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INNOVATION AGENCIES REVISITED: THE CASES OF SITRA, FRAUNHOFER, DARPA AND BNDES

Master's thesis

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I hereby declare that I am the sole author

of this master's thesis and it has not been

presented to any other university for examination.

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Abstract

Although the cases of Sitra, Fraunhofer, DARPA and BNDES have been extensively examined, there are no articles analysing these cases in terms of autonomy, decision making practices and human resource management and at the same time bringing out the effects of the current techno-economic paradigm and comparing the cases from Weberian point of view. These are interesting points to explore because all of the chosen cases are often seen in both academic and policy circles as outstanding success stories. This paper is built on presumption and supported by literature that classical innovation agencies are strong powerful Weberian organisations that are located in the centre of a public administration system. After analysing the cases of Sitra, Fraunhofer, DARPA and BNDES, the thesis reveals that there is no single practice in terms of autonomy and central-peripheral positioning, however it was clearly apparent that all of the cases have highly decentralised internal decision making processes and Non-Weberian human resource management systems (except in the case of BNDES that has a clear career and meritocratic recruitment system). Although the results are specific to particular cases, they can serve as best practices and might prove to be helpful also for other innovation agencies.

Keywords: Sitra, Fraunhofer, DARPA, BNDES, autonomy, decision making, human resource management, innovation agencies

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Introduction

The current master´s thesis explores widely discussed cases of Sitra, Fraunhofer, DARPA and BNDES with a novel joint focus on autonomy, decision making practices and human resource management. These dimensions are analysed from the point of view of the current techno-economic paradigm and Weberian practices. These are an important points to explore because there are no papers discussing these issues from a comparative perspective and all of the chosen cases are seen in academic and policy literatures as outstanding success stories.

The structure of the paper is as follows: first of all, theoretical framework is outlined together with two research questions that help to keep the focus of the paper. The main part of the thesis consists of four separate case studies, i.e. Sitra, Fraunhofer, DARPA and BNDES dealing with the questions of autonomy, decision making practices and human resource development in these four organisations. Towards the end of the paper, the answers to the research questions are given in the discussion part of the work that is followed by conclusion and bibliography.

Methodology

The research question(s) should determine the approach – qualitative or quantitative analysis. Experience has shown that frequently method-based approach is used, i.e. method has been chosen and then decided what could be researched in that way. One could say that former example suits the natural sciences. Nevertheless, search for truth is important, not for an easier, more convenient and always practical way out. (Drechsler 2000, 253)

In the current paper object-based approach is used and qualitative method seemed to be the best choice for empirical analysis. Research questions are well fixed together with chosen dimensions, thus there is not much flexibility. The sample is purposeful, i.e. not random because four concrete cases have been chosen for case studies. Yet, it could be argued that if the sample is not random it is not possible to make generalisations. At the same time, this is also not the purpose of the current work. Rather the goal is to bring out information concerning the set dimensions and further discuss on the basis of formulated research questions whether the chosen agencies rather support the notions of classical studies of innovation agencies represented by Johnson (1975, 1982; 1999), Evans (1992; 1995) and Wade (2003) or mainly the findings and suggestions of more recent research into innovation agencies by Breznitz (2007), Breznitz and Ornston (2013) and Zysman and Breznitz (2012).

There are many reasons for choosing qualitative method, including studying the topic in detail and in depth, not searching for complete overview nor identifying the overall general trends. (Patton 2002, 14) All of the chosen institutions are active in the present time. It is quite common in quantitative research that sample with special characteristics (so-called positive cases) is chosen and that is the case also in the paper. (Goertz, Mahoney 2006, 239)

Mainly one method is used for gathering the information and that is the analysis of the documents. The author also managed to conduct several web-based interviews, but only with Sitra. Also other methods were initially taken into consideration, but especially those two seemed to be the most suitable options. There was quite a lot of material available on the chosen cases, both by previous research and by the organisations themselves. Usually their focus was different from the current study, but nevertheless, finding the necessary information was possible. On the one hand, written academic sources already include the knowledge that has been considered as important and therefore brought out. On the other hand, academic and in particular studies by the organisations themselves may suffer from subjective bias in one form or other. Also, all of the interesting articles or materials were not necessarily available. In the current case not only academic sources, but also official homepages and secondary documents proved to be helpful. The second method mostly supported the first one in case of Sitra. The so-called Weberian dimensions – autonomy, internal decision making and human resource management – are relatively little studied, therefore there is a need for detailed information, profound material analysis and deeper overview. Interviews were topical because they focused on specific issues, processes and factual knowledge.

Theoretical framework

In the history of innovation agencies there is a successful and widely discussed case from Japan – the Ministry of International Trade and Industry (MITI) that many authors have used as a starting point or basis for building up a theory. For example, according to Johnson (1982), Japan became an economic miracle thanks to its pilot developmental agency, MITI, that had classical Weberian bureaucratic and context-specific structures and was located at the centre of public administration. That specific structure was needed, according to Johnson, in order to utilise concrete strategy of development, including innovative activities. Key element was professional elite bureaucracy that has become to be associated Weber and his work on bureaucracy. (Weber

1978) MITI had central industrial policy role and only the best people working for the organisation. (Evans 1992, 152) Career in government service was at that time very prestigious and desirable in Japan. (Johnson 1975, 12) Weber suggests an ideal model or a hypothesis of what kind of internal organisation of government offices would be capable of promoting growth and support markets. He was certain that what he called bureaucracy (domination by legal-rational methods with specific features such career system, meritocratic recruitment and promotion, but also strong policy and in particular implementation autonomy) was the best type that supports the growth of the market. (Weber 1978; Evans 1995, 22, 30) As Evans succinctly put it, Weber´s bureaucrats´ main task is to follow their assignments and thus contribute to achieving the goals of the organisation. (Evans 1992, 146, 163) But for the bureacracy to be functioning and effective in achieving organisational goals, insulation (autonomy) from other social actors is needed. In addition, predictable rules are necessary in order to predict individual choices and further organisational outcomes. According to Weber, such concrete organisational structure leads to bureactratic effectiveness. (Weber 1978; Evans 1992, 176-177; Evans 1995, 3, 29, 41) Hereafter such bureaucratic features are called Weberian.

In Peter Evans' classical analyses the Weberian bureaucracy is the point of departure for internal structure. (Evans 1995, 39) Evans further observes that today functioning Weberian bureaucracy is rather in short supply – particularly in developing countries –, therefore agencies that can foster growth should be built around strong Weberian type of internal structures in order to be successful. (Evans 1992, 176) He stayed confident concerning the opinion that meritocratic recruitment, long-term career perspectives, clear hierarchical differentiation, clearly defined set of rules, insulation and autonomy from social actors and collective projects in order to fulfil the goals of the organisation are essential principles to obtain and follow. (Evans 1995, 244) Also Chibber points out similar notion that an autonomous and centralised rule-following bureaucracy is needed for development. (Chibber 2002, 952-953) Johnson as well supports the thought about such bureaucracy and argues that it should not be eliminated. (Johnson 1975, 28) Further, Johnson (1982) pointed out the characteristics of capitalist developmental state and one of the important points was the notion of having a pilot agency that is managed by elite economic bureaucracy. State should be an active player guiding the market and engaging with various social partners. In addition, it is important to make a difference between ruling and reigning to maintain relative autonomy of the state. (Johnson 1982, 309-310) However, he emphasises that Japanese model is not transferable due to long and non-repeatable learning processes. (Johnson 1999, 41)

Wade (2003) makes prescriptions on how governments should act in order to foster economic growth and encourage the competitiveness of industries. One of the prescriptions includes establishing a pilot agency that is central, unified and would steer the respective policies. This agency should have a fairly small staff, employees should be the best people available, have a sense of national mission and again follow the principles of Weberian bureaucracy. Agencies should also have operational goals and analyses how policies affect the goals. (Wade 2003, 33, 371-372) Sine *et al* (2006) make a similarly affirmative point that Weberian bureaucratic organisational structure is again relevant especially for new ventures because they are already very flexible and established in accordance with the environment, but often have left basic bureaucratic principles behind that if applied could indeed boost the performance, lower coordination costs and increase specialisation. (Sine *et al* 2006, 129-130)

However, there is an almost completely recently emerged opposing view supported mainly by Breznitz. Thus, Breznitz and Ornston (2013) argue that innovation based experimentation that fosters country´s development and growth is not so likely to occur in such central Weberian style organisation as argued by previous generation of researchers who mostly based their findings on East Asian cases, but rather at the periphery of the public sector. This argument is supported with their two case studies: Finland (the same case will be also analysed later in the paper) and Israel. The findings revealed that indeed such agencies that have fewer resources and less prestige are not influenced so much by the political communities and thus are more likely to engage in radical innovation type of activities. (Breznitz, Ornston 2013, 1221-1222) Central positioning may in contrast to opinion shared by Johnson (1975; 1982; 1999), Evans (1992; 1995) and Wade (2003) decrease innovative activities through greater political interference that reduces flexibility. This is the case, according to Breznitz and Ornston, with Finland and Israel as well because the agencies (Sitra in Finland and Office of the Chief Scientist in the Israeli Ministry of Trade and Industry) were initially highly successful as peripheral agencies that have become less flexible over the recent years as their profile and thus centrality within the government increased. (Breznitz, Ornston 2013, 1227-1228) The notion also supports another case analysed in the paper, DARPA, that is considered very flexible and innovative and at the same time is not at the centre of public administration having relatively low political profile. (Whitford & Schrank 2011, 279)

At the same time, the agencies that are not situated at the core of the public sector have three main innovation encouraging characteristics as observed by Breznitz and Ornston (2013). First, as already stated earlier, those agencies are less targeted by political influence, less vulnerable to

lobbying and other possible outside effects. In that sense, they are more able to experiment and feel free in their actions. Secondly, in a process of experimentation they usually try to develop alternative ways of working and do so with collaboration of various partners. Thirdly, again with reference to their political profile, alliances with rather non-traditional partners will be established that once again supports the so-called "out of the box" thinking away from the ruling paradigm. Namely, these agencies would be the ones who promote radically new science, technology and innovation policies. (Breznitz, Ornston 2013, 1224-1227)

Essentially the argument is that since innovation based industries operate in a highly uncertain environment and conditions it is not applicable to use the long-term planning approach. Innovation means that something new is brought to the market, therefore markets and products are not known and it is not possible to plan it in detail and fix the conditions in advance. (Breznitz, Ornston 2013, 1224-1225; Breznitz 2007, 5, 15) Zysman and Breznitz (2012) bring out many changes that have taken place over the last decades such as intensification of global competition and increased effects of information and communication technology (ICT). (Zysman, Breznitz 2012, 130, 133) These fundamental changes in technological development have been researched extensively; for instance, Carlota Perez (2006) provides insights into what she calls techno-economic paradigms. According to Perez, there have been five techno-economic paradigms over the past 200 years and right now we are living in the fifth one, i.e. in the age of ICT that aas also stressed by Zysman and Breznitz, among many others. (Perez 2006, 35-36) Such long term views on technological development either assume implicitly or in fact argue explicitly that the world has been transformed – or is transformed periodically every 50-60 years – and thus also innovation agencies change and, more specifically that Weberian-type management is not applicable to rapid innovation based industries. (Breznitz 2007, 5) Economic activities have experienced huge changes in nature and composition since the 1970s. Dunning states that if the main source of wealth used to be natural resources, after that, tangible created assets then now we have come to an age where intangible created assets (knowledge) bring wealth. He also suggests that the present stage of capitalism could be called alliance capitalism because firms do a lot of cooperation in order to share costs, gain knowledge, to speed up innovation, to promote asset-augmenting or asset-exploiting activities. Markets have gone through liberalisation and communication between different countries is becoming increasingly easier and cheaper. (Dunning 2002, 8-12) The production has fragmented, at the same time, according to Porter (2000), clusters emerge that are geographically proximate groups where various actors, including firms, universities, Research and Development (R&D) institutions,

presenters of state power and financial institutions, belong. (Porter 2000, 254) Arthur has said that it is possible to predict even future of technologies based on clusters. (Arthur 1994, 7)

It should be noted that nobody today can successfully function in a vacuum and more importantly, innovation is usually understood as a non-linear and multidisciplinary process that is not happening in isolation and is mostly concerned with interaction between organisations and institutions. (Woolthuis *et al* 2005, 609) Therefore, probably needless to say, environment plays a significant role and in order to be successful the characteristics of the respective surrounding environment have to be taken into account in daily operations. Such arguments seem to suggest that Weberian autonomy and insulation of innovation agencies may not be as relevant anymore.

In contrast to Johnson (1982), Breznitz (2007) argues that in case of innovation-based industries strategic planning by the state is not useful and in the era of global production networks the products are not manufactured by vertically integrated large firms. Instead of long-term planning, there should be a flexible structure in order to react quickly in a highly uncertain and constantly changing environment. Thus, the ideal type Weberian bureaucracy is no longer desirable in innovation agencies. Breznitz suggest a new model with less Weberian bureaucracy and more independence from the state. At the same time agencies should operate in close relationship with the industry, possess expert knowledge and skills. In addition, innovation agencies should be able to react quickly to changes and have more differentiated and flexible human resource management system. (Breznitz 2007, 14-17, 32) To support the ideas of Breznitz, it is relevant to bring out Burns and Stalker (1961) distinction between organic and mechanistic organisations. Their concept supports the thoughts of Breznitz in a sense that in terms of turbulent environment Burns and Stalker suggest less formally defined tasks and more focus on horizontal coordination that enables to cope better in dynamic environments. (Burns, Stalker 1961) In the line of such arguments, one can argue that Weberian bureaucracy is a more mechanistic structure that is more suitable for static environments. Of course, the central idea of Breznitz in not to indicate that all peripheral agencies would do better in terms of radical policy and that there are many different models, not just one that could lead towards the success. (Breznitz 2007, 209) In essence, he argues that what innovation agencies need is not anymore central strongly Weberian pilot agency *a la* MITI that was well-suited to mass production world of large integrated companies and supplier networks, but rather a diversity of innovation agencies with more flexible tasks, with closer ties to diverse sets of social partners, with some Weberian features (such as strong policy autonomy) and with some new features (flexibility in internal decision making processes and human resource management).

Looking at these two contrasting streams of arguments – Weberian agencies of mass-production era and non- or at least much less Weberian agencies of the ICT era, to put it in a nutshell – it is possible to pose two following research questions or hypothesis that this paper tries to answer:

1) Is autonomy as specialisation (what goals organisation follows) important factor why innovation agencies are successful; more specifically, is autonomy in specialisation more important than central-peripheral location of innovation agencies?
2) How much do changes in nature of technological advances – changes in techno-economic paradigms – matter in terms of internal management structures and human resource development of successful innovation agencies?

The main part of the paper analyses the cases of Sitra, Fraunhofer, DARPA and BNDES. These case studies were specifically chosen because they represent widely discussed outstanding success stories. They are so-called best practice cases. Further, as there is clearly no common type of innovation agency, the chosen organisations also reflect this as they are all fundamentally different in their aims and actions. Finnish Innovation Fund (Sitra) is a public fund acting as a venture capitalist with focus on turning R&D projects into business plans. Fraunhofer in Germany could also be called a technology transfer centre and is the largest application-oriented research organisation in Europe. The Defense Advanced Research Projects Agency (DARPA) in the USA is engaged in high-risk high-payoff R&D projects, but does not do research on its own. Last case is the Brazilian Development Bank (BNDES) that is a state-owned company, structured to promote national development and job creation among Brazilian firms. As all four are different cases, this fact should help to answer the above-mentioned research questions perhaps in richer detail than comparative study of similar innovation agencies.

Following from the discussion above, in what follows three main (Weberian) dimensions are analysed concerning every separate case to find answers to the research questions. First dimension is autonomy that looks at external autonomy, i.e. where the organisation stands in terms of institutional landscape (central-peripheral location) and internal autonomy, i.e. autonomy in specialisation meaning whether the agency can set its own strategic and policy goals and decide independently upon implementation. Secondly, internal management structures´ part explores the decision making processes, vertical and horizontal differentiation and distribution of authority within the organisation. Thirdly, human resource development looks at how many people are working for the organisation, how are they managed, what are the motives and main characteristics of employees; what are promotion and hiring practices. These three

dimensions were precisely elected because they all represent important aspects in terms of Weberian bureaucracy and thus serve as a basis for discussion in answering raised research questions.

SITRA

Finnish National Fund for Research and Development (Sitra) was first set up in conjunction with and under supervision of the Bank of Finland on 5th of December 1967 to celebrate the 50th anniversary of Finland´s independence.[1] (Ahlqvist 2013, 341) Since the national government needed to find a way how to support emerging companies, Sitra was chosen to allocate public investment funds to solve the problem. Later, in 1991, it was transferred into an independent policy foundation under the Finnish Parliament. (OECD 2006, 43) Creation of Sitra was not an original idea, but imported from Sweden where Riksbankens Jubileumsfond was successfully established. (Breznitz, Ornston 2013, 1230) Sitra is considered to be a key independent intermediary policy implementation organisation in Finland whose one of the main objectives is turning R&D projects into business plans. (Tuunainen 2011, 338-339) Sitra´s responsibilities and tasks are outlined and stipulated in Sitra law. (EU 2010, 69) Through Sitra, Finnish Government has been active for a long time in financing seed and early-stage innovations. (OECD 2011, 114) Ahlquist and Moisio (2013) further bring out providing state with advice and initiating systemic changes as some of the other important tasks of Sitra. (Ahlquist, Moisio 2014, 40; also Institutional Mapping of Finland's National System of Innovation, 5)

Sitra´s position within the institutional landscape and autonomy

Sitra plays an important role within the Finnish institutional landscape because many authors consider the national economy to be dependent on innovation. Moreover, since business-driven innovations are quite rare it has become an essential entity of how to turn R&D projects into real business plans that could be eligible for receiving investments. Since many young and fast-growing companies might not yet have access to institutional lenders (e.g. banks and insurance companies), venture capital firms are one possible answer to the problem. It is a well known thought that a pure idea itself does not automatically stand for an economic success.

[1] "Sitra' is an acronym crafted from the Finnish title that can be directly translated as 'A jubilee fund to celebrate the independence of Finland'." (Ahlqvist 2013, 341)

Implementation is the key followed by introducing the product to the market. (Taatila *et al* 2006, 312–313, 320)

According to Utterback, there are three phases of technological development – fluid, transitional and specific phase. Throughout the entire development, product and process innovation are interdependent, i.e. if product innovation decreases then process innovation increases respectively. (Utterback 1996, 83, 92) Sitra steps in usually in the fluid phase that is technologically highly uncertain, processes time-consuming and expensive. External advice and financing opportunities are crucial for innovators especially in that first stage. (Varis, Littunen 2010, 144) Already in the transitional phase process innovation is playing increasingly bigger part that marks an end to radical innovation because it is getting increasingly more expensive and harder to make big changes, so the focus is on incremental innovation. In addition, needs of the consumer are getting more clear and companies understand better what they need to produce. It could be said that Sitra helps companies through the fluid phase and in the transitional phase the business plan has usually already emerged. The last phase is specific phase where a very specific product is produced with high efficiency and low costs. (Utterback 1996, 95-96)

Therefore, Sitra in essence acts as a venture capitalist that distributes capital between providers and entrepreneurial companies. (Sapienza *et al* 1994, 4) To follow the thought of Sitra acting as a venture capitalist, some main features can be brought out. For example, one of them is active involvement in managing the firm. (Bertoni, Randone 2004, 64) After making an investment in the company, a representative is placed on the Board of Directors, so that Sitra can constantly keep an eye on developments and have direct communication with the company. (Tuunainen 2011, 343) Also advisory activities are important for the survival of the company and for its overall success. (Bertoni, Randone 2004, 64) In that case Sitra is active as well providing advisory services in business and investment analysis, and in fund structures. (Sitra 2014a) Besides defining Sitra as a public intermediary foundation and venture capitalist, it is a hybrid state organisation that operates partly like a think–tank and partly like a fund. It has considerable autonomy in opening new initiatives. Especially from the mid-2000s, Sitra has been initiating important strategic systemic changes in Finland that until today remain as the core agenda of Sitra. (Ahlqvist 2013, 334-335)

There are various categorisations and thoughts how to locate Sitra within the institutional landscape. OECD findings place Sitra to the category of public venture capital organisations together with two other public organisations: Start Fund of Kera Ltd and Industry Investment Ltd. (Institutional Mapping of Finland's National System of Innovation, 5) Varis and Littunen

(2010) in their quantitative study place Sitra to the financial organisations for innovation in Finland together with Tekes (The Finnish Funding Agency for Technology and Innovation), SME Foundation, The Foundation for Finnish Inventions, Finnvera, and The Regional Council of Northern Savo. (Varis, Littunen 2010, 135)

From the autonomy point of view, one OECD paper by Tuunainen (2011) names Sitra as a form of public foundation that acts under the direct supervision of the Finnish Parliament. (Tuunainen 2011, 340) Another OECD paper by Numminen (1996) presents the structure of public sector R&D in Finland allocating Sitra as an independent public fund under supervision of the Parliament Trustees of the Bank of Finland. (Numminen 1996, 6-7) Thus, Sitra is a unique public organisation in a sense that although it is under supervision of the Finnish Parliament, it is free from governmental control. (Jaalivaara web-based interview 2014) It does not belong to any of administrative sectors of the Government of Finland and makes its own investment decisions that are approved either internally or by its Board of Directors depending on the size of investment. (Marttila web-based interview 2013, 2014)

Sitra has a complete independence and autonomy in creating and delivering new activities because there are no political constraints or budgetary delays since operations are funded with endowment capital and operative financing activities (EU 2010, 70; Sitra 2013a, 9) Although funding from the governmental side is possible, then according to Sitra´s Head of Legal Affairs, Jorma Jaalivaara, it is very rare and has not happened during the last 15 years. (Jaalivaara web-based interview 2014) Thus, on the financial basis it is autonomous, i.e. not funded from taxes or from the state budget and that enables to operate through multiple channels, i.e. setting up projects, designing policy processes, publishing reports and as stated previously, transforming inventions into innovations or ideas into businesses. (Ahlqvist 2013, 334-335; Jaalivaara web-based interview 2014; Sitra 2014b)

Since Sitra acts directly under the auspices of the Finnish Parliament, it has to submit an annual report on its operations to the parliament. (Sitra 2013a) There have been opinions that Sitra has become politicised. While it was supervised by the Bank of Finland until 1991 it did not have much contact with political interference. After 1991 Sitra´s strategy has been affected by political community and focus on social problems such as health care and municipal reform have been the results of political influence. (Breznitz, Ornston 2013, 1230, 1234, 1246)

Parliamentary Trustees of the Bank of Finland act as the Supervisory Board of Sitra. This Supervisory Board elects the Board of Directors and the President of Sitra, also approves the

strategy. Auditors from the parliament side audit annually Sitra´s accounts, financial statements, administration and annual report. For that time members of the Board of Directors and President are discharged from liability. (Sitra 2013a, 31; Marttila web-based interview 2013, 2014) The Supervisory Board has stated that Sitra´s finances are stable and operations well managed.

Structure and decision making

In 2012 Sitra went through a major reform that changed the content and functions of the organisation. More specifically, from 2004 until 2012 Sitra was operating in a fixed-term programme-oriented way that was not sufficient any more. A reform in organisational structure and specialisation was proposed by the management team of Sitra and decided by the Board of Directors to make a shift towards a project- and theme based organisational model that runs as a matrix organisation. New structure and specialisation on themes has already arguably provided greater reactivity, clarified the link between strategy and day-to-day operations, plus shown more efficient time and resource management concerning specific topics. (Sitra 2012, 6)

Matrix management or structure stands for an organisational arrangement where functional and divisional parts have equal powers. It is risky, hard to maintain and needs very good communication and information flows in order to survive. In case of Sitra, one line is managed by projects and another managed by themes, thus workers have to be responsible to both – project and theme managers. However, as stated above, this kind of structure has been working for the organisation and there is no current need for further changes. It could be said that Sitra in terms of organic vs mechanistic organisation, tends to move towards organic because not all of the tasks are formally and in detail described and emphasis is more on horizontal coordination instead of focusing highly on vertical hierarchical relations. (Sine *et al* 2006, 121) Thus, Sitra is not a typical hierarchical organisation and has acknowledged the challenges of constantly changing environment and pays attention to flexibility and responsiveness to changes.

In 2011 a procedural reform was launched and in May 2012 the reform came into action with only three broader themes remaining: empowering society; resource-wise and carbon-neutral society; and practices for sustainable well-being and employment with their practical initiatives grouped under eight key areas that at the same time stand for specialisation fields in the organisation. The purpose of the first theme is to create efficient public administration, also to encourage society to take more responsibility while promoting businesses that could solve social problems. The second theme, resource-wise and carbon-neutral society, promotes green

economy and third, practices for sustainable well-being and employment, stands for, as the name is saying, sustainable businesses and practices. (Sitra 2014b; Sitra 2013a, 6-10; Marttila web-based interview 2013; 2014). Thus, instead of having various separate programmes as before 2012, Sitra now works with specific themes and key areas that keeps them focused and bring closer to their vision. Key areas stand for practical projects with usual length of approximately two years putting strategic objectives into practice. (Sitra 2013a, 9) Sitra´s Board Report of 2012 brings out effectiveness as their main operating focus together with its continuous monitoring. Work is done in a target-oriented way. (Sitra 2014c) People working with the themes are responsible for the performance management of the key areas. (Sitra 2013a, 10)

Sitra´s goals are stated in their strategy, but not all of the strategy is visible to the public. The strategy is generated together by Sitra´s staff and Board of Directors. Strategy is constantly developed and updated bringing in new content and focus points of the three themes and eight key areas. (Sitra 2013a, 9) Concrete policy goals as well as principles how the goals and tasks should be implemented are initiated and proposed by the management team of Sitra. The Board of Directors of Sitra decides which of those goals will be implemented and followed. (Marttila web-based interview 2013, 2014) Currently, Sitra´s Board of Directors that could be named as the most important decision making body consists of six persons: one permanent under-secretary, two permanent secretaries, two professors and Sitra´s President. The Board of Directors takes also social responsibility issues into account while making the decisions in order to make responsible investment of the endowment capital. (Sitra 2013a, 7, 14)

Human Resource Management

It is important that Sitra's employees have reasonable autonomy and certain degree of freedom concerning their actions. (Heiskanen, Heiskanen 2011, 114) Sitra cannot be imagined to operate as a rigid hierarchical organisation due to the nature of tasks and need to react quickly to the changes. In 2009 Sitra employed 115 people. During that year many personnel events were organised with focus to share know-how, train people in communication skills and introduce new enterprise resource planning system. (Sitra 2010, 17) In 2010 the number of workers remained at the same level (116 people) from which approximately 40% were employed under a fixed-term employment contracts. Sitra created strategic, financial and human resources indicators, i.e. a steering panel, to compile feedback on personal resources of the staff and cooperation between individuals as well as units. Later the data from the survey was used as a

key element in development discussions. (Sitra 2011, 16-17) At the end of 2011 Sitra had 115 employees. Five main competencies were identified that all of the employees must have and they are kept in mind in recruitment and development discussions. (Sitra 2012, 16) At the end of 2012 there were 106 employees working for Sitra and quite a substantial number of workers are still there for a fixed-term employment relationship making up a high personnel turnover. The number is over 30% of the employees and it is because of the nature of the tasks being undertaken in fixed-term key areas and projects. (Sitra 2013a, 14-15) Today, Sitra is a team of 110 domestic and international specialists of whom about 70% hold a university degree.

Therefore, majority of the employees at Sitra can be characterised as having a university degree and solid previous work experience. Since changes occur constantly, people working there need to be in possession of such basic skills as adjusting quickly to new situations, be goal-oriented and responsible for their actions, besides having such necessary skills as good communication skills, networking skills and expertise in a given field. Every employee has his or her personal development goals together with Sitra goals that are updated every six months. (Sitra 2013a, 14-15)

At the beginning of each year, Sitra employees give formal feedback about Sitra´s leadership and its component areas to their supervisors. Development discussions take place where supervisors depending on discussions set development goals with their own supervisors. Also, at the beginning of each year the attainment of the goals that were set a year ago are evaluated in hope to make procedures and processes more effective as well as human-friendly. (Sitra 2013a, 15) Sitra´s vision and goals are kept in mind by employees while doing their everyday work.

Sitra's case can be summed up as follows: first, in terms of autonomy it has very high policy autonomy (legally defined) and it is one among many innovation agencies in Finland (semi-peripheral, but quasi-Weberian); second, internal management is fluid and decentralised matrix management with high project turnover which leads to, third, also to high turnover, with 30% of the staff doing contract based. Thus neither internal management or staff show Weberian elements.

FRAUNHOFER

Fraunhofer as an innovation agency is an outstanding success story to illustrate the case of Germany. Organisation´s name comes from a noted German researcher, entrepreneur and inventor Joseph von Fraunhofer and organisation´s full name is Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V., further in the paper just referred to as Fraunhofer. (Thum, Schraivogel 2009, 36–37; Statute of the Fraunhofer-Gesellschaft 2010, 2) Fraunhofer was founded in March 1949 in Munich as a non-profit organisation with mainly administrative function – raising funding for allocation to industrial research projects. Research funding was granted in 1951 when Fraunhofer had only three employees. At the beginning years of Fraunhofer, applied research was seen as unscientific, thus due to a bad image and struggle for survival it was in crises about five years after the initial foundation. (The long road to Fraunhofer´s success 2009, 6) Nevertheless, it did not remain so and in 1959 there were already 130 people working for the company, Fraunhofer boasted nine Institutes of its own and considerable revenues were earned. (Fraunhofer 2004, 4) Another five years later, all together 19 Institutes were established with staff of more than 700 people. For the 25th anniversary Fraunhofer had expanded remarkably with over 1700 employees and earning over 100 million marks of revenue for the first time. Year after year generated business volume and number of people working for the organisation have risen notably until today as being the largest application-oriented research organisation in Europe with over 23 000 highly educated and qualified workers who see themselves as the shapers of the future. Currently it maintains 67 Institutes and research units working in close association at 40 locations in Germany, plus has research centres all over the world – in Europe, USA and Asia. (Thum, Schraivogel 2009, 8-35; Fraunhofer 2014a; Fraunhofer 2014b) Fraunhofer is seen as a good innovation engine for business and industry not only in Germany, but also in other European countries. (Thum, Schraivogel 2009, 8, 35) There is a network of industrial players, other research institutions, universities, etc who together form a great force in order to assure the strength of research. (Fraