TALLINN UNIVERSITY OF TECHNOLOGY

Faculty of Social Sciences

Ragnar Nurkse School of Innovation and Governance

Rauno Mäekivi

PRIVATE SECTOR PARTICIPATION IN RESEARCH, DEVELOPMENT AND INNOVATION POLICY: A TECHNOLOGY PERSPECTIVE

Master's thesis

Supervisors: Dr. Erkki Karo and

Dr. Veiko Lember

Tallinn 2015

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

Author Rauno Mäekivi
……. (date) 2015

The master's thesis meets the established requirements
Supervisor Dr. Erkki Karo
……. (date) 2015

The master's thesis meets the established requirements
Supervisor Dr. Veiko Lember
……. (date) 2015

Accepted for examination ……. (date) 2015
Board of examiners of public administration master's theses
Dr. Veiko Lember

ABSTRACT

In recent year, the cooperation between economic and political actors in policy making has been a subject of active academic debate among the innovation and industrial policy scholars. However, it is rarely elaborated on how these processes exactly take place. Furthermore, participation and cooperation is often viewed as a universal principal that must be used as much as possible regardless of the policy context or the politico-economic structure of the country. This paper sets out to develop a deeper understanding of the cooperation processes within specific technological sectors and politico-economic structures. For the theorethical framework, the varieties of capitalism (rational-choice institutionalism) and discursive institutionalism literatures are combined with the evolutionary theory on technological trajectories. Energy technology, ICT and biotechnology sectors are chosen for the detailed analysis due to their policy relevance and different levels of technological maturity. The empirical analysis concentrates on the Estonian research, development and innovation policy and more specifically on national technology programs. Two research questions are posed: How is the private sector involved in the research, development and innovation policies of Estonia? How do these processes vary between energy, ICT and biotechnology sectors? The results show that the Estonian politico-economic structure poses several challenges for technology development and there are only minor variations in participation processes between technology sectors while the theoretical framework would expect more varied systems of cooperation and participation.

Keywords: Estonia, public-private sector cooperation, participatory policy making, varieties of capitalism, discoursive institutionalism, technological trajectores, energy technology, ICT, biotechnology

TABLE OF CONTENTS

INTRODUCTION

During the recent decade there has been an sharp increase in the industrial policy literature expressing the need for more cooperation between the state and the economic actors (e.g. see Rodrik 2008; OECD 2014). This has been also to an extent echoed by the systems of innovation literature, which puts the emphasis on interactions between multiple actors such as research institutions, private sector and the state (for more see Edquist & Chaminade 2006; Edquist & Hommen 2008). However, even if the necessity of participation in policy making is stated, the specific processes behind it are often left unelaborated. Participation is mostly viewed as „the more the merrier", while neglecting the economic and political structures that shape and limit these processes. In addition, the differences in technology regimes and how participation relates to varying needs of different technologies tends to be overlooked as well.

The current thesis will set out to tackle these issues. By using Estonia as an example, this paper will set out to analyse how the private sector actors participate in research, development and innovation (RDI) policy making. This issue is of empirical and policy importance in Estonia as cooperation between the state and the private sector is emphasized in the national strategic documents (e.g. Eesti teadus- ja arendustegevuse ning innovatsiooni strateegia 2014–2020; Eesti ettevõtluse kasvustrateegia 2014-2020). In addition, the issue of public-private sector interactions tends to be a problem which constantly keeps emerging in the media as well (e.g. see ERR 2014, Postimees 2014, Äripäev 2014, Äripäev 2015).

The analysis will take into account the politico-economic characteristics of Estonia as well as analyze the differences of participation dynamics accross different technologies: energy technologies, ICT and biotechnology. As energy, ICT and biotechnology have been set as some of the key focus sectors (or growth areas) for the Estonian research, development and innovation system and smart specialization strategy (Eesti Arengufond 2013, 5) and as these technologies vary in their levels of maturity (and thus in their needs for policy interventions), they prove to be both policy relevant as well as academically interesting cases to analyse. More specifically, the national technology programs – key policy efforts to target the specific needs and economic potential of these technologies via targeted policy coordination and public-private cooperation – in the respective areas will serve as a unit of analysis for the thesis. This will allow to discover and analyse bottlenecks in the RDI policy and technology development as well as give some insight to the origin of these problems.

The following research questions are central to this study:

1. How is the private sector involved in the research, development and innovation policies of Estonia?

2. How do these processes vary between energy, ICT and biotechnology sectors?

The empirical contribution of this paper explains the participation processes in Estonian RDI policy making and reveals the bottlenecks in different technology sectors. The theoretical contribution of this paper is the combination of the literatures on the varieties of capitalism and discursive institutionalism and on the evolutionary theory of technological trajectories in order to explain different contexts and types of private sector participation in RDI policy making.

The paper will first construct a framework for analysing different participation processes. For the theoretical framework, a combination of theoretical viewpoints will be used. Firstly, the rational-choice institutionalism perspective in the form of the varieties of capitalism (VoC) literature will be discussed. This will contribute to the discussion by allowing to distinguish between different types of market economies, which in turn show different interactions between the state and the private sector as well as the impact on policies. Secondly, another important dimension will be added to the discussion through the literature on discursive institutionalism, which will allow to differentiate between polity contexts and thus show the variation of discourse (or dialogue) between the state and stakeholders in different polity setups. If the VoC framework allows one to analyze the macro-level institutions that influence policy making processes in a specific country, then the discursive institutionalism enables one to get in-depth insights into the meso-level processes of policy evolution. In section 2., the participation processes will be explained in the context of technologies. By discussing the literature on the evolutionary theory of technological trajectories, a crucial dimension to the research question – the description of different technology sectors and the implications they present when it comes to interests, coordination and interactions with the state – will be added.

These theoretical topics will be at first explained separately in detail through relevant literature. Thereafter, these theories will be combined together and operationalized in order to create a coherent framework of different types of participation processes. This can be then used to show

what type of participation may suit a particular technology sector. The theoretical framework can then be used to analyse participation practices in the case of Estonia.

In section 3, the method of the empirical analysis will be briefly explained and the empirical analysis will take a look at participation during the RDI policy making with specific focus on national technology programs. In section 4, the results from the empirical analysis will be discussed in relation to the theorethical framework in order to answer the research questions. Finally, the overall conclusions will be provided and limitations of the paper discussed alongside with proposals for further research.

1. PRIVATE SECTOR PARTICIPATION IN POLICY PROCESSES

1.1. Varieties of Capitalism

The varieties of capitalism literature distinguishes between ideal types of political economies The main distinction, brought out by Hall & Soskice (2001) and used by several other authors (e.g. Buchen 2004; Feldmann 2006), recognizes two[1] ideal types of political economy. These are the liberal market economies (LMEs) and coordinated market economies (CMEs). According to Hall & Soskice (2001), in LMEs the firms coordinate their activities through market arrangements and hierarchies while CMEs rely on non-market relationships. Thus, the latter clearly depends more on strategic interaction with other actors than the former. (Hall & Soskice 2001, 8) This variation however is also seen in different institutional setups. In LMEs relations are generally managed by arms-length market transactions and formal contracts, while in CMEs the coordination is much more institutionalised (Feldmann 2006, 835-836; Hall & Soskice 2001, 9-10). This means that in CMEs one can expect to likely have more (larger) unions, employer associations and possibly other sectoral and inter-sectoral coordinative bodies/networks. On the other hand, in LMEs the aforementioned types of organisations and institutions are relatively weak (or non-existant) due to the strong reliance on market-mechanisms and formal contracts.

As the institutional setups of private sectors may differ, the interaction with the state and its general role differ as well. From the policy making perspective, the basic idea of the state is to enhance the coordination between economic actors, thus improving the cooperation and interaction between these actors (Hall & Soskice 2001, 45). In LMEs the state takes upon itself the role of setting rules and settling conflicts (preserving the market), meanwhile the administration of those rules is left to self-regulating bodies or regulatory agencies (Schmidt 2009, 521). For example, markets can be used to secure this coordination, thus the task of the policy-makers becomes to improve the functioning of markets (Hall & Soskice 2001, 46). This means that the state takes a more *laissez-faire* approach, allowing the market-mechanisms to coordinate interactions between the private enterprises. Consequently this so called „hands-off" approach leads to little direct interaction (or dialogue) between the public and private sectors. According to Schmidt (2009), in CMEs the state has a different role. The state takes actions not only to resolve conflicts or set rules in the market, but also to facilitate actions between

[1] Schmidt (2009) does indeed bring out also a third type – mixed market economies (or state influenced market economies), where the state has an even bigger role than in the liberal and coordinated market economies. However this in need of more research and is besides the point of this paper.

economic actors. Thus, the rules are often set and administered jointly among the businesses, labor organisations and the state, where the latter acts as a (more-or-less) equal partner. (Schmidt 2009, 521-522)

This variation of institutional structures and environments inevitably breeds different policies. According to Hall & Soskice (2001) in LMEs, „where coordination is secured primarily through market mechanisms, better economic performance may demand policies that sharpen market competition“ (Hall & Soskice 2001, 46). Examples of these policies include among others general government subsidies for basic research, tax incentives, deregulation (Hall & Soskice 2001, 49). However, CMEs „may benefit more from policies that reinforce the capacities of actors for non-market coordination“ (Hall & Soskice 2001, 46). These entail policies, which are directed towards improving the competencies of firms (e.g. technology, skills) on a more precise sectoral/firm level. In order to facilitate this, the government needs more information from the private sector, which eventually means more interaction with this sector. (Hall & Soskice 2001, 46-49) Thus, the institutional context (along with different ways of coordination) matters in regard to which policies are expected to work. Hall & Soskice (2001) examplify this rather well using the cases of UK (as an example of LME) and Germany (as an example of CME):

> „Because the institutional context of the British economy encourages the acquisition of general skills and militates against sectoral coordination, its government is likely to enhance skill levels more by expanding formal education than by trying to foster sectoral training schemes modeled on the German. Conversely, competition policies that serve Britain well might erode the capacities of German firms for nonmarket coordination.“ (Hall & Soskice 2001, 46-47)

Therefore, it is also possible that different contexts are more suitable for different types of innovation. According to Hall & Soskice (2001), due to institutional factors[2], LMEs provide a more suitable environment for radical innovation. Meanwhile the institutional factors[3] in CMEs support incremental innovation. (Hall & Soskice 2001, 39-41) This is at the very least partially

[2] Among those is the reliance on market interactions, which causes acquiring subsidaries and companies with new technology easy. Also the corporate structure in LMEs has power centralised at the top, which makes changing business strategies relatively easy. Highly mobile labor force and fluid labor markets also make the hiring (for the project) and firing (after the project) of staff with particular needed skills simple. (Hall & Soskice 2001, 40-41)

[3] Such as pre existing dense inter-corporate networks make acquiring subsidaries and companies (with new technologies) more difficult. In addition the corporate structure is more decentralised (with consensus decision-making and strong worker representation), meaning any sudden changes in business strategy will be much harder to implement. Also the relatively long employment tenure will inevitably make hiring and firing of staff difficult. Cooperation between companies is supported by highly coordinated industry relations, corporate structures and corporate governance. Developed networks prevent hostile takeovers and long employment tenures tend to enhance company specific skills. Instead of product competition, the inter-corporate networks promote product differentiation. (Hall & Soskice 2001, 39-41)

controversial since this notion has been criticised in the context of developed countries (e.g. see Taylor 2004, Macneil 2013). However, it still remains to be tested in the context of Central Eastern European countries (Karo & Looga 2014, 4). In a nutshell, VoC literature demonstrates how the economic structure varies and this may influence how the coordination is secured and reproduced through different mechanisms, which also leads to different types of policies.

1.2. Polity dimension

Varieties of capitalism (part of rational-choice institutionalism) explains institutions as the result of economic actors (as rational strategic calculators) trying to solve problems of coordination. Thus, the institutions are created to advance actors' self-interests (Hall & Taylor 1996, 12-13; Hall & Soskice 2001, 6; Schmidt 2009, 519; Campbell 2007, 2). However, this approach is highly firm centric and thus neglects the role of the state. Meanwhile „the state constitutes the political institutions that frame the interactions between political and economic actors" (Schmidt 2009, 517). Here discursive institutionalism (DI) allows to explain how the political institutional context can influence policy reform differently, even in the same variety of capitalism (Schmidt 2009, 525). Thus, the polity dichotomy discussed in the literature of DI can be used to complement the VoC literature.

Two institutional contexts can be recognized here. First, simple polities are systems where the governing function is channeled more-or-less by a single authority (primarily the executive branch) and a greater emphasis is set on the communicative discourse. Simple polities can include elements such as strong cabinet, restrained judiciary and a centralised neutral bureaucracy. Second, compound polities are systems where coordinative discourse prevails and where the governing activity is much more dispersed between different actors. Compound polities can include elements such as a strong separation of powers, weak party organisations and a decentralised bureaucracy. (Schmidt 2008; Karo & Looga 2014; Hope & Raudla 2012) As it seems, the different institutional settings also emphasize different types of discourse. This is crucial to the understanding of different ways of actor participation in the policy making processes.

As mentioned before, there are two types (with different functions) of political discourse – coordinative and communicative. The first provides policy actors (individuals and groups) with a common language and an ideational framework, through which they can together construct a

policy (or programmatic ideas), debate its merits, refine it and discuss its implementation. On the other hand, the communicative discourse consists of political actors (individuals and groups), who are involved in persuading the public through discussion and deliberation, that the policies (developed in coordinative discourse) are necessary and appropriate. (Schmidt 2002, ch. 5; Schmidt 2009)

In essence coordinative discourse can then be seen as a process, where there is a variety of stakeholders (interest groups, businesses, experts etc) involved in the policy making process before the implementation of specific policy. Here, their input allows them to have substantial influence over the content of the policy. Meanwhile the communicative discourse resembles more to a policy legitimization or public informing process, where the basic idea is to justify the need for the policy and its appropriateness. However, there is still room for input from the public and as Schmidt (2002) notes the opinion of public can still be taken into account and the policy adjusted (Schmidt 2002, 237). However, any changes in this stage will arguably be less substantial or much harder to implement.

Simple polities then are characterised by weak coordinative discourse, but with strong communicative discourse. According to Schmidt (2002), the policy debate occurs not in discussions between stakeholder/interest groups, but in the wider public, through press, experts, interest group leaders and the opposition. The public has very little power to adjust the policy programme and debate over it (except maybe in adversarial matters). The main possibilities for the public at this stage is to either agree with the programme or protest against it. (Schmidt 2002, 240-242) Thus, in simple polities the participation/involvement stays more-or-less on the level of informing the public (or businesses, as the case of this paper) and far from the level what could be called cooperation. On the contrary, compound polities are characterised by weaker communicative discourse and strong coordinative discourse, which as Schmidt (2002) explains, means that the policy consists of a multitude of ideas from several different (but important) policy actors. Thus, the main discussion and debate takes place with the constituents (interest groups, businesses, stakeholders). In this system, cooperation becomes the key issue, as the intent of these interactions is not to inform constituents, but moreso to reach a compromise and consensus. (Schmidt 2002, 243-245)

In short, for simple polities the interaction between the state and the business interests could be seen as a process of informing, justification, legitimization as the state has enough authority to

impose the planned course of action without significant substantive coordination with the constituents. For compound polities the importance of informing the general public is fairly low and much more emphasis is put on the discussions and debates (and cooperation) with policy actors as the authority is divided between different stakeholders (such as businesses, trade unions etc.).

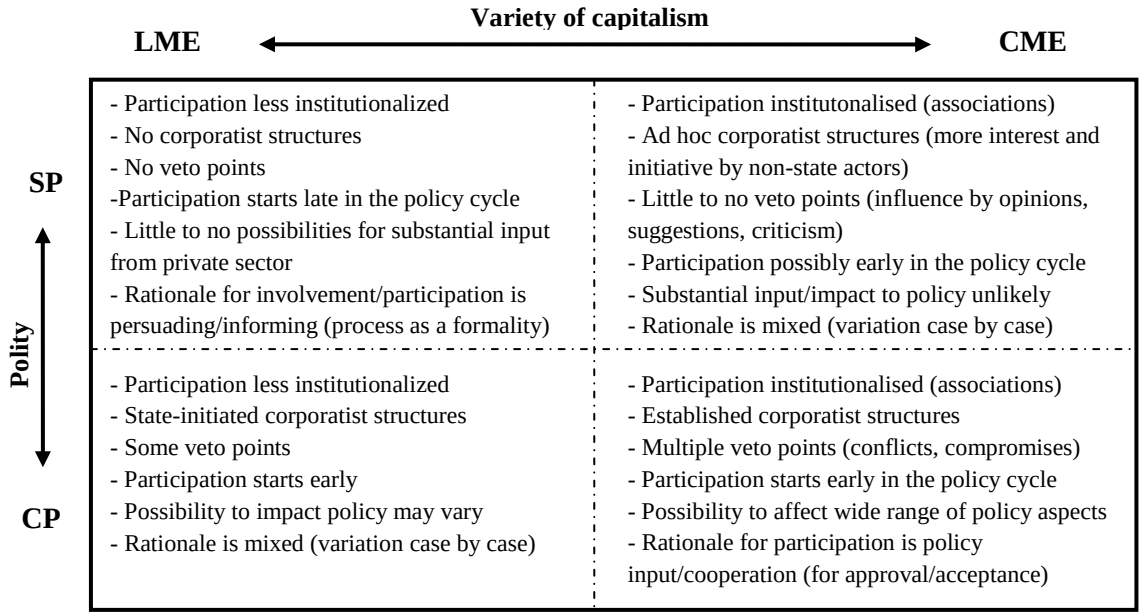
The conceptual „ladder“ model of participation, which takes an empowerment perspective on participation (Arnstein 1969; Pretty 1995; Green & Hunton-Clarke 2003; Reed 2008), provides a more detailed look into the simple vs. compound polity dichotomy. This theoretical literature helps to differentiate, based on the scope and scale of empowerment, between different types of participation from informing the stakeholders, consulting the stakeholders, cooperating with the stakeholders to empowering the stakeholders. In other words, the extent of participation differs. On the informing level, the participants have almost no possibilities to influence policy making, which makes the level of participation generally low as it is mainly based on informing the stakeholders. This means that the participants have relatively weak power to influence the policy program's contents; thus, participation is mainly a formality. On the cooperation and empowering level, the stakeholders are asked for their views, input and they are able to have considerable power in the decision-making and/or in determining the contents of the policy. Thus, the latter opens also up the possibilities for negotiations, compromises, conflicts and trade-offs, but also more influential feedback from the participants. The informing level of participation coincides well with the communicative discourse (in a simple polity) and cooperation/empowering level participation clearly connects well to the coordinative discourse (in a compound polity).

1.3. Summary of the theoretical discussions and the analytical framework

The earlier discussion on varieties of capitalism and on different types of polities can be combined and used to analyze participation processes during policy making. A matrix can be drawn in order to better illustrate and distinguish between different ideal types of participation (see Figure 2). However as the VoC and polity literatures only distinguish between two ideal types of politico-economic structures, thus the four different ways of participation can also be regarded only as ideal (radical) types. In the following subsections, the different types of participation will be explaimed in dtail. Two pure models will be distinguished – where polity

and market characteristivs reinforce each other – and two potential mixed models where there seems to be a potential contradiction between the polity and market.

Figure 2. Theoretical framework combining varieties of capitalism (LME; CME) and polities (SP; CP)



Source: Structure based on Schmidt (2009), modified by author

1.3.1. Compound polity and coordinated market economy model

In systems characterized by compound polity and coordinated market economy traits, the participation of the private sector in policy processes is rather stong and takes places already in the coordinative discourse and is organized and institutionalized in the forms of corporatist structures (e.g. tripartite agreements between mutliple actors). This model gives much more power (veto-points) to the economic actors during policy discussion/negotiation, which in turn can create conflicts, but also force the state to settle for a compromise.

Due to the dominance of coordinative discourse, the participation is expected to be much more substantial. In the sense, that economic actors, not only are treated as more-or-less equal partners in the discussion with the government, but are also involved with the policy formulation early on (in regards to the policy cycle) and thus have a say in a wide range of policy aspects (e.g. in the very rationale/idea of the policy). In addition, due to the coordinative discourse in the compound polity the rationale for participation/involvement is shifted towards getting policy input from economic actors early in and throughout the process in order for the policy to be accepted (and implemented) later on. In extreme cases this can mean that the participation can be characterised

as a cooperation, extremely lengthy process, due to the government and private sector being more-or-less equal in negotiations. In the end, the policy can either fail to succeed (as common ground is not obtained) or the policy is a product of cooperation between the public and private sectors. Schmidt (2009) for example places Germany into this institutional category (Schmidt 2009, 527).

1.3.2. Simple polity and a liberal market economy model

The simple politiy and a liberal market economy is the exact opposite. As the interactions between businesses in LMEs are coordinated using market mechanisms (e.g. competition and contracts), the participation in policy making is less (or not at all) institutionalised. Due to the emphasis placed on communicative discourse instead of coordinative discourse, the policy input from the economic actors will be less substantial and the participation will occur rather in the later than earlier stages of the policy (formulation) cycle.

Due to the centralised decision-making authority and low institutionalisation of the private sector in this model, the influence of the private sector (to impact the policy discussion and its detailed formulation) will be low. In thus model, policies do not necessarily need broad-based agreements or compromises to be implemented. Thus, the rationale for having private sector participation is shifted towards justification and legitimization of the policy in order to persuade the overall public that the policy is needed and appropriate. In extreme cases this can mean that the participation process is taken as a formality (in order to state that formally the process happened), meaning that the participants give no real input into policy formulation policy makingand the discussion resembles more the one-sided informing communication, rather than dialogue. This is especially the case when the participation takes place during the later stages of policy formulation, when the substance of the policy has already been set in stone. Thus, any proposals for changes from participants at that stage will be difficult to implement regardless of the willingness of the policy makers.

Schmidt (2009) places for example the United Kingdom into this category (Schmidt 2009, 527). Estonia has also generally been placed into the simple polity category (e.g. see Hope & Raudla 2012; Kattel & Raudla 2013; Thorhallsson & Kattel 2013) and also into the liberal market economy category (e.g. see Feldmann 2006; Karo & Looga 2014).

1.3.3. Mixed cases

This framework offers also two mixed models: – a simple polity and coordinated market economy models and a compound polity liberal market economy model. While the two cases discussed above are easy to distinguish and are theoretically holistic, the mixed cases have no clear outlines and seems to exhibit theoretical and conecptual contradictions in terms of the expectations set by the characteristics of the polity and economic structures. Thus, if these models exist, they may also be treated as policy or institutional design failures.

For example, it can be argued that, the EU's integration and policy processes have been changing the aforementioned and more coherent models, especially in the newer member states and economies influenced by the recent economic crisis. In other words, the responses to economic crisis have changed policy processes and coordnation patterns and some of the coordinated market economies (e.g. Slovenia) are moving closer to the liberal market economy models (Stanojevic 2012; Karo & Looga 2014). The variation and vagueness of these types makes finding any clear-cut examples of countries difficult as well. However, these mixed versions shall still be atleast tried to be discussed here.

A simple polity and a coordinated market economy model would have institutionalized private sector interest formulation and representation (due to CME characteristics) in the form of e.g. industry and employer associations. These structures would however have fairly weak power and access pathways to influence policies (as the decision-making authority in simple polities is centralised). This would mean that in extreme cases, the private sector could have specific interests in the early stages of policy formulation; however, the state would have no need to formally take it into account. Thus, the veto-points would be non-existent and the institutionalised participation would possibly be based on the private sector being able to state opinions and suggestions with no real (formal or informal) power to have them implemented. Here, the rationale for allowing participation/involvement from the side of the political and policy actors would be mainly to justify the policy or persuade the public. However, there would still exist a higher chance to have some input/impact from the private sector implemented (than in a simple polity with LME). This is due to having the institutionalised setup to atleast provide criticism, which would give the private sector more possibilities for input than in simple polities with a liberal market economy. However, this would largely depend on the specific cases.

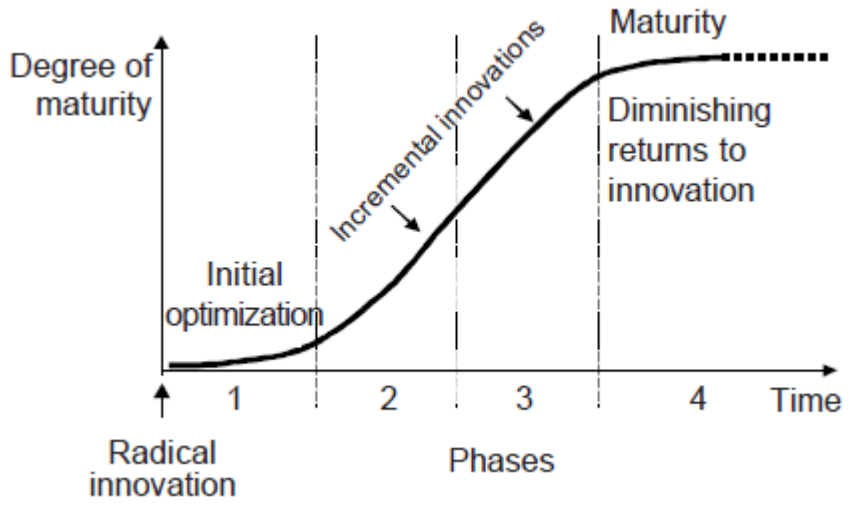
In compound polity liberal market economy model, the power-inetest relations would be reversed. The polity actors would be interested and open to business participation in policy processes (the key discourse would be coordinative), but the market actors would lack institutionalized forms of interest formulation and representation. This could lead either to specific lobbying interests of single actors or generic critique of the the role of teh state on coordinating the economy. Schmidt (2009) places USA for example into the compound polity with a liberal market economy category (Schmidt 2009, 527).

This framework provides also a suitable basis in order to analyze the issues within different technology sectors as potential cases where the ideal-type models and also mixed cases may appear. Thus, in the following chapter the theoretical framework will be further enhanced and combined with the evolutionary theory on technological change. This will allow to connect the aforementioned participation processes with context-specific technology needs and issues. This will provide a useful theoretical framework for analying the participation processes in the energy technology, ICT and biotechnology sectors of Estonia.

2. Technological trajectories and RDI policy context

According to the evolutionary theory of technological change, technologies go through different phases as they develop (or as they mature). The early innovations within a technology sector are dominated usually by radical innovations, however as a technology matures incremental innovation becomes primary. (Utterback 1996; Perez 2001; 2009) Figure 1 can be used to illustrate the development of a technology.

Figure 1. Technological trajectory (evolution of a technology)



Source: Perez (2001)

During the radical innovation phase, the LME-type market-mechanism dominated approach might be sufficient. However, as the technology becomes more mature and incremental innovation starts to dominate (to diffuse the radical innovations into more markets and market segments), the interaction between the economic actors and the state should change as well. Organizations that were in the beginning of technological life-cycle capable of bringing forth radical changes face the problems related to technological and institutional path-dependencies and lock-ins. In other words, it takes more efforts and investments to change economic organizations (from technology developers to users) once the technology matures. Thus, as also discussed above, for incremental innovation, a CME type environment may be more suitable. However, as different technological trajectories are often overlapping, there is hardly ever an ideal overlap between the technological needs and existing institutions of coordination; according to the evolutionary perspective, this is one of the crucial sources of the differences between innovation and economic performance of economies.

Here, the Schumpeterian notion of "creative destruction" also comes into play. Drechsler *et al.* (2006) argue, that the private sector is motivated by agents acting in their own self interest (profit maximization) and if the the state relies strictly on market-mechanisms for coordination (basically the markets to regulate themselves) then this leads to undesired, unstable and inefficient outcomes. As the economy over time, being more and more oriented towards profit maximization, will put pressure on to the state and its societal structures. In order to decrease the negative effects, the state must go through institutional change and reshape its governance structures. (Drechsler *et al.* 2006, 19-20)

Therefore, the state needs to eventually take up a far more greater role than the just the preserver of the market. As the technology matures, the reliance on market-mechanisms can bring negative effects. In order to mitigate these problems, the state must step into a greater coordinative discourse (or dialog) with the private sector. This means that the state has to not only step into a greater dialogue with different economic actors, but also act as a „partner" for companies and facilitate the actions between these economic actors.

The technological sectors (energy, ICT and biotechnology), that this paper analyses vary in their levels of maturity. Energy as a complex, established legacy sector (will be explained later) with clear conflicting interests and networks is the most mature. Meanwhile ICT can be considered as a maturing/converging sector, with clear interests and networks already formed. At last, biotechnology is the least mature of these three, with a lack of private sector interests, except for science. Next, each of these sectors will be looked at more closely.

2.1. Energy technology

The energy technology sector is usually referred to as as a legacy sector (or as a complex, established legacy sector). Weiss & Bonvillian (2009) characterise energy as a sector, where the processes of both technology push and market pull are inhibited by the preferences for „legacy technologies" (technologies based on fossil fuels). These legacy technologies are heavily subsidized and deeply embedded in the political and economic systems and in public expectations. As a result, new prevalent technologies have less chance of being developed and being successful. (Weiss & Bonvillian 2009, 32)

This obviously hinders the technological development in the sector and thus poses a serious problem. Essentially what can be seen the causes[4] for this problem is a variation of market failures and conflicts of interest. The public interest is divided between broad environmental friendly goals (mainly represented by the specific interest groups) and cheap, convenient energy. Meanwhile the existing „legacy" technologies have vested interests to continue their current business models and dispose of threats to their position. Over time, these legacy technologies have been able to penetrate and gain relevant power in the political arena. Furthermore this has helped them gain a competitive advantage when it comes to governmental subsidies, institutional and infrastructure support, but also for human resources and knowledge. The situation is not helped by imperfect market conditions in the energy sector, which require large initial investments and are dominated by network economies. (Weiss & Bonvillian 2009; 2013; Negro *et al.* 2012)

Negro *et al.* (2012) propose four policy recommendations to alleviate these problems: (1) states must form policies that match the phase of the specific technology (match the different needs of different innovation systems/technology sectors); (2) policies should be consistent and long term (with possibilities to impose changes as the needs of economic actors change); (3) in order to avoid incumbents proposing their own agenda, the state needs to closely listen to a variety of economic actors (including new smaller actors) and take their different interests in account; (4) state needs to put pressure on the incumbents in order to reduce the locked-in situation (creating better conditions for new technologies to strive) (Negro *et al.* 2012, 3844-3845).

An argument can also be made, that renewable energy technologies can be seen as creating the shift towards the next techno-economic paradigm together with ICT (which the current paradigm is based on). This means combining ICT solutions into the energy sectors (e.g. to the electric power grid, to electric vehicle technologies). However, in order to facilitate this shift it is also stressed that the state should take an active role in balancing out the conflicting interests (i.e. to balance out the resistance from the incumbents/legacy sectors). (Mathews 2012, 19-20) Thus, the government should not dictate and the private sector follow, instead there should be a

[4] Weiss & Bonvillian (2013) bring out six causes: (1) Existing subsidies and price structures favor existing (legacy) technologies; (2) Government institutional architecture and infrastructure has been structured to accommodate the needs of existing technologies; (3) Existing well established and powerful interests resist technologies that threaten their business models; (4) Imperfect market favors existing technologies; (5) Public interest is conflicted - cheap and convenient energy vs. environmental goals; (6) Existing human resource structures and knowledge has adapted to the needs of existing technologies.

collaboration between the two in order to roadmap the difficulties and obstacles and then set the plan to overcome them (Weiss & Bonvillian 2009, 41).

Returning back to the theoretical framework on different types of participation, in the case of the current developments of the energy sector, a compound polity and a coordinated market economy model of participation would suit best for the sectors' needs and for solving the aforementioned issues. Due to energy being a fairly mature technology with a variety of different interests and stakeholders (which are gathered into associations/unions), participation should be conducted at the association/union level. This would allow to involve a wide range of stakeholders. As there are incumbents, who try to resist technology change, then the participants (especially the non-legacy sectors) should have several veto points. This way the government could cooperate with various stakeholders in order balance different interests and ensure the development of energy technologies.

2.2. ICT

When the energy technology sector can be described as a complex legacy-sector, ICT can be currently descibed as an application-oriented (or diffusion-oriented) sector. ICT is thus described (both academically, but also ncreasingly in the policy discussions) as a horizontal and key enabling technology, meaning that ICT solutions can be applied in a wide variety of different fields and sectors. ICTs form the basic infrastructure for innovation and growth in all sectors, and, thus it is reasonable to develop ICT in connection with the enhancement of other industries and fields (Perez 2012, 216).

For example, in the manufacturing industry there is nearly no working place without ICT support and ICT (along with nanotechnology and material technology) provides almost endless possibilities to develop new products, speed up manufacturing or add new functionalities to pre-existing products. Thus ICT has become an enabling technology and a driver of innovation in manufacturing. (Bessey *et. al* 2009, *92*-115) The same applies to many other fields, including education (e.g. see Fu 2013) and healthcare (e.g. see Lang & Mertes 2011; Löhr *et. al* 2010).

In the European Union (EU) policy discourse this notion is described in the context of key-enabling technologies (KETs):

> „KETs are knowledge intensive and associated with high R&D intensity, rapid innovation cycles, high capital expenditure and highly-skilled employment. They enable process, goods and service innovation throughout the economy and are of systemic relevance. They are multidisciplinary, cutting across many technology areas with a trend towards convergence and integration. KETs can assist technology leaders in other fields to capitalise on their research efforts.“ (Commission of the European Communities 2009b, 2)

ICT is regarded as a key-enabling technology in the EU policy discourse (see for example Commission of the European Communities 2009a; 2009b; 2012). Thus, it is suggested that the research, development and innovation policies should help other policies (e.g. energy, health, transport) to innovate faster in the vertical markets and thus respond to societal challenges via greater utilization of ICTs (Commission of the European Communities 2009a, 9). This shows how the discussion over R&D in the ICT sector has moved from basic research towards application-oriented research. Further, it is also a sector with a „booming“ competitive market, which can be clearly seen within the „killer apps“ segment[5].

In sum, ICT is a maturing industry, but not as mature as for example energy (discussed in chapter 2.1.), and as a key enabling technology its borders are much more fluid in terms of what sectors, segments and interests are invloved in the development of the sector. While the ICT companies are networked to an extent, the interests however are still fairly clear and not as conflicting as in the case of energy technology. Thus, from the perspective of policy and participation processes, it is important to involve both the ICT industry and the other industries/areas (where ICT can be applied) in to the policy making. The participation should be conducted on the association/union level in order to involve various stakeholders. In order to diffuse and integrate ICT solutions, various stakeholders from the ICT and other industries should be involved in a cooperation with the government. To achieve cooperation, the compound polity and a coordinated market economy model of participation may be the most suitable the ICT sector. Yet, currently most ICT progress (especially in the killer app segment) is driven by LME economies such as the USA.

[5] E.g. Uber is anticipated as the highest grossing IPO of 2015 with the value of ~36 billion euros, while at the same time its market share is threatened by Lyft and Sidecar (Nasdaq 2015a). Whatsapp was acquired by Facebook for ~16 billion euros (Forbes 2014). Also there are other highly valued (app-based) ICT companies on the market (that are anticipated to go public): Dropbox, Pinterest, Spotify, Snapchat and Airbnb (Nasdaq 2015b).

2.3. Biotechnology

Biotechnology can be characterized as a science-based sector. This means the whole biotech industry is not only dependent on science, but it is also actively involved in the process of creating or advancing science itself and thus relies heavily on collaboration and cooperation[6] with universities and other research institutes (Bartholomew 1997; Pisano 2006a, 2). Biotechnology, being driven mainly by science-push and having yet to develop clear business models, can clearly be seen as the less mature of the three technologies discussed by this paper. Indeed, most of the business models in the biotechnology sector are borrowed from the ICT-related industries, which however are unable to serve the needs of the basic science and the needs of the firms at the same time. Due to these reasons, biotechnology is unable to attract the necessary talent and investments. (Pisano 2006b, 2)

Due to biotechnology being a science-based sector, the lines between research organisations (read universities) and firms are often blurred. Most of biotech enterprises are founded based on new advancements/technologies developed by certain researchers/scientists at universities. Usually, the founders also retain an equity stake in the company as well as their post in the university. Thus, these businesses and universities develop a close relationship. (Pisano 2006b, 2) Due to this notion, it is difficult to separate business interests from the researchers interests in the biotechnology sector. Biotechnology has also been recognized as a key-enabling technology by the EU (see for example Commission of the European Communities 2009b), thus supporting the application-oriented research is also important. Yet, the critical perspectibes argue that the horizontal application potential is still rather vague and years ahead.

Thus, it can be even argues that in the biotechnology sector the government should be careful when involving economic actors during policy making. The economic actors may be interested in lobbying for establishing their products and business models as industry standards. Further, as the line between researchers and the private sector is blurred, then the companies' interests could be non-existant and dominated by researchers interests. These interests however might not necessarily be the same. Researchers could have less interest in finding application for biotechnology than doing basic research. Thus, it might be useful to not involve economic actors

[6] For the purposes of transferring knowledge and technology

from the biotechnology at all. In that sense, it can be argued that there is certain logic in biotechnology being driven (at its early phases characterized by strong uncertainty) by simple polity LME models or by mixed model of compound polity and LME where business (and academic) interest are not either allowed or capable to influence policy processes. At the same time, the government can still involve more closely representatives from other industries (where biotechnology research outcomes could be used already now) in order to define the demand and direction for biotechnology policy in short- and mid-range. However, in order for the government to be able to determine these needs, a close cooperation must be achieved with these industries.

2.4. Summary of the theoretical discussion

Based on the theorethical discussion in chapters 1 and 2, several conjectures can be made. Keeping in mind, that Estonia is generally characterised in regards to the politico-economic structures a simple polity and a liberal market economy, there are several technology specific issues that might prove difficult to solve. For example, balancing the interests of incumbents and new entrants (but also various other stakeholders) in the energy technology sector seem to require a compound polity and a coordinated market economy approach. Here the simple polity and a liberal market economy type of participation might not prove to be sufficient enough to provide the necessary involvement of multiple stakeholders in a cooperative manner.

In the case of ICT, the Estonian politico-economic structures might be suitable for narrow ICT specific progress (as in the „killer apps segment“ referred to in chapter 2.2.). However, these structures will probably be unable to fully facilitate the needed ICT diffusion (or application-oriented R&D) to other sectors/areas. This is again due to the simple polity and liberal market economy structures being unable to participate enough of a wide variety of stakeholders and due to the lack of coordinative discourse (for more see chapter 1.2.).

In the case of the biotechnology sector, a differentiation must be made between the economic actors of the biotechnology sector and the economic actors from other sectors (similarly as in ICT). Estonian politico-economic structures might be suitable for decreasing the possible harmful impact from the self-interested biotechnology economic actors. However, for involving actors from other industries and sectors, the simple polity and liberal market economy structures might restrain from achieving the necessary levels of participation.

3. EMPIRICAL ANALYSIS

The empirical analysis will consist on a study of private sector participation in the general RDI policy making in Estonia and of the analysis of specific national technology program management structures. First, the methods used for this analysis will be detailed. After which the participation in RDI policies, based on information from two ministries (detailed below), will be analysed. After this, the particular technology programs will be looked at.

3.1. Method

Current paper can be characterised as qualitative research. The methods used here to collect and analyse empirical data will rely mostly on semi-structured interviews and document analysis. The interviews were conducted with different government bodies and selected associations that represent the private sector in the specific technology sectors. Mainly the focus will be on two ministries, the Ministry of Economic Affairs and Communications (MKM) and the Ministry of Education and Science (HTM), as these are the ministries directly responsible for RDI policy making.

The semi-structured interviews (listed in Appendix A) were conducted with key-persons, that have been in direct contact with either the specific technology programs or with overall participatory processes in the context of RDI policy making. Due to the focus on RDI policies, the largest part of the inteviews were conducted with employees[7] of the two aforementioned ministries. In addition requests for an interview were sent out to several agencies[8], that were involved in managing these technology programs. Two professional associations were contacted from the private sector: the Union of Electricity Industry of Estonia and Estonian Association of Information Technology and Telecommunications. Both are strong associations from their respective sectors and are actively in contact with policy-makers and were involved in specific technology programs. It must be mentioned, that even though a large number of requests was sent out, then a significant number of organisations failed to reply. However the implications of this shortcoming will be further discussed in the chapter on limitations and further research.

[7] All of the interviewees were chosen from the departments directly responsible for RDI policies.
[8] These include: Estonian Development Fund, Estonian Research Council, Enterprise Estonia Foundation, Archimedes Foundation, Information Technology Foundation for Education

In the document analysis, a more detailed focus is set on the national technology programs. The national technology programs were set as one of the main measures used to achieve the goals of the wider RDI strategy (2007-2013) in Estonia. These programs were essentially divided into two types: Key technology R&D programs (ICT; biotechnology; material technology programs) and socio-economic R&D programs (energy technology; environmental protection and technology; health technology programs). These programs are oriented towards sectors of importance for the Estonian economy that already have high levels of research. Due to this, it is noted that achieving the active participation of the private sector is a priority. (Eesti teadus- ja arendustegevuse ning innovatsiooni strateegia 2007–2013; Riigikontroll 2012)These technology programs have come under strict scrutiny of the states audit office (for more see Riigikontroll 2012), however they have not yet been analysed in depth from the public-private cooperation and technology specific needs perspectives.

As there are separate technology programs for energy technology, ICT and biotechnology then it is possible to analyse sectoral differences in the private sector involvement in these programs. Further, it will allow to analyse these technology programs in regards to the theoretical framework in chapters 1 and 2 and thus allow to make assumptions on the development of energy technology, ICT and biotechnology in Estonia.

3.2. Participation in the R&D&I policies

There seems to generally be two different rationales for opening the RDI policy making processes for the participation of the private sector. First, the gathering of expert knowledge as the ministries themselves lack the detailed knowledge on specific matters (Interview B). Second, as the policies are often not (regarded as) complicated enough to require the gathering of expert knowledge from the outside, then another major reason for participation is developing a common understanding on specific matters (Interview F). Thus, the reasons for participation can generally be seen as the need for specific knowledge and policy acceptance/viewpoint harmonization.

Generally the participation is an informal process and conducted with specific existing contacts (Interview B; F). Within the involvement there exists a general fear of self-interests from the participants. For example when it comes to funding decisions, then it is feared that the economic actors will want to influence the funding to maximize their own profits (Interview B, C).

However, the participation of private sector generally varies between two ministries to a certain extent. MKM involves mostly the private sector in the way of umbrella organizations and professional associations (Interview E). However as the capacities (of these representative organisations) to provide input and represent the interests of their members often vary (Interview B; C; E; F), then there are instances where businesses are contacted directly (Interview B).

In the case for both ministries, this varies between different technology sectors. According to the interview (B), the biotechnology sector is deemed fairly easy to grasp, as there appears to be a small number of companies which revolve around even fewer key people (just as discussed in chapter 1.2.3.). Also these key people are deemed generally strong personalities, who make themselves „visible“ and show initiative for participation. As these same people have been involved with numerous programs and are familiar through competence centers, then reaching out and communicating with them is deemed relatively easy. (Interview B) As for the biotechnology sector, it can be seen that the communication between the industry and MKM is informal as the key people from the industry have been long-time partners/contacts to the ministry. In the ICT sector selecting participants is also regarded fairly simple, since Estonian Association of Information Technology and Telecommunications (ITL) is generally seen as a fairly strong representative network of the ICT industry interests (Interview B).

The energy sector is regarded as more complicated. As there exists a variety of different associations and a multitude of interests, then it is generally regarded as not so easily understandable as the biotechnology sector. Here it would probably be necessary to coordinate the innovation policy with the Energy Department in MKM as they, being in charge of energy policy, have a better overview of different stakeholders and the sectors complexities. (Interview B)

On the contrary the partners (in regards to whom the ministry involves during policy making) of HTM can mostly be seen as schools, universities and research institutions (Response B; Interview C). The logic behind there, is that the definition of the primary stakeholders sets certain boundaries and focus for the participation on certain measures (Response B). Thus the primary target group of the Ministry of Education and Science are the universities and research institutions as most of the measures have been involved with purchasing/gathering machines and equipment for research (Interview C).

This does not however mean that HTM neglects the private sector from the policy making processes entirely. According to the interview (F), when it comes to ICT, then here ITL can almost be regarded as a strategic partner. However the ICT industry's interest is mostly centred on the development of human capital and less on research and science policies. Thus here the substance in their involvement is limited when it comes to R&D measures. When the measure is not accompanied by no real (for example monetary) commitments on behalf of the ICT industry, then their input usually ends up as less substantial. In the case of biotechnology most of the contacts for HTM are scientists/researchers, as the private sector here revolves around these key people. (Interview F, but see also Suurna 2011)

When it comes to the energy sector, then HTM has some contacts with specific enterprises (such as Viru Keemia Grupp AS regarding the science policy and Eesti Energia AS regarding the education policy), however this is rather the exception than the norm. The reasoning here is, that the science policy of the public sector in the energy sector has been generally absent and the science and R&D is usually left to be conducted/supported directly by the enterprises themselves. (Interview F) The problem here is, that it might work (to an extent) in the case of large corporations with the capacity to support science and R&D (Interview C), however for most enterprises developing this competence is too complicated and costly (Interview D). Also there is the risk, that these enterprises move R&D outside the country, to a more suitable (supporting) environment, which has to an extent already happened (Interview C; D).

3.3. The technology programs

Next this paper will look at the national technology programs in Estonia. The following programs will be discussed in detail: (1) „the Estonian Energy technology program" (ETP); „the Estonian info- and communication technology higher education and R&D program 2011-2015" (IKTP); and „the Estonian biotechnology program" (BTP). These prove empirically relevant as they clearly set out to deal with the development of energy technologies, ICT and biotechnologies. However even more importantly they all set forth the mission of involving relevant stakeholders in these technology sectors and generating more cooperation between the sector and the government („Eesti info- ja kommunikatsioonitehnoloogia kõrghariduse ning teadus- ja arendustegevuse programm 2011-2015", 11; „Eesti energiatehnoloogia programm", 4; „Eesti biotehnoloogia programm", 4-5).

In order to facilitate this, all of these programs are formed and led by different steering committees and advisory boards. These committees and boards consist of members from ministries, agencies, sectoral associations and other (economic) actors. All of these programs also have a program manager, which originates from an agency of the ministry in charge of the program. The general management structure is nearly identical between these three technology sectors, however the composition of actors varies to a certain degree.

In addition, the basic underlying principles and responsibilities are similar for these structures in all three programs, thus let them be stated here. The steering committee is in charge of approving the goals, instruments, finances for the program; appointing the program manager and evaluating their performance; approving projects within the program; approving any and all monitoring and analysis based on program manager's proposal. („Eesti energiatehnoloogia programm", 30-35; „Eesti info- ja kommunikatsioonitehnoloogia kõrghariduse ning teadus- ja arendustegevuse programm 2011-2015", 25-26; „Eesti biotehnoloogia programm", 26-30)

The basic responsibilities of the program manager is to organise cooperation between businesses (private sector) and different institutions, along with expert groups and research partners, for the implementation of the program. Also by leading the program team, the manager forms the plan for goals, instruments and implementation, which is then forwarded for an approval within the steering committee. The program manager also communicates information to the public. („Eesti energiatehnoloogia programm", 30-35; „Eesti info- ja kommunikatsioonitehnoloogia kõrghariduse ning teadus- ja arendustegevuse programm 2011-2015", 25-26; „Eesti biotehnoloogia programm", 26-30) Basically the program manager develops (along with the program team) the content for program. Also the program manager ise the bridge for communication and coordination between different entities from both inside and outside of the government and between the steering and advisory bodies (Interview A).

As the title already suggests, the basic purpose of the advisory board is to advise the steering committee, program manager and program team in setting sector specific visions and goals for R&D and innovation. However also to make proposals to the specific program related institutions regarding the implementation of the program. The advisory board has no voting priviledges in the matters involved with the implementation of the program, thus it can rely only on proposing evaluations, opinions, suggestions and visions, which will be added to the activity reports of the program. Then there is of course the expert network of the program, however this

varies based on the specific topics in the program. („Eesti energiatehnoloogia programm“, 30-35; „Eesti info- ja kommunikatsioonitehnoloogia kõrghariduse ning teadus- ja arendustegevuse programm 2011-2015“, 25-26; „Eesti biotehnoloogia programm“, 26-30) The information flow between the advisory board and steering committee is handled by the program manager. The program manager prepares proposals, presents them to the advisory board for comments, then takes these comments into account (or not) and brings the final proposal to the steering committee for acceptance (or rejectance). (Interview F) Thus as it can be seen already, the participation in these programs is fairly institutionalised (corporatist structures).

Even though these programs resemble to each other in regards to the management structure, then there are still significant differences between them. For example the IKTP is funded differently from the ETP and BTP. IKTP has a separate funding source within the HTM and the only government body that the program is coordinated with is MKM. However ETP and BTP were national coordinative programs, thus the basic logic was that ministries (from various fields) work together in order to recognize bottlenecks in the specific technology fields and to find solutions. (Interview B) Also ETP was basically oriented towards achieving energy policy goals (not necessarily R&D&I policy goals) through supporting science. BTP was however geared towards developing key enabling technologies. IKTP was also originally oriented towards developing key enabling technologies, however it focused more on the human resource side. (Interview F)

Before moving forward to specific technology programs another comment must be made. These technology programs were formulated and implemented many years ago (ETP was approved by the government as early as 2008; BTP 2009; and IKTP 2011). Thus in hindsight several mistakes have been recognized by policy-makers themselves and it has been characterised as a *learning-by-doing* process. (Interview B; F) The following sub-chapters will now take a separate and more closer look into these technology programs.

3.3.1. Energy Technology Program

The steering committee for the ETP consists of the following members: (1) the Ministry of Economic Affairs and Communications (lead ministry); (2) Ministry of Education and Science; (3) Ministry of Environment; (4) Ministry of Agriculture; (5) Ministry of Finance; (6) Environmental Investment Centre Foundation; (7) Archimedes Foundation; (8) Enterprise

Estonia Foundation (EAS); (9) Estonian Research Council (formerly known as Estonian Science Foundation). All of these appointees have one seat in the steering committee except for the Ministry of Economic Affairs and Communications, which has two (one as the regular member and one for the chairman of the committee position). The responsibility of managing ETP has been given to the Enterprise Estonia Foundation, which is an agency of the Ministry of Economic Affairs and Communications. („Eesti energiatehnoloogia programm“, 30-31; ETP website „Programmi juhtimine“)

The ETP advisory board consists of the following members: (1) University of Tartu; (2) Ministry of Economic Affairs and Communications; (3) Tallinn University of Technology; (4) Estonian Research Council (foundation); (5) Estonian University of Life Sciences; (6) Estonian Chamber of Commerce and Industry; (7) Estonian Association of Engineers; (8) Union of Electricity Industry of Estonia; (9) Estonian Wind Power Association; (10) Estonian Gas Association; (11) Viru Chemistry Group AS; (12) Eesti Energia AS; (13) Peep Siitam from Energiasalv OÜ (first manager of the ETP). The chairman position here belongs to the University of Tartu. („Eesti energiatehnoloogia programm“, 35; ETP website „Programmi juhtimine“)

In the case of ETP the goals were set as the following: (1) Defining the energy sectors RDI priorities, formulating a RDI plan and coordinating its implementation; (2) Defining the direction for the education in the energy sector; (3) Improving the effectiveness, transparency and reducing the duplication in funding development in the energy sector; (4) Improving the international cooperation; (5) Improving inter-ministerial cooperation in the energy sector; (6) Improving the cooperation between the state and the energy sector and the cooperation inside the energy sector. (Eesti energiatehnoloogia programm, 4) Thus, from this division of actors it can be clearly seen that, economic actors participate only as a advisory body. The steering committee however exists purely of government institutions. The private sector here is represented mostly by various associations and unions, however the two larger energy corporations (Viru Keemia Grupp AS and Eesti Energia AS) have separate seats. Based on the interview (B), the basic logic behind the program was, to develop technologies in the way that the private sector would state the demand/need and then universities/research institutes would try to fulfill those needs through research. The private sector generally was not able to define its technological needs aside from biofuels and (oil-shale) mining, which resulted evidently in weaker involvement of the private sector. Overall this communication happened between the state and private sector enterprises as

the technology needs were enterprise specific. Here the professional associations were not involved. (Interview B)

3.3.2. ICT Program

The steering committee here consists of the following actors: (1) Estonian Association of Information Technology and Telecommunications (ITL) (chairman); (2) Ministry of Education and Science (three seats, based on different departments; lead ministry); (3) Ministry of Economic Affairs and Communications; (4) Skype Technologies OÜ; (5) Codeborne OÜ (part of ITL); (6) Baltic Computer Systems AS (part of ITL). The same steering committee is also used for another cooperation program (with the private sector and universities) called IT Academy. („Eesti info- ja kommunikatsioonitehnoloogia kõrghariduse ning teadus- ja arendustegevuse programm 2011-2015“, 25-26; IKTP website „Juhtimine“; „IT Akadeemia“) The advisory experts to the steering committee are Tallinn University of Technology and University of Tartu (and possibly other *ad hoc* experts in specific matters). The program is managed by the Information Technology Foundation for Education (HITSA), which is an agency of the Ministry of Education and Science. (IKTP website „Juhtimine“)

The program set forth seven goals: (1) Raising the international competitiveness of the Estonian ICT higher education; (2) Raising the competitiveness of R&D in the ICT sector of Estonia; (3) Improving the cooperation between research institutions and the ICT sector; (4) Improving the application-oriented R&D in the ICT field; (5) Improving the cooperation on all levels (including inter-ministerial cooperation; state-ICT sector cooperation and the cooperation inside the ICT sector); (6) Increasing the participation of Estonian research institutions in cooperation with the private sector in internationl technology platforms and common initiatives; (7) supporting the IT Academy and other ICT higher education initiatives. („Eesti info- ja kommunikatsioonitehnoloogia kõrghariduse ning teadus- ja arendustegevuse programm 2011-2015“, 11)

Here of course the decision making power seems to be much more dispersed. As half of the steering committee consists of ICT sector representatives and the other half of the government actors. Even the chairman in this case is actually ITL and not the government as in the case of ETP. As for the decisions, a 2/3 majority vote is needed („Eesti info- ja kommunikatsioonitehnoloogia kõrghariduse ning teadus- ja arendustegevuse programm 2011-

2015“, 26), so the private sector can be seem to have some type of veto-points. Of course this is somewhat hindered by the rule that if a ministry (from the same field as the underlying motion) objects, then the 2/3 majority vote gets overruled and the motion automatically rejected. This of course seems to be a type of „safety measure“ for the government to decrease the possibility of the ICT sector being able to push through proposals that the government (as a whole) does not agree on.

However from the three technology programs, that are discussed in this paper, IKTP had the strongest involvement of industry actors (Interview F). ITL had a major influence during the writing of the program, even to the extent where the distribution for funding was changed as ITL requested more funds to be aimed towards the support of education. This strong participation made the formulation process longer to the extent that the program was implemented several years later than other technology programs. (Interview C) ITL has been actively contributing ideas and input on the higher education topics and for promotional events (Interview A).

3.3.3. Biotechnology Program

The steering committee for BTP consists of the following actors: (1) Ministry of Economic Affairs and Communications (lead ministry for this program); (2) Ministry of Education and Science; (3) Ministry of Agriculture; (4) Ministry of Environment; (5) Ministry of Finance; (6) Ministry of Social Affairs; (7) Estonian Research Council (formerly known as Estonian Science Foundation); (8) Archimedes Foundation. (BTP website „Programmi Juhtimine“)

Meanwhile the advisory board consists of the following: (1) University of Tartu; (2) Ministry of Economic Affairs and Communications; (3) Estonian Academy of Sciences; (4) Tallinn University of Technology (three seats, based on various topics); (5) Estonian Food Industry Association; (6) Estonian Forest and Wood Industries Association; (7) Estonian Chamber of Agriculture and Commerce; (8) Federation of Estonian Chemical Industries. The program is managed by the Enterprise Estonia Foundation. (BTP website „Programmi Juhtimine“)

The biotechnology program set forth basically three broad goals: (1) Developing the critical mass of skilled labour and funding in the priority development areas in response to the growth needs of the private sector; (2) Changing the emphasis from basic research to applied research and commercialisation; (3) Raising the awareness of traditional industries and the public sector on biotechnology. The priority development areas of the program were the following: functional

food, food processing, molecular diagnostics and drug discovery technologies. („Eesti biotehnoloogia programm, 4-13“)

Here the composition is similar as with the ETP. The government actors form the steering committee, meanwhile all other policy stakeholders are taken into account as advisors (through the advisory board). As established before, then the biotechnology sector does not have a strong private sector and the main mechanism for innovation here is (instead of market pull) science push. What can be witnessed in the case of BTP is strong horizontal coordination between different government entities, which is of course important as biotech is a large sector with many possible applications in different fields. According to the interview (B) in the case of BTP the participants for mostly selected based on scientists/researchers and profesisonal associations where biotechnology could find application. This is largely due to the biotechnology private sector being centred around scientists themselves. The communication here was informal, due to the sector being fairly small and contacts already familiar. As the policy-makers lacked specific expert knowledge (as biotechnology is very much science based), thus the involvement of specific experts became necessary. (Interview B)

4. DISCUSSION

In this chapter, the paper returns back to the theoretical framework established earlier in order to analyse the gathered empirical information. The policy rationale for allowing and encouraging private sector participation in RDI policy can be seen the same for all of the technology sectors. As established earlier, the purpose for participation is to gather expert knowledge (that the ministry does not have) and/or policy acceptance/viewpoint harmonization.

However there are some significant differences between the technology sectors regarding the question of twho is involved in the policy making. Biotechnology is the only sector, where instead of associations,a key group of enterprises/people is involved directly through informal communication/participation. The biotechnology field is regarded as specific and complex enough to need expert knowledge from the economic actors (Interview B). Thus, the participants have likely a strong influence/impact on the policy formulation and content.

This however opens up the possibility of the policy being captured by the key actors' self interest. In the case of Estonia, Suurna (2011) has identified links between biotechnology enterprises (with fairly high profit returns) in Estonia and R&D personnel. Furthermore these biotechnology companies have converged around a small number of key people in the academic world. (Suurna 2011, 102) Thus, in the case of Estonia the specific biotechnology industries' interests are difficult to differentiate from the research/academic interests. As discussed in chapter 2.3., researchers have a self-interest to do basic research instead of applied research, which means that finding applications for biotechnology solutions in other industries/sectors can prove to be less important and more difficult. As the business models are still fairly unclear in biotechnology and even if the assumption can be made that specific biotechnology industry interests do exist (separately from research/academic interests), strong participation (of the biotech industry) can still prove to be troublesome to the technology development: - the economic actors may be be motivated to promote their niche business models as the new industry standards (for more see chapter 2.3.) to the policy-makers and this may limit policy support of (or openness towards) various other business models and emphasis placed on the diffusion of biotechnology technologies into other sectors (especially as biotech is also often considers as key enabling technology).

In the case of the biotechnology program, a similar set of issues occurs. Instead of informal participation, a corporatist structure can be seen with a fairly clear management structure (with certain rules and regulated procedures). This however applies to all of the technology programs. Also here, a variety of different economic actors can be seen to be involved with similar possibilities to impact the policies. This includes economic actors from the biotechnology industry, but also the associations of industries where biotechnology could be applied. This presents a twofold issue.

First, the representative associations from other industries/sectors being involved is a welcoming sight for finding applications and diffusuon pathways for biotechnology. However, their participation seems not strong enough for generating any sort of cooperation as they are involved as mere advisors. In addition, the advisory board is dominated by academics/researchers which leads to the second issue. If the associations from other industries/sectors involvement is not strong enough, then the involvement of the academic/research staff may bee too strong. Most of the advisory board consists of representatives of universities, or other academic staff. This leads back to the discussion on the differences between basic and applied research. Limited involvemenet and participation of industries where biotechnology could find and strong involvement of academic/research staff may result in a lack of support for applied research. Thus, the biotechnology program presents an interesting issue of participation being too strong and too weak – or not sufficiently balanced by conuterweilien powers – at the same time.

In sum, there are some noticeable differences in participation parctices between the general biotechnology RDI policy and the specific biotechnology program. While the general participation in the biotechnology sectors is conducted generally through informal communication with long-time contacts, then BTP set fort a specific institutionalised management structure with very clear participation parctices. However, leaving these inherent differences to the side, the issues (in the case of the program and the general participation in the sector) are relatively similar. In both cases the involvement is dominated by certain key actors, who have very specific business models and interests, which restrain the applicability of biotechnology and the overall development in the sector.

In the case of ICT, ITL is generally seen as the primary stakeholder to participate in the policy making processes from the ICT sector. This is largely due to the private sector being well organized into ITL and thus ITL itself being a fairly strong representative body. Similar to the

biotechnology sector, the general participation in policy processes is conducted through informal channels, as ITL is mostly seen as a long-term strategic partner for different projects and programmes (especially in the case of HTM). However, as the key policy rationale for participation (outside the IKPT program) is mostly focued on involving ITL to develop common viewpoints and understandings and gain expert knowledge, ITL have little to no veto-points in the overall policy making process. Further, given the maturity levels of the technology and globalized markets of technological diffusion, the sector has dominant interest in human capital and quality of ICT education (as opposed to technology and R&D policy). However, in the case of the IKTP program, the ICT sector can be seen to have a substantial influence over the policy, having veto-points in the steering committee. In broad terms, the IKTP's goals divide into two: developing human capital (workforce) for ICT and enhancing R&D (especially application-oriented R&D) (Interview A). The goals were brought out in more detail in chapter 3.3.2. The same two issues have also been raised in literature analysing Estonian ICT sector (e.g. see Karo & Kattel 2010, Kalvet & Tiits 2012). The participation of the ICT industry can be characterised here as strong (atleast the strongest of these three programs). This can seem beneficial in dealing with the human capital issue, as due to the strong coordination between the ICT sector and the government, the policies affecting human capital (e.g. education) can be steered directly towards the needs of the ICT sector.

We can argue that form the perpeoctive of supporting the diffusion (application-oriented R&D) in the ICT sector (see also the section 2.2), the IKTP program has several shortcomings. Firstly, the program involves only the ICT industry and the government while it fails to include actors from other sectors into the management structure. Involving actors from different industries (e.g. manufacturing) and from different policy areas (e.g. energy, healthcare, education) is crucial in order for ICT to diffuse to other sectors/areas as discussed in chapter 2.2. Thus, there is a conflict between the participation and the goal of the program to improve the application-oriented R&D in the ICT sector.

Secondly, there is also a lack of coordination with other ministries in charge of different policy areas (e.g. Ministry of Social Affairs, Ministry of Environment). No other ministries (except MKM) are included in the management structures of the program, which does not entirely fare well with the goal of the program to improve cooperation on all levels (especially inter-ministerial cooperation and the overall cooperation of the state and the ICT industry). This stems from the different structure and funding of the program. While ETP and BTP were coordinative

programs jointly funded by different ministries, then IKTP was fully funded by HTM. However in the sense of diffusing ICT (and applied-oriented R&D), the program might have benefitted from being coordinative, rather than in isolation from other ministries.Thus, both a lack of sufficient participation as well as a lack of horizontal coordination between ministries can be seen. Due to this issue, the program fails to establish coordination with other sectors (such as healthcare, energy, traditional industries) and other policy areas, which in return sets restraints on the diffusion of ICT and on enhancing the cooperation.

Even further, the implementation (and management) of R&D policy seems to be almost completely forgotten in the IKTP program, even though it is clearly written into the goals of the program (see chapter 3.3.2.). The program in general is managed by HITSA, however HITSA claims to be actively in charge of only the human capital side of activities, whereas the R&D side is supposedly set to be managed by the Archimedes Foundation (Interview A). Archimedes Foundation however recognizes itself only as an implementing agency, which deals with forming reports, processing cost documents and mediating funding from the EU structural funds. They have no role in the design of the policy content nor in the participation of enterprises in the planning or implementation stages of the program. (Response A) The lead ministry for this program (HTM), itself describes the program as being basically solely oriented towards developing human capital (Interview F). Thus, clearly several crucial goals[9] of the IKTP program have been left unmanaged and thus cannot be accomplished.

The energy sector is characterized by the policy-makers as a difficult and not-as-clear when it comes to choosing who to involve. Here the participation is to a certain extent lower in the RDI policies, as the state generally takes a *laissez faire* attitude towards R&D in the energy sector. Returning to the theorethical discussion in chapter 2.1., Eesti Energia AS can be seen as an incumbent (or as a lead actor of the legacy sector) since it dominates the whole energy sector and has vested interests in oil-shale (fossil fuel resource) (for more see Tõnurist 2015, 5-10). What makes it interesting is that Eesti Energia AS is a state owned enterprise, thus it would be generally expected to be in close coordination with the government. However, it is quite the opposite as while Eesti Energia AS does innovative investments, there is a lack of policy coordination and acknowledgement from the state (Tõnurist 2015, 10).

[9] These include: (1) Raising the competitiveness of R&D in the ICT sector of Estonia; (2) Improving the application-oriented R&D in the ICT field („Eesti info- ja kommunikatsioonitehnoloogia kõrghariduse ning teadus- ja arendustegevuse programm 2011-2015“, 11)

In the case of the energy technology program there are also multiple issues present. One of the many goals stated for this program was to increase the cooperation between the state and the energy sector (for more see chapter 3.3.1.). However, as the energy sector actors have only the role of an advisor in the progrem with no veto rights, the the program management structure partly hinders the possibilities of the program establishing any real cooperation between the state and the sector.

Furthermore, this is also reflected in the way the priority directions for development[10] were set. Here again the group with deciding power consisted of government actors, universities, parliament's environmental commission, Estonian Association of Engineers and Estonian Employers' Confederation. Thus, in the decision-making group the energy sector's interests can mainly be seen represented by the two latter organisations. However, these two organisations are broad multi-sectoral institutions, which have been characterised as relatively limited in their demands on technology topics (Interview B). The energy interest groups were however involved in working groups and discussions. However, the results still had to be confirmed by the group mentioned before. Thus, this did not support the goal of cooperation.

Further, various associations from the energy sector can be seen to be represented in the advisory body. Thus, different interests are indeed represented. However, when looking at the incumbents (e.g. Viru Keemia Grupp and Eesti Energia), they see to have a small over-representation here, as they are also represented by the associations/unions (which [hopefully] represents the general interest of their members and not particular vested interests) as well as separate companies.As mentioned earlier in chapter 3.3.1., during the design of the program the enterprises were contacted directly in order to map out their specific technology needs. Here the incumbent enterprises, were more capable in stating their needs than the other economic actors. Thus, the incumbents can be seen to have a bigger influence on the program, which can derive from different levels of capacities within associations and economic actors. However, it can be expected expected that the incumbents still have an advantage (for more see chapter 2.1.). Thus, the state essentially should try to balance their capabilities in order to „even the playing field".

[10] ETP priority directions of development: (1) oil shale technologies, (2) new technologies based on renewable energy sources and the optimisation of the energy system based on those technologies, (3) nuclear energy („Eesti energiatehnoloogia programm", 9).

However, it can be argued that the ETP has not fully managed to balance these interests. This has affected the fulfillment of several goals, such as setting the RDI priorities of the energy sector and defining the directions for education in the energy sector. As the incumbents have had the dominant position, they have also had a bigger influence over the program than other economic actors.

The reasons behind some of these shortcomings for all technology programs have been recognized by the policy-makers themselves. Firstly, in the cases of both the ETP and BTP, the programs were managed by a single person from a ministerial agency, thus not only was he overwhelmed with tasks, but also his mandate for coordinating with different policy actors was messy. The program was designed to be above the ministries, but the program manager was selected from within the ministry (from an agency belonging to the lead ministry). Thus, his mandate for giving orders and for other ministries to follow these was only voluntary and based on mutual agreements. (Interview B; Majandus- ja Kommunikatsiooniministeerium 2014) This also sets restraints to the capacity to organise participation/involvement and the balancing of different interests, but also to coordination inside and outside of the government.

Secondly, the programs also were designed differently regarding the management and funding. ETP and BTP were coordinative programs, which made funding more complicated as it was done in cooperation with other ministries. IKTP had separate funds from the HTM which made the funding and designing the policy easier. In return however, IKTP could have perhaps benefitted from more coordination with different ministries as discussed earlier. (Interview B; C)

Returning to the conjectures made in chapter 2.4. The empirical analysis proves to an extent that Estonia as a simple polity and a liberal market economy is unable to fully repond to the needs of the anakyzed technologies in their current phases of development. In the case of the energy technology sector, the politico-economic structure of Estonia is unable balance out the interests from the incumbents. In the case of ICT, not enough economic actors are involved in order to take into account the application-oriented nature of ICT. The only assumption that did not find proof empirically was the case of biotechnology. While according to theory the simple polity and liberal market economy structure should be beneficial in keeping vague interests of economic actors out of the policy-making, in the case of Estonia it was not true.

Generally however, the participation processes varied to little extent between technologies. The biggest variation was in the levels of networking in various technologies. In more mature technologies the associations/unions were already well developed (e.g. ICT and energy) and thus the participation was conducted on the association/union level. For the case of biotechnology as a less mature technology, the networks have yet to been developed and thus the participation was conducted based on key actors in the field. Apart from that, no other connection between participation and technoligy maturity existed. As a matter of fact, the participation processes otherwise were quite similar especially in the cases of technology programs (i.e. the polity characteristics dominate over the technological needs). The variations that occurred in the participation in the technology programs were either due to different levels of networking or due to different funding schemes that translated into differences in management structures. For example, BTP and ETP were funded by a multitude of ministries and thus they were coordinative programs; the IKTP was funded only by HTM and had almost no coordination accross different ministries.

CONCLUSION

The evolutionary theory on technology trajectories explains how technologies in different levels of maturity have specific issues that need particular policy responses. Energy can be characterised as a mature complex established legacy sector, where balancing the interests of various stakeholders is of utmost importance. ICT can be described as a maturing/converging application-oriented sector, where diffusing ICT into other sectors (e.g. manufacturing) and areas (e.g. health, energy) has become crucial this stage of development. Biotechnology can be characterised as a less mature science-based sector, where also the diffusion of biotechnology into other sectors plays an important role, however it is hampered by lack of specific business models and vague interests.

These specific issues and needs from the technologies set forth requirements for different types of policy coordination between the economic and political actors. However, as states have different politico-economic structures, also the participation processes during policy making processes are different. This may support or restrain states from successfully supporting technological development. Using the rational-choice institutionalism (varieties of capitalism) and discursive institutionalism literature, it was possible to construct and differentiate between various politico-economic structures and different types of participation.

The paper set out to analyze the private sector participation in the research, development and innovation policies of Estonia. As Estonian politico-economic structure is well described in various academic literature, then it offered a good opportunity to analyze how the private sector is involved in the research, development and innovation policies of Estonia and how do these processes vary between energy technology, ICT and biotechnology sectors.

The results show that generally the participation process occurs as a informal process in the case of all three technologies whereas the participants are chosen based on longtime partnerships and previous contacts. The rationale for participation is generally the need for expert knowledge in matter concerning specific technology fields and/or the harmonization of perspectives. Also the participation process varies only to a minor extent between technology sectors. Variance only occurs in the levels of networking as more mature technology sectors have networked into associations/unions with clear representative interests, while less mature technology sectors remain still segregated. However, in the cases of national technology programs, the participation

processes were generally the same in all three technology sectors. The only differences stemmed from the use of different funding schemes, which translated into differences in management structures. These differenes in the structure of the programs had little to do with technologies and different levels of maturity.

Estonian politico-economic structure poses several difficulties in RDI policy making for responding to the specific needs of these technologies. More specifically, it fails to cope with the multitude of conflicting interests in the energy technology sector. It also does not provide the necessary policy support for the diffusion of ICT solutions into other sectors and policy areas. In the biotechnology sector, there is a lack of policy support for the diffusion of biotechnology into other sectors/areas, but also there is the problem of narrow (academic) interests having too much control over policy content.

LIMITATIONS AND FURTHER RESEARCH

The empirical analysis conducted in this paper has certain limitations that must be kept in mind. Firstly the empirical evidence is mostly from the perspectives of the ministries. Even though initially several agencies was also contacted, however due to lack of replies and time constraints these interviews were not actively pursued. From the private sector point of view only two interviews were planned from the beginning (see chapter 3.1.). Unfortunately Estonian Association of Information Technology and Telecommunications was unreachable even after trying to contact numerous people through different mediums. Thus it must be kept in mind, that these conclusions are made based mostly on the information received from the policy makers and information gathered from the policy-related documents. In addition, all of the national technology programs had multiple people managing and formulating the programs in different times (Interview B; C). Thus in order to fully analyse and get all the details a huge number of people must be interviewed.

This would have however far exceeded the capacity of this master's thesis. Also these factors limit the analysis only to a small degree. The information received from the policy makers provides an essential base from which to make preliminary conclusions while keeping in mind that more information could be gathered. Furthermore these conclusions can always be further confirmed or rebutted by further research with for example more cases and/or more interviewees. Thus as a suggestions for further research is to test the framework on different cases and/or see whether the private sector adds any new information to the existing cases (RDI policies as well as other sectors). In addition hypothetically these findings could be tried to be explained by alternative theories, for example the small states theory[11], which would add another dimension on participation next to the politico-economic structures.

[11] Small states theory might help to explain the informal communication between policy makers and economic actors. Especially in the cases where the number of economic actors is extremely limited and vague interests exist (e.g. the biotechnology sector).

BIBLIOGRAPHY

Eesti ettevõtluse kasvustrateegia 2014-2020. Available at: http://kasvustrateegia.mkm.ee/ (16.05.2015)

Eesti teadus- ja arendustegevuse ning innovatsiooni strateegia 2007–2013. Available at: https://www.hm.ee/sites/default/files/tai_strateeiga_2007-2013.pdf (17.05.2015)

Eesti teadus- ja arendustegevuse ning innovatsiooni strateegia 2014–2020. Available at: http://www.hm.ee/index.php?popup=download&id=12422 (16.05.2015)

Eesti biotehnoloogia programm. Available at: http://www.eas.ee/images/doc/ettevotjale/innovatsioon/bio/btp_programmdok_2009_12.pdf (15.04.2015)

Eesti energiatehnoloogia programm. Avaliable at: http://www.eas.ee/images/doc/ettevotjale/innovatsioon/energia/etp_programmdok.pdf (15.04.2015)

Eesti info- ja kommunikatsioonitehnoloogia kõrghariduse ning teadus- ja arendustegevuse programm 2011-2015 Available at: http://www.hitsa.ee/files/IKT.pdf (15.04.2015)

IT Akadeemia *HITSA IT Academy program's website*. Available at: http://www.hitsa.ee/ikt-haridus/ita (17.04.2015)

Eesti Arengufond (2013) „Nutikas Spetsialiseerumine – kvalitatiivne analüüs."

Arnstein, S. R. (1969) „A Ladder Of Citizen Participation." *Journal of the American Planning Association*. Vol. 35, No. 4, 216-224.

Bartholomew, S. (1997) „National Systems of Biotechnology Innovation: Complex Interdependence in the Global System." *Journal of International Business Studies*, Vol. 28, No. 2, 241-266.

Bessey, E., Bueno, R., Decubber, C., Chlebus, E., Goericke, D., Groothedde, R., Hanisch, C., Jovane, F., Mendonca, J., Paci, A., Westkämper, E. and D. Williams (2009) „Research, Technology and Development for Manufacturing.“ In Jovane, F., Westkämper, E., Willams, D. (eds). *The ManuFuture Road: Towards Competitive and Sustainable High-Adding-Value Manufacturing*. 89-121.

Buchen, C. (2004) „What kind of capitalism is emerging in Eastern Europe? Varieties of Capitalism in Estonia and Slovenia.“ *Draft for Research Seminar on "Managing the Economic Transition".*

BTP website „Programmi juhtimine“ *EAS website for the Biotechnology program*. Available at: http://www.eas.ee/et/ettevotjale/ettevotte-arendamine/innovatsioon/biotehnoloogia/programmi-juhtimine?showall=1&limitstart= (19.04.2015)

Campbell, J. L. (2007) *The Rise and Transformation of Institutional Analysis*. Available at: http://www.researchgate.net/profile/John_Campbell29/publication/228432019_The_rise_and_transformation_of_institutional_analysis/links/0c96052e9563bd0ee3000000.pdf (14.05.2015)

Commission of the European Communities (2009a) „A Strategy for ICT R&D and Innovation in Europe: Raising the Game.“ *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions*.

Commission of the European Communities (2009b) „Preparing for our future: Developing a common strategy for key enabling technologies in the EU." *Commission staff working document accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions.*

Commission of the European Communities (2012) „A European strategy for Key Enabling Technologies – A bridge to growth and jobs.“ *Communication from the Commission to*

the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions.

Drechsler, W., Backhaus J. G., Burlamaqui, L., Chang, H., Kalvet, T., Kattel, R., Kregel, J. and E. S. Reinert (2006) „Creative Destruction Management in Central Eastern Europe: Meeting the challenges of the techno-economic paradigm shift.“ In Kalvet, T., Kattel, R. (eds). *Creative destruction management: Meeting the challenges of the techno-economic paradigm shift*. Tallinn: PRAXIS Center for Policy Studies. 15-30.

Edquist, C. & C. Chaminade (2006) „Industrial policy from a systems-of-innovation perspective.“ *EIB Papers*, Vol. 11, No.1, 108-134.

Edquist, C. & L. Hommen (2008) *Small Country Innovation Systems: Globalization, Change and Policy in Asia and Europe*. Cheltenham: Edward Elgar.

ERR (2014) „Ettevõtjad: poliitikud ei kuula meid.“ Available at: http://uudised.err.ee/v/majandus/aecfdc3c-486d-4a53-a121-438425e8f536 (17.04.2015)

ETP website „Programmi juhtimine“ *EAS website for the Energy technology program*. Accessible at: http://www.eas.ee/et/ettevotjale/ettevottearendamine/innovatsioon/energiatehnoloogia-programm/programmi-juhtimine (17.04.2015)

ETL webpage „Liikmed“ *Union of Eletricity Industry of Estonia*. Available at: http://www.elektriliit.ee/eesti-eletrit%C3%B6%C3%B6stuse-liidu-liikmed (08.05.2015)

Feldmann, M. (2006) „Emerging Varieties of Capitalism in Transition Countries: Industrial Relations and Wage Bargaining in Estonia and Slovenia.“ *Comparative Political Studies*. Vol. 39, No. 7, 829-854.

Forbes (2014) „Exclusive: The Rags-To-Riches Tale Of How Jan Koum Built WhatsApp Into Facebook's New $19 Billion Baby.“ Available at:

http://www.forbes.com/sites/parmyolson/2014/02/19/exclusive-inside-story-how-jan-koum-built-whatsapp-into-facebooks-new-19-billion-baby/ (16.05.2015)

Fu, J. S. (2013) „ICT in Education: A Critical Literature Review and Its Implications.“ *International Journal of Education and Development using Information and Communication Technology*. Vol. 9, No. 1. 112-125.

Green, A. O. & L. Hunton-Clarke (2003) „A Typology of Stakeholder Participation for Company Environmental Decision-Making.“ *Business Strategy and the Environment*. Vol. 12, 292-299.

Hall, P. A. & D. Soskice (2001) *Varieties of Capitalism*. Oxford: Oxford University Press.

Hall, P. A. & R. Taylor (1996) “Political Science and the Three New Institutionalisms.” *MPIFG Discussion Paper 96/6*.

Hope, M. & R. Raudla (2012) „Discursive institutionalism and policy stasis in simple and compound polities: the cases of Estonian fiscal policy and United States climate change policy.“ *Policy Studies*. Vol. 33, No. 5, 399-418.

IKTP website „Juhtimine“ *HITSA website for the Estonian info- and communication technology higher education and R&D program*. Available at: http://www.hitsa.ee/ikt-haridus/ikt/juhtimine (17.04.2015)

Kalvet, T. & M. Tiits (2012) „Implementing Open Innovation in Catching-up Economies: Evidence from Estonia's ICT Sector.“ *Proceedings of the 5th ISPIM Innovation Symposium, Seoul, Korea - 9-12 December 2012*.

Karo, E. & R. Kattel (2010) „Avatud innovatsioon ja arengud innovatsioonisüsteemis ja -poliitikates ning poliitikasoovitused Eestile.“ In Kalvet, T., Karo, E., Kattel, R. (eds). *Eesti ettevõtete uued võimalused – ärimudelid, avatud innovatsioon ja riigi valikud*. Tallinn: Eesti Vabariigi Majandus- ja Kommunikatsiooniministeerium. 85-94.

Karo, E. & L. Looga (2014) „Understanding institutional changes in economic restructuring and innovation policies in Slovenia and Estonia.“ *Journal of International Relations and Development*. 1-34.

Kattel, R. & R. Raudla (2013) „The Baltic Republics and the Crisis of 2008–2011.“ *Europe-Asia Studies*. Vol. 65, No.3, 426-449.

Lang, A. & A. Mertes (2011) „E-Health Policy and Deployment Activities in Europe.“ *Telemedicine and e-Health*. Vol. 17, No. 4. 262-268.

Löhr, H., Sadeghi, A. & M. Winandy (2010) „Securing the e-health cloud.“ *Proceedings of the 1st ACM International Health Informatics Symposium*. 220-229

Macneil, R. (2013) „Seeding an Energy Technology Revolution in the United States: Re-Conceptualising the Nature of Innovation in 'Liberal-Market Economies'.“ *New Political Economy*, Vol. 18, No. 1, 64–88.

Majandus- ja Kommunikatsiooniministeerium (2014) „Eesti biotehnoloogia programmi mõjuanalüüs.“

Mathews, J. A. (2012) „The renewable energies technology surge: A new techno-economic paradigm in the making?“ *Working Papers in Technology Governance and Economic Dynamics no. 44*.

Nasdaq (2015a) „Will Uber Be the Hottest IPO of 2015? - Stocks in the News.“ Available at: http://www.nasdaq.com/article/will-uber-be-the-hottest-ipo-of-2015-stocks-in-the-news-cm430929 (16.05.2015)

Nasdaq (2015b) „A Look At The Most Anticipated IPOs Of 2015.“ Available at: http://www.nasdaq.com/article/a-look-at-the-most-anticipated-ipos-of-2015-cm438722 (16.05.2015)

Negro, S. O., Alkemade, F. & M. P. Hekkert (2012) „Why does renewable energy diffuse so slowly? A review of innovation system problems.“ *Renewable and Sustainable Energy Reviews*. Vol. 16, No. 6, 3836-3846.

OECD (2014) *Making Innovation Policy Work: Learning from Experimentation*. OECD Publishing.

Perez, C. (2001) „Technological change and opportunities for development as a moving target." *Cepal Review*, 75, 109-130.

Perez, C. (2009) „Technological revolutions and techno-economic paradigms." *Cambridge Journal of Economics*. Vol. 34, No. 1, 185-202.

Perez, C. (2012) „Technological Revolutions and the Role of Government in Unleashing Golden Ages" In Grinin, L.E., Devzas, T.C., Korotayev, A. V. (eds). *Kondratieff Waves Dimensions and Prospects at the Dawn of the 21st Centry*. Volgigrad: Uchitel Publishing House. 211-218.

Pisano, G. P. (2006a) *Science Business: The Promise, the Reality, and the Future of Biotech*. Harvard Business School Press.

Pisano, G. P. (2006b) „Can science be a business? Lessons from biotech." *Harvad Business Review*. Vol. 84, No. 10, 114-124.

Postimees (2014) „Ligi: ettevõtjaid kuulatakse palju enam kui nende osakaal valijaskonnas." Available at: http://majandus24.postimees.ee/2934545/ligi-ettevotjaid-kuulatakse-palju-enam-kui-nende-osakaal-valijaskonnas (18.04.2015)

Pretty, J. N. (1995) „Participatory Learning For Sustainable Agriculture." *World Development*. Vol. 23, No. 8, 1247-1263.

Reed, M. S. (2008) „Stakeholder participation for environmental management: A literature review." *Biological Conservation*. Vol. 141, No. 10, 2417-2431.

Riigikontroll (2012) „Riigi tegevus teadus- ja arendustegevuse võtmevaldkondade edendamisel." *Riigikontrolli aruanne Riigikogule.* Available at: http://www.riigikontroll.ee/DesktopModules/DigiDetail/FileDownloader.aspx?AuditId=2232&FileId=11464 (15.05.2015)

Rodrik, D. (2008) “Industrial Policy: Don’t Ask Why, Ask How” *Middle East Development Journal Demo Issue*, 1-29.

Schmidt, V. A. (2002) *Futures of European capitalism*. Oxford: Oxford University Press.

Schmidt, V. A. (2008) „Discursive Institutionalism: The Explanatory Power of Ideas and Discourse.“ *Annual Review of Political Science.* Vol. 11, No. 1, 303-326.

Schmidt, V. A. (2009) „Putting the Political Back into Political Economy by Bringing the State Back in Yet Again.“ *World Politics.* Vol. 61, No. 3, 516-546.

Stanojević, M. (2012) „The Rise and Decline of Slovenian Corporatism: Local and European Factors.“ *Europe-Asia Studies.* Vol. 64, No. 5, 857–77.

Suurna, M. (2011) „The developments in the business models of biotechnology in the Central and Eastern European countries: The example of Estonia.“ *Journal of Commercial Biotechnology*. Vol. 17, No. 1, 84-108.

Utterback, J. M. (1996) „Innovation and Industrial Evolution.“ In Utterback, J. M. (ed) *Mastering the Dynamics of Innovation*. 79-102.

Taylor, M. Z. (2004) „Empirical Evidence against Varieties of Capitalism’s Theory of Technological Innovation“ *International Organization*. Vol. 58, No. 3, 601-631.

Thorhallsson, B. & R. Kattel (2013) „Neo-Liberal Small States and Economic Crisis: Lessons for Democratic Corporatism.“ *Journal of Baltic Studies*. Vol. 44, No. 1, 83-103.

Tõnurist, P (2015) „Framework for analysing the role of state owned enterprises in innovation policy management: The case of energy technologies and Eesti Energia.“ *Technovation*. Vol. 38, 1-14.

Weiss, C. & W. B. Bonvillian (2009) *Structuring an Energy Technology Revolution*. Massachusetts: The MIT Press

Weiss, C. & W. B. Bonvillian (2013) „Legacy sectors: barriers to global innovation in agriculture and energy.“ *Technology Analysis & Strategic Management*. Vol. 25, No. 10, 1189-1208.

Äripäev (2014) „Lõhe riigi ja ettevõtjate vahel nõrgestab konkurentsivõimet.“ Available at: http://www.aripaev.ee/uudised/2014/10/08/lohe-riigi-ja-ettevotjate-vahel-norgestab-konkurentsivoimet (18.04.2015)

Äripäev (2015) „Riik ei saa toimida ettevõtjateta.“ Available at: http://www.aripaev.ee/arvamused/2015/02/12/riik-ei-saa-toimida-ettevotjateta (19.04.2015)

APPENDIX A: List of interviews and responses

List of interviews conducted by the author specifically for this paper:

Interview A. Employee of the Information Technology Foundation for Education. Audio recording. 27.04.2015.

Interview B. Employee (1) of the Ministry of Economic Affairs and Communications. Audio recording. 28.04.2015.

Interview C. Employee (1) of the Ministry of Education and Research. Audio recording. 29.04.2015.

Interview D. Employee of the Union of Electricity Industry of Estonia. Audio recording. 30.04.2015.

Interview E. Employee (2) of the Ministry of Economic Affairs and Science. Audio recording. 05.05.2015.

Interview F. Employee (2) of the Ministry of Education and Research. Audio Recording. 07.05.2015.

List of responses used in this paper[12]:

Response A. Employee of the Archimedes Foundation. E-mail response. 30.04.2015

Response B. Employee (3) of the Ministry of Education and Science. E-mail response. 21.04.2015

[12] These include electronic letters that were written as responses to the author's requests for an interview. However these responses contained details and explanations, which are empirically relevant for this paper and thus are used in the analysis.

APPENDIX B: Summary in Estonian

ERASEKTORI KAASAMINE TEADUS- JA ARENDUSTEGEVUSE NING INNOVATSIOONI POLIITIKASSE: TEHNOLOOGIAPÕHINE VAATENURK

Käesolev magistritöö uurib ettevõtete kaasamist lähtuvalt poliitilis-majanduslikust struktuurist ja tehnoloogiate arengust tulenevatest vajadustest. Tulenevalt kaasamise kui probleemi aktuaalsest käsitlusest nii Eesti meedias kui ka poliitika dokumentides, sai antud töö puhul oluliseks püstitada kaks uurimisküsimust: (1) Kuidas toimub erasektori kaasamine Eesti teadus- ja arendustegevuse ning innovatsiooni (TAI) poliitikates?; (2) Kuidas erinevad need kaasamisprotsessid energiatehnoloogia, IKT ja biotehnoloogia sektorite vahel? Käesoleva töö teoreetiline raamistik lähtus erinevate kaasamistüpoloogiate konstrueerimisel peamiselt poliitilis-majanduslikust struktuurist tulenevatele erisustele. Siinkohal on kasutatud peamiste teooriatena kapitalismitüpoloogiaid (*varieties of capitalism*) ja diskursiivset institutsionalismi (*discursive institutionalism*).

Siinkohal võttis käesolev töö fookusesse kolm erinevat tehnoloogia sektorit: energia tehnolooogia, IKT ja biotehnoloogia. Antud tehnoloogiate valik tulenes sellest, et tegu on esiteks riiklikes strateegiate mainitud oluliste tehnoloogiatega (näiteks: nutika spetsialiseerumise kontekstis) ning teiseks kuna kõik kolm tehnoloogiat on erinevas küpsusstaadiumis (*level of maturity*). Selleks, et tehnoloogiate küpsusastmest/arengujärgust tulenevaid vajadusi mõista, kasutas käesolev töö tehnoloogiliste trajektooride evolutsioonilist teooriat (*evolutionary theory on technological trajectories*). Sellest tulenevalt kombineeriti tehnoloogiate vajadused/probleemid varasemalt konstrueeritud kaasamise tüpoloogiaga, mille tulemusel oli võimalik teha eeldusi Eesti poliitilis-majanduslik struktuuri võimekuse kohta vastata tehnoloogiate vajadustele.

Meetodika osas on käesolev magistritöö olemuselt kvalitatiivne ning keskendus empiiriliste andmete kogumise pool-struktureeritud intervjuudele ja dokumendianalüüsile. Empiirilist osa on töös käsitletud kahelt tasandilt. Esiteks on tööd käsitletud lühidalt üldise TAI poliitikatesse kaasamise tasandilt ning teiseks on fookusesse võetud kolm riiliku tehnoloogiaprogrammi: Eesti energiatehnoloogia programm; Eesti info- ja kommunikatsioonitehnoloogia kõrghariduse ning teadus- ja arendustegevuse programm 2011-2015; ja Eesti biotehnoloogia programm. Siinkohal

võimaldab TAI laiem käsitlus koos spetsiifiliste tehnoloogiaprogrammide käsitlusega võrrelda valitud tehnoloogia valdkondade kaasamispraktikate erisusi.

Empiirilise analüüsi tulemusena leidis töö, et kaasamine toimub kõigis kolmes tehnoloogia valdkonnas informaalse suhtluse teel ning kaasatavateks on enamasti varasemad kontaktid ja pikemaajalised partnerid. Kaasamise põhjuseks on üldjuhul spetsiifiliste ekspertteamiste vajadus seisukohtade (kui ka otsuste) kujundamisel ja/või vaatenurkade ühtlustamine. Käesolev analüüs näitas, et kaasamine Eesti kontekstis erineb ainult minimaalselt tehnoloogia sektorite vahel. Antud erinevust põhjustavad võrgustumise erinevad tasemed tehnoloogia sektorites, kus küpsemad tehnoloogiad on rohkem koondunud erialaliitudesse kui vähemküpsemad tehnoloogiad. Riiklike tehnoloogiaprogrammide puhul oli kaasamine samuti ühetaoline ning otsesed seosed tehnoloogiate erinevast küpsusastmest tulenevate vajadustega puudusid. Käesolev magistritöö leiab samuti, et Eesti poliitilis-majanduslik struktuur põhjustab olulisi probleemkohti ja väljakutseid energia tehnoloogia, IKT ja biotehnoloogia arendamisel. Selle tulemusena, Eesti senine ühetaoline kaasmispraktika TAI poliitikate puhul ei ole võimeline toetama tehnoloogiate arengujärkudest tulenevaid spetsiifilisi vajadusi.