between specific agents of Receiver and Provider types, such as to express gratitude and stop or to initiate further collaboration. The diagram is based on two responsibilities of e-Resident role and three responsibilities of Mentor one.

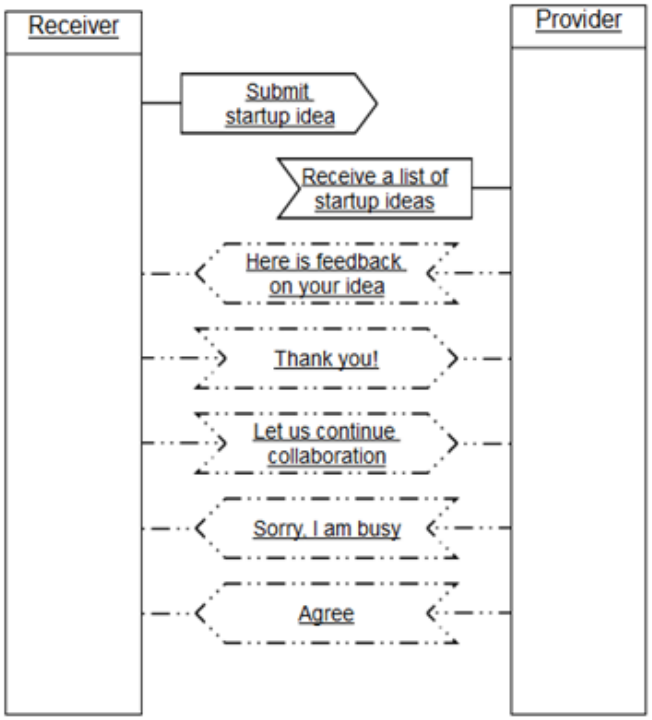

Figure 21. The interaction frame for establishing a connection between Receiver and Provider

The second diagram is devoted to the interaction between Receiver and Assistant agent types when learning from previous projects (see Figure 22). To begin with, an agent of Receiver type informs Assistant one about having a question to Provider one. In response, Assistant agent either informs an agent of Receiver type that a question is sent or, in the case similar questions are found in previous projects, offers to check search results. Afterward, Receiver agent receives search results as a nonaction event. The exchange of gratitude takes place between agents of both types. In certain cases, Receiver agent informs Assistant one that the necessity to contact Provider one is still present. Under such circumstances, Assistant agent refers a question to Provider agent. The interaction finishes with an agent of Provider type receiving a question. So, this interaction frame considers alternative options for communication between Receiver and Assistant agents, for instance the first one might be satisfied with search results or continue with contacting Provider agent. Two responsibilities of e-Resident role and three responsibilities of Startapo role are reflected in this diagram.

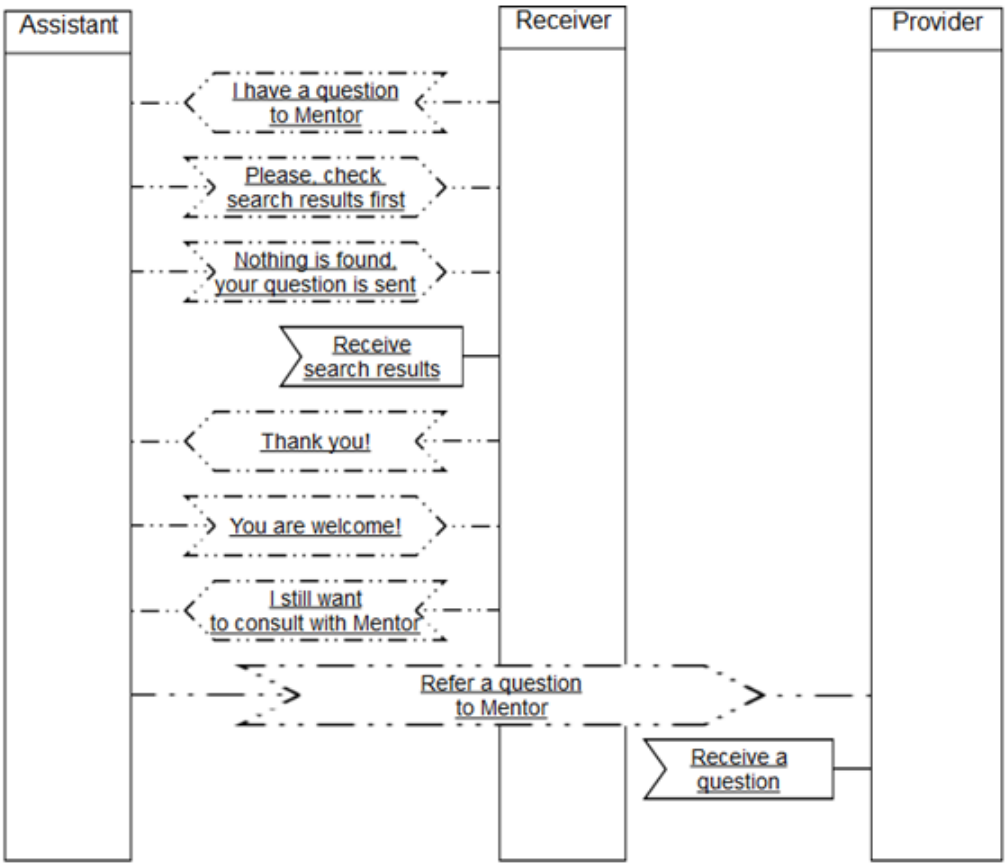

Figure 22. The interaction frame for learning from previous projects between Receiver and Assistant

Overall, the modeled interaction frames elaborate on two main communication directions in the system: between Receiver and Provider, and between Receiver and Assistant. It should be emphasized that interactions between these agent types include more possibilities than the ones depicted above. The goals of establishing a connection between Receiver and Provider and learning from previous projects between Receiver and Assistant are chosen as exemplary cases. Another important point is that interaction frames demonstrate all possible interactions between agent types, so both negative and positive answers are included, for instance Assistant agent providing Receiver one with search results and informing the latter that nothing is found. In total, the provided diagrams reflect four different responsibilities of e-Resident role, three ones of Mentor role, and three ones of Assistant one.

3.4. Behavior models

To create a transition between interaction of agent types and behavior of specific agents, it is necessary to consider scenarios. This type of behavior model provides step-by-step descriptions of achieving system goals by agents performing system roles (Sterling & Taveter, 2009, p. 94). Scenarios are particularly useful when achieving a certain goal requires collaboration between agents that perform different roles, because required interactions can be specified. On the basis of two exemplary scenarios, behavior agent and behavior interface models will be defined. The first one demonstrates the behavior of an agent that belongs to a certain type, the second one summarizes behavioral units and specifies their anterior and posterior conditions (Ibid, p, 101). To represent these models, both UML and BPMN notation will be employed. The models below elaborate on interaction frames for achieving the goals "Establish a connection" and "Learn from previous projects" as the examples of virtual incubation system.

The first scenario is devoted to establishing a connection between agents performing e-Resident and Mentor roles (see Table 10). The scenario is initiated by an agent performing e-Resident role. Though submitting a startup idea is a triggering event for agent interaction in this scenario, previous private activities are also important to demonstrate because they serve as prerequisites of the interaction. To begin with, e-Resident and Mentor agents perform separate activities to log into the service with the help of e-ID Card and PIN1 types of resources. Then, an agent acting e-Resident role submits the form with an idea. The activity might be repeated to submit multiple ideas. It should be emphasized that Mentor role is not involved here, as ideas arrive in the system. At the next step, an agent performing Mentor role receives a list of startup ideas from all e-Resident agents. The quality goal here is to have a wide choice of ideas, which is essential for startup incubators to be interested in the service. At this point, agent interaction begins by submitting feedback to the owner of a specific idea, with the quality goal of being useful. The sides finalize achieving the goal by submitting and accepting a request to continue the collaboration. As can be seen, establishing a collaboration between agents performing e-Resident and Mentor roles requires six steps. Each agent has two activities to perform on their own, namely the first and the second ones for e-Resident, and the first and the third ones for Mentor. The collaboration starts with the fourth step.

Goal	Establish a connection				
Initiator	e-Resident				
Trigger	The Receiver submits a startup idea				
Failure	The collaboration is not established				
Condition	Step	Activity	Agent types and roles	Resources	Quality goals
	1	Log in to the service	Receiver/e-Resident, Provider/Mentor	e-ID Card, PIN1	
Repeat if necessary	2	Submit the form with an idea	Receiver/e-Resident	Startup Idea	
	3	Receive a list of startup ideas	Provider/Mentor	Startup Idea	Wide choice of ideas
	4	Submit feedback to the idea owner	Receiver/e-Resident, Provider/Mentor	Feedback	Feedback is useful
	5	Submit a request to continue to the mentor	Receiver/e-Resident, Provider/Mentor		
	6	Accept a request from the idea owner	Receiver/e-Resident, Provider/Mentor		

Table 10. The scenario for achieving the goal "Establish a connection"

To continue with agent behavior model, it begins with the rule that an agent acting as e-Resident has access to the service (see Figure 23[2]). Then, an agent logs into the service. The second rule is that an e-Resident agent has a startup idea, which leads to the activity of submitting the form with an idea. At this point, Mentor role activities begin with the rule that an agent performing this role has access to the service. Then, an agent receives a list of startup ideas. In case a Mentor agent is interested in an idea, feedback is submitted; otherwise the scenario fails. The next rule relates to e-Resident role, as an agent is expected to find the feedback useful and submit a request to continue. In the opposite case, the scenario is not fulfilled. The last rule is that a Mentor agent is available for further collaboration, which leads to an acceptance of the request. So, six rules are required to perform all activities of agents, namely the first, second, and fifth rules belong to e-Resident role, and the third, fourth, and sixth ones belong to Mentor role. In three cases, an alternative decision by an agent might lead to the failure: Mentor agent might be not interested in an idea, e-Resident agent might not find feedback useful, and Mentor agent might not be available to continue collaboration. Behavior interface model provides a summary of the discussed rules and activities (see Table 11).

[2] This figure has been edited as a static image, because AOM4STS tool does not have all required elements for representing an agent behavior model at the moment of conducting this study

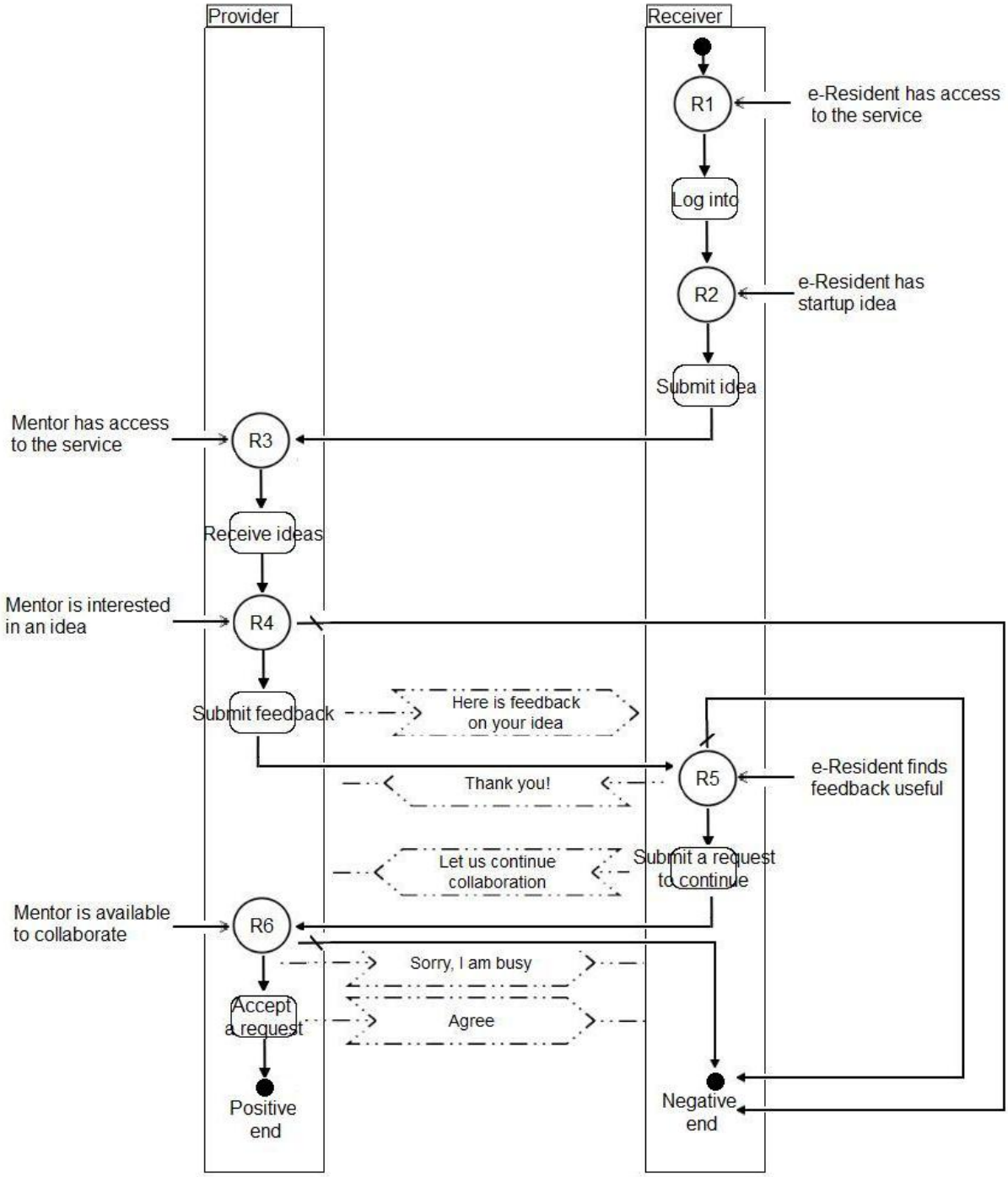

Figure 23. The agent behavior model of establishing a connection between Receiver and Provider

Precondition	Activity	Postcondition
e-Resident has access to the service	Log into	e-Resident can submit an idea
e-Resident has a startup idea	Submit the form with an idea	e-Resident can receive feedback
Mentor has access to the service	Receive ideas	Mentor can submit feedback
Mentor is interested in an idea	Submit feedback	e-Resident can consider feedback
e-Resident finds feedback useful	Submit a request to continue	Mentor can consider continuing collaboration
Mentor is available to collaborate	Accept a request	Collaboration is established

Table 11. The behavior interface model of establishing a connection between Receiver and Provider

The second scenario demonstrates learning from previous projects between agents acting as Startapo and e-Resident (see Table 12). The scenario is initiated by e-Resident agent, with submitting a question to Startapo agent serving as a triggering event. The key resource type here is Question. This activity might be repeated in case an agent performing e-Resident role wants to modify the question. In response, an agent acting as Startapo demonstrates search results from previous projects. In this case, the key resource type is Search Results. This activity also has a quality goal of providing a relevant piece of advice. In some cases, this might be the final step and the next two ones might be not required. However, e-Resident agent can submit a request to continue with contacting Mentor agent. The scenario is finalized with referring a question to an agent acting as Mentor and addressing a question by this agent. Overall, the scenario has five steps, where three first ones demonstrate collaboration between e-Resident and Startapo agents and two latter ones involve Mentor agent to provide the service.

Goal	Learn from previous projects				
Initiator	e-Resident				
Trigger	The Receiver submits a question				
Failure	The Receiver does not receive response				
Condition	Step	Activity	Agent types and roles	Resources	Quality goals
Repeat if necessary	1	Submit a question to Assistant	Receiver/e-Resident, Assistant/Startapo	Question	
	2	Receive search results from previous questions	Receiver/e-Resident, Assistant/Startapo	Search results	Advice is relevant
	3	Submit a request to continue with contacting the Provider	Receiver/e-Resident, Assistant/Startapo		
	4	Refer a question to the Provider	Assistant/Startapo, Provider/Mentor		
	5	Address a question	Provider/Mentor		

Table 12. The scenario for achieving the goal "Learn from previous projects"

Coming to agent behavior model, it starts with the rule that an agent acting as e-Resident has a question (see Figure 24[3]). In such case, an agent submits a question to an agent performing Startapo role. The second rule is that Startapo agent has a question received, which leads to submitting search results. An alternative path is to refer a question to Mentor agent, which is executed when nothing is found. The third rule is that e-Resident agent finds a piece of advice from Startapo agent sufficient, and in this case, no further actions are performed. Otherwise, an agent acting as e-Resident submits a request to continue with contacting Mentor agent. At the next step, Startapo agent has a request received and, as a result, refers a question to Mentor agent. The final rule is that Mentor agent has a question received and either addresses it or fails to do so. So, five rules are required to meet the goal, where three first ones deal with a positive scenario of interaction between e-Resident and Startapo agents. Three alternative decisions are possible: Startapo agent might refer a question directly to Mentor one, e-Resident agent might be willing to contact Mentor one even after receiving search results, and an agent performing Mentor role might fail to respond. Only the latter case leads to the failure of this scenario. The discussed rules and activities are summarized in behavior interface model (see Table 13).

[3] This figure has been edited as a static image, because AOM4STS tool does not have all required elements for representing an agent behavior model at the moment of conducting this study

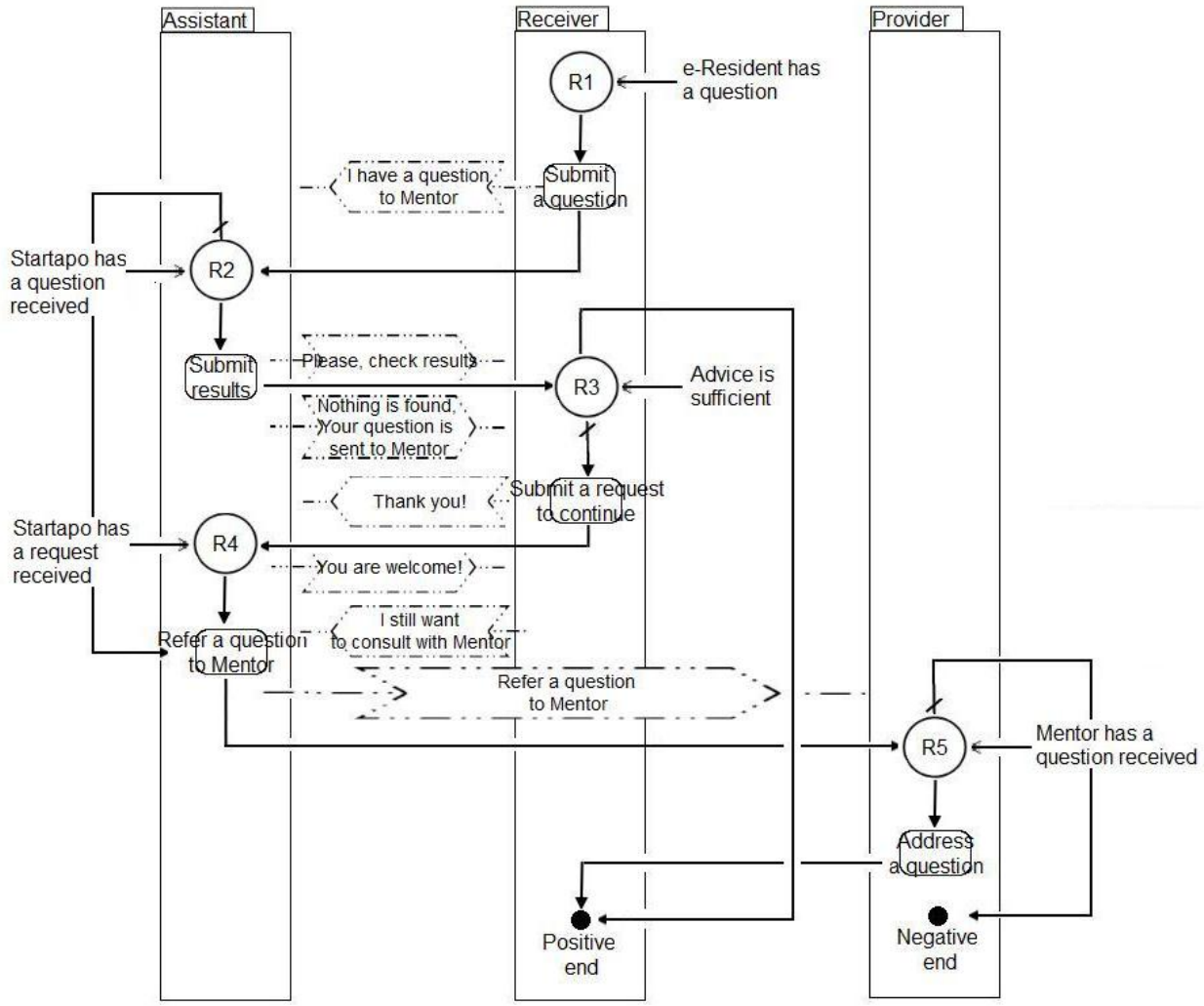

Figure 24. The agent behavior model of learning from previous projects between Receiver, Assistant, and Provider

Precondition	Activity	Postcondition
e-Resident has a question	Submit a question to Startapo	Startapo can provide assistance
Startapo has a question received	Send search results	e-Resident can check a piece of
Advice is not sufficient	Submit a request to continue	Startapo can provide assistance
Startapo has a request received	Refer a question to Mentor	Mentor can provide support
Mentor has a question received	Address a question	e-Resident has a question addressed

Table 13. The behavior interface model of learning from previous projects between Receiver, Assistant, and Provider

In total, behavior models elaborate on interaction ones by providing actions of specific agents and rules for these actions. In order to demonstrate the benefits of behavior models for virtual incubation case, two exemplary cases of establishing a connection and learning from previous projects were continued. In the first case, reaching the goal requires six steps, with collaboration between e-Resident and Mentor agents starting from the fourth one – submitting feedback on an idea. Correspondingly, six rules are necessary to perform these actions, with three alternative decisions leading to three possible scenario failures. For instance, Mentor agent might not be available for further collaboration. Such big number of possibilities to fail is related to the fact that agents are at the very beginning of cooperation. In the second case, three steps are required to reach the goal between e-Resident and Startapo agents, and two more steps are necessary in case Mentor agent has to be involved. Among five rules, three alternative decisions are possible; however, only one of them leads to the scenario failure. Specifically, the goal is not reached when an agent performing Mentor role fails to address a question. Such situation is explained by the fact that Mentor agent serves as a backup option to assist e-Resident agent with learning when Startapo agent's help is not sufficient.

Summing up the system design analysis, the agent activities aimed at meeting user needs in virtual incubation system have been clarified. The agent model, namely Receiver, Provider, and Assistant, includes both the orientedness on providing virtual incubation between Provider and Receiver and the integration of artificial intelligence to assist in this process. A partial knowledge model demonstrates the attributes that Receiver type agents know about the environment, other agents, and conceptual objects in the system. For instance, agents performing Mentor role are identified by name and incubator affiliation in String type. An additional value of this model is that it specifies the connections of Receiver agent type with different types of knowledge items; for instance, one object of e-ID Card type corresponds to one agent of Receiver type. Moreover, interactions between agent types happen only in two directions: Receiver and Provider, and Receiver and Assistant, which underlines user centricity of the system. The modeled interactions correspond to the responsibilities of agent roles that belong to these agent types. For instance, an agent of Provider type provides feedback on an idea of an agent that belongs to Receiver type. At the final step, the behavior of specific agents is modeled. It is possible to see how many actions it takes to implement a certain goal and which rules must be followed. Providing an example, three failure

possibilities exist when establishing a connection between e-Resident and Mentor agents. As a result of system design analysis, two exemplary cases of system goals are ready for implementation in virtual incubation service on the basis of e-Residency.

4. Discussion on created models

The provided models have certain beneficial features that should be emphasized. The agent-oriented modeling approach allows designing virtual incubation system with a particular focus on modifying abstract service ideas into specific agent behavior. The approach also enables capturing interactions in the system, which is particularly important for incubation processes. Another feature is that user centricity is reflected in the models. These three features are described in detail below.

To begin with, abstract service ideas from the background part have been translated into specific agent behavior in the models. For instance, the vast choice of applicants and startup ideas is defined as crucial for Estonian incubators to be interested in the service. At the first step, this idea is turned into value proposition in the business model, namely ‘to access a community of business-oriented people interested in Estonia’. So, Estonian incubators are defined as customers willing to pay to get the access to e-residents’ startup ideas, and the latter ones are defined as users willing to receive mentorship. On this basis, ‘Establish a connection’ between agents performing e-Resident and Mentor roles is introduced as one of the key goals in the goal model, with its subgoals and quality goals bringing in crucial features, for instance ‘Wide choice of ideas’ as a quality goal.

In the role model, two responsibilities of e-Resident role and three responsibilities of Mentor one are defined to reach this goal, such as ‘Apply for collaboration with Mentor’. The organization model helps to specify that Mentor role is benevolent to e-Resident one, as service provision connects them. The domain model maps the environment for service provision, such as e-Residency Website and e-ID Card type of objects. Coming to the agent-acquaintance model, it introduces Receiver and Provider agent types, thereby placing e-Resident and Mentor roles intro different types to prepare the ground for modeling their interaction. The knowledge model builds upon the domain one, for instance by specifying that an agent of Receiver type identifies Provider one by ‘Name’ and ‘Incubator’ basic attributes.

The interaction model is based on the role, domain, and agent-acquaintance ones, thereby specifying how establishing a connection takes place. For instance, an agent of Provider type submits an idea to the system as an action on the environment.

At the last step, the behavior of particular Provider and Receiver agents is derived from the goal, role, agent-acquaintance, and knowledge models, for instance if an agent performing e-Resident role does not find feedback useful, establishing a connection fails. As can be seen, the chosen modeling approach allows translating an abstract notion of reaching a community of people with startup ideas into specific behavior of agents of Provider and Receiver type who perform the actions. Therefore, the agent activities are derived from the business value that the e-service is supposed to bring. Considering business orientedness of e-Residency project, this feature seems to be pivotal for designing new services on the platform.

Coming to the second notion, the agent-oriented approach prioritizes the most important feature in virtual startup incubation – interactions. Main value propositions of the service are accessing e-residents for Estonian incubators and receiving mentorship for e-residents. With the chosen modeling approach, it is possible to create the service that is oriented on the interactions between the two. Specifically, the system is based on an exchange between Provider and Receiver agent types, with Assistant type playing a supporting role. The system communications can be specified as much as required, for instance expressing gratitude is included into Provider-Receiver interaction frames. Another example is that alternative behavior of each agent is conceived in the system design, for instance Assistant agent refers a question to Mentor agent directly if search results are empty. Overall, the chosen modeling approach appears to be particularly useful when recipient-provider interactions play a crucial role in obtaining the value from e-services, which is the case with virtual incubation. It is possible to represent the details of e-resident-mentor communication while preserving the main focus.

The third aspect to mention is that the created models implement user centricity ideas. This implementation is achieved through introducing agent roles as the most basic feature. Thus, in the organization model, it can be seen that agents performing Mentor and Startapo roles are not connected directly, but via e-Resident one, who is the end user. Correspondingly in the agent-acquaintance model, interactions take place only in two directions: Receiver and Provider, and Receiver and Assistant. The models limit interaction possibilities to the ones

relevant for the end user. Moreover, the quality goals in the system help to focus on satisfying its user. Though they are more difficult to measure than operational goals, it seems important to include them as an indicator of the system performance. For instance, connecting with an agent performing Mentor role is supposed to evoke positive feelings in the one acting as e-Resident. So, the models of virtual incubation service are user centric primarily due to their interaction patterns and quality goals. This modeling approach appears to be relevant for all new services on e-Residency platform because these services start being designed for its end user – e-residents, and not for a different user group, namely Estonian citizens, for whom the existing services provided via e-Residency portal were initially created.

Overall, applying the agent-oriented approach to virtual incubation service allows achieving valuable results. Thus, the key background ideas can be translated into specific system features, which is demonstrated by the case of establishing a connection between agents performing e-Resident and Mentor roles. Thereby, the e-service details are oriented on its business value, which seems to be particularly important for e-Residency as a business-oriented service platform. Also, the focus on interactions allows reflecting most important features, namely the ones specifying how agents acting as e-Resident and Mentor communicate at different stages of startup development. This notion appears to be beneficial for any e-service where provider-recipient interactions are the cornerstone. Finally, user centricity is reflected through modeling the quality goals and interaction pathways, particularly linking both Provider and Assistant agent types to the end user. This feature seems to be useful for all new services on e-Residency platform because they need to be oriented on their target audience, namely e-residents.

Limitations

Before proceeding with the conclusions of the study, it is worthy to outline its limitations. This way, future research directions will be mapped. Also, in the case of modeling new services for e-Residency, the project is in the process of an active evolvement and new data are being added virtually every day. It seems to be relevant to reflect upon future research opportunities in this regard. This section will address new theoretical angles, research design limitations, and modeling extension possibilities to go beyond the current investigation.

The first point is that background part of the study barely highlights different aspects of e-Residency that would be important to scrutinize further. The chosen approach is related to the needs of modeling a particular service on e-Residency platform, rather than conducting a full-scale social science research on the project. One more reason for a limited deepness of the background part is that the data on the initiative is still scarce at the moment of conducting this study. In the future, it is recommended to investigate the phenomenon of e-Residency in depth from various relevant perspectives, for instance institutional analysis or innovation systems theory. Looking at e-Residency from different points of view might help clarify the nature of this project in a global context. Another important aspect is that more data will allow analyzing the phenomenon more precisely.

The next limitation is that the marketing study on the virtual incubator users can be specified and extended. This research is focused on translating the discussed ideas for virtual incubation service on e-Residency into service models. Due to the mentioned focus, the main attention has been paid to modeling activities rather than conducting market research. Therefore, this research can be advanced further. For instance, it might be beneficial to do in-depth interviews with potential service users to get more accurate ideas for service design. Also, it might be relevant to cover a larger and, possibly, representative sample of e-residents through e-mail surveys. In addition, the study on virtual incubation is open for further marketing research efforts, for instance user experience analysis.

The final limitation deals with the fact that modeling of the virtual incubator is possible to advance. In the current research, it is demonstrated that the agent-oriented modeling approach can be effectively applied to modeling new services on e-Residency. In this regard, it might

be relevant to apply other modeling approaches, such as enterprise architecture, and compare their usefulness for the case with the chosen one. Another possibility is that only two exemplary goals, namely establishing a connection between an e-resident and mentor and helping e-resident learn from previous projects, were modeled through all stages. So, the model can be complemented further. It is logical to continue with simulating the service resources with the help of CPN model, which is available in AOM4STS tool, and creating an implementation layer. Last but not least, other new services on e-Residency can be modeled with the help of the agent-oriented approach to clarify its applicability.

In total, the current research has several possibilities for extension. The background of e-Residency might be relevant to analyze through various social science perspectives to explain the nature of this initiative better. Another opportunity is that the marketing research on virtual incubation service users is far from being complete, with both new methods and larger samples appearing to be useful to apply. Concerning modeling, other approaches might be relevant to compare with the agent-oriented one to represent the service ideas. Also, the current model could be extended beyond exemplary cases and complemented with an implementation layer. Finally, it seems appropriate to apply the agent-oriented modeling approach to other new services on e-Residency.

Conclusions

The presented study addressed the question how new e-services for e-Residency project can be designed through the case of virtual incubator service. To tackle the research problem, the background of e-Residency service platform and virtual incubation service was outlined. From this background, the research hypotheses were formed. To test the defined hypotheses, the agent-oriented modeling approach was justified as appropriate to translate the ideas from the theoretical part into service models. The latter ones specified motivation and service design layers for the virtual incubator on e-Residency, thereby addressing all hypotheses that were posed. At the end, the general advantages of the chosen modeling approach and the limitations of the current study were outlined.

Outlining the background findings, e-Residency was defined as a platform that offers Estonian governmental services for business needs of the citizens of other countries. The demand to introduce business-oriented services developed by private providers for e-residents on top of the available services that were initially created for Estonian citizens was clarified. Institutionally, the platform was described as the one aimed at facilitating virtual registration of businesses in Estonia following the existing international institutions. At the same time, it was found that less than 5% of the users establish new companies in Estonia with the help of the project, whereas more than one-third of them claim to be willing to do so. In this context, virtual incubation service was defined as suitable for e-Residency platform, because the service is business-oriented, conceivable to run upon the available services, such as digital authentification, and institutionally legitimate since e-residents from any country can develop their startup ideas in the virtual environment. Moreover, the service seemed relevant in terms of increasing the number of new companies registered with the help of e-Residency and facilitating the use of other services on the platform.

In the second part of the background section, a startup was defined as a process of turning an idea into a company. Startup Development Phases model was used in this study to conceptualize the startup development stages, namely problem/solution, vision/founders, product/market, and business model/market, and the activities at each stage, namely market, product, financing, and team creation ones. The relevance of startup incubation, which helps entrepreneurs cover these steps, was contextualized through IT market saturation and

Estonian expertise in the field. An important distinction was drawn between incubators and accelerators, as only the first ones deal with turning startup ideas into new companies. Also, virtual incubation was claimed to be potentially advantageous in comparison with the ordinary one, because with its help, business development could be prioritized over auxiliary services, distractions, such as relocation, could be reduced, and communication among the participants could be made more efficient. It was also clarified that five Estonian startup incubators were interested in providing virtual incubation to e-residents, with their main motivation being to get the access to diverse startup founders and ideas. In their turn, an exemplary sample of twelve e-residents expressed their interest to the service, expecting to receive relevant mentoring and support services. All these background findings were reflected in the hypotheses of the study.

Coming to the main findings, zero hypothesis of the study was refuted. It was possible to translate all theoretical ideas for virtual incubation service on e-Residency platform into service models. To begin with the business model, two user groups were defined: e-residents and startup mentors. It was prioritized for the service to capitalize on the demand expressed by these two groups, more specifically on providing the access to global startup ideas to Estonian incubators and the access to Estonian expertise in startup development to e-residents, with a possibility to enter the EU market through establishing a business in Estonia. The focus was also made on assisting the parties to make their communication during all main phases of startup development more efficient than with ordinary incubation services. Another important feature is that the virtual incubator was conceived as a service utilizing the possibilities of the existing e-Residency services, for instance digital authentification. The goals of e-Residency project were also reflected, as the service seeks to benefit Estonian incubators and to provide the access to collateral services offered via the platform. Such business model combined the business value of the service with governmental aspects of e-Residency as a service platform.

At the motivational layer, the service models reflected the focus on developing startup ideas into companies, particularly through defining the system goal as “Develop an idea into a startup.” This goal was split into six ones that include establishing a connection between the parties, covering four stages of developing a startup, and making use of collateral services. It is worthy to emphasize that subgoals and quality goals were provided for each of the six main goals to reflect more specific ideas from the background part. For instance, “Form vision and

founders" goal was divided into six subgoals, and one of them "Stabilize the team" was specified as having two quality goals, namely "Balanced work division" and "Defined ownership." Such goal structure helped to reflect all main ideas for the service and to place them hierarchically.

To cover the mentioned goals, four agent roles were introduced, namely e-Resident, Mentor, Startapo, and Another Service Provider. For each role, responsibilities and constraints were provided from the goal model. The relationships between the roles were defined in the following way: Mentor and Another Service Provider provide services to e-Resident, and Startapo is under the control of e-Resident. Such role structure allowed to reflect the necessity to provide mentoring and auxiliary services to the end user through Mentor and Another Service Provider roles. In its part, the role of Startapo was introduced to make communication between e-Resident and Mentor agents more efficient through achieving two main goals: "Learn from previous projects" and "Proceed with the next step." As can be seen, both human and non-human agents were presented in accordance with the system goals. Moreover, user centricity was emphasized, because all roles are connected via e-Resident one. In addition, two environments were specified for the system, e-Residency Website and Virtual Service, with objects of e-ID Card type serving as a means of the access to the system. In total, the created role and domain models allowed to demonstrate the roles by performing which the defined goals are achieved, to emphasize user centricity through defining relationships between e-Resident role and other ones, and to sketch the environment in which the roles and goals are confined.

At the system design layer, the agent activities to implement the motivation of the system were outlined. To start with, three agent types, namely Provider, including Mentor and Another Service Provider roles, Assistant, including Startapo role, and Receiver, inluding e-Resident role, were specified to provide virtual startup incubation and to improve this provision with the help of artificial intelligence. In its part, the knowledge model elaborated on the domain model, providing the system view of an agent of Receiver type. For example, it was specified that e-ID Card type objects were connected with Receiver agents as one-to-one, because each e-Resident holds a unique ID for authentification in the system. Moreover, the interactions between agent types and, on their basis, the behavior of specific agents were provided for two exemplary goals: "Establish a connection" and "Learn from previous projects." These models demonstrated how agents belonging to Receiver and Provider, and

Receiver and Assistant types could interact in order to reach the goals. For instance, establishing a connection between agents performing e-Resident and Mentor roles was modeled as having three failure possibilities before completing a positive scenario. So, the provided models defined agent types to perform the roles, the emphasis on the end user was elaborated through providing a partial knowledge model for Receiver type agents, and two exemplary cases of system goals were prepared for the implementation through specifying the interactions and behavior necessary to achieve them.

Since all background ideas were successfully modeled, the hypothesis that the agent-oriented modeling approach is appropriate to translate the mentioned ideas into service models was confirmed. Also, it was demonstrated that this approach allows connecting abstract notions, such as reaching a community of people with startup ideas, and specific agent behavior to implement these notions. Therefore, every service activity at every level can be tied to the business value, which seems to be a key feature for modeling e-Residency services due to their business orientation. Moreover, the agent-oriented approach turned out to be particularly suitable for the case because of the reflection of the crucial interactions between e-resident and mentor, as well as e-resident and artificial intelligence assistant. So, the employed approach seems to be particularly useful for the services where provider-recipient interaction brings the business value, such as startup incubation. Finally, the focus on the end user was reflected in the created models, for instance via the interaction pathways in the system. Such user centricity of the approach appears to be crucial for designing new services aimed at the target audience of e-Residency.

To provide the final word, the topic of designing new services for e-Residency seems to be open to further research efforts. This study indicated a tentative approach how such services can be modeled by the case of virtual incubation service. In the future, it is relevant to scrutinize the background of e-Residency through various theoretical lens and collect more data on the project. The marketing study on the demand for virtual incubation service can be also extended via applying larger samples and new research methods to the community of e-residents. Finally, both the current service model can be complemented and other modeling approaches can be compared with the agent-oriented one to model new services for e-Residency better.

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Appendices

Appendix One: The list of Estonian incubators and their contact persons that were sent online survey

1. *Tartu Centre for Creative Industries* (info@lmk.ee), *Ave Anniste*, project manager (ave@lmk.ee)
2. *Tallinn Business Incubators* (info@inkubaator.ee), *Anu Lõhmus*, project manager (anu@inkubaator.ee)
3. *Tartu Science Park* (info@sciencepark.ee), *Henri Hanson*, project manager (henri.hanson@sciencepark.ee)
4. *Tallinn Science Park Tehnopol* (info@tehnopol.ee), *Martin Gorosko*, startup incubator manager (martin.gorosko@tehnopol.ee)
5. *GameFounders* (accelerator) (info@gamefounders.com), *Kadri Ugand*, co-founder (kadri@gamefounders.com)
6. *Startup Wise Guys* (accelerator) (info@startupwiseguys.com), *Calum Cameron*, incubator manager (calum@startupwiseguys.com)
7. *Mektory* (startup laboratory) (http://www.ttu.ee/projects/mektory-eng/), *Anu Oks*, coordinator (anu.oks@ttu.ee)
8. *Garage48* (startup hackathon series) (info@garage48.org)
9. *Ahujaht* (business idea competition), *Harri Tallinn*, team manager (info@ajujaht.ee)
10. *Buildit* (accelerator), *Aleksander Tõnnisson*, chief executive officer (aleksander@buildit.ee)
11. *Startup Garage* (summer program), *Siim Rooba*, chief executive officer (siim.rooba@gmail.com)
12. *Tech Sisters* (enterpreneurial community) (team@techsisters.org)
13. *Vunk* (accelerator programme) (vunk@vunk.eu)
14. *Elevaator* (startup laboratory) (info@elevaator.com)
15. *Digix* (incubator) (info@digix.eu), *Martin Aadamsoo* (martin@digix.eu)
16. *University of Tartu (UT) Idea Lab* (startup laboratory), *Maret Ahonen*, manager (maret.ahonen@ut.ee)
17. *Loov Eesti* (incubator), *Eva Leemet*, chief executive officer (eva@looveesti.ee)

Appendix Two: The names and organizations of Estonian e-residents as provided by them in online survey

1. *Tsutomu*
2. *Usman Alex Kadiri. Hephaestus Ventures*
3. *Ichiro Komoto*
4. *Volodya*
5. *Yasuhiro Yoshida,* Self-employed
6. *Jonathan Webber*
7. *Mihoko Nagata* (Ms) Self employed (Freelance executive assistant, writer)
8. *Marko Kazhich, Zamphyr*
9. *Anguilla-Counts Inc*. an Anguillian not for profit company
10. *Franky, WageCan Inc.*
11. *Ravi Srinivasan*
12. *Louis-Pierre Morin, Proxee Solutions*

Appendix Three: The hypotheses and questions for the online survey of Estonian startup incubators

Hypotheses

H1. Estonian incubators have expertise mostly in information technology startups (Q1)
H2. The incubators are not completely satisfied with the choice of applicants in Estonia (Q2)
H3. The incubators are willing to expand to online incubation services via e-Residency (Q3)
Investigation of ideas for the service (Q4-Q5)

Questions

Q1. Could you name the areas of startups your incubator has most expertise in?
(e.g. robotics, fashion, etc.) (open question)

Q2. How satisfied are you with the choice of applicants for your incubation services in Estonia? (closed question, 5 point scale)

Q3. If you had an opportunity to provide virtual incubation for people from around the world via e-Residency platform, would you use it? Please, briefly explain why. (open question)

Q4. What are your main expectations from such virtual service? What would make you join? (open question)

Q5. Could you name 3 main features you would offer during virtual incubation if you had an unlimited budget? (open question)

Q6. Please, mention your name and organization (optional open question)

Appendix Four: The hypotheses and questions for the online survey of e-residents

Hypotheses

H1. e-Residents have startup ideas (Q1)
H3. e-Residents find Estonian expertise relevant for their needs (Q2)
H2. e-Residents are interested in virtual startup incubation via e-Residency (Q3)
Investigation of ideas for the service (Q4-Q5)

Questions

Q1. Do you have a startup idea at the moment? (closed question, yes/no/own answer)

Q2. Do you find Estonian expertise in startups relevant for your business needs? (closed question, yes/no/own answer)

Q3. If you had a virtual service to develop your (potential) startup idea into location-independent business via e-Residency platform, would you use such service? (closed question, yes/no/own answer)

Q4. What are your main expectations from such virtual service? What would make you join? (open question)

Q5. Could you name 3 main features you would like to have in virtual incubator? (open question)

Q6. Please, mention your name and organization (optional open question)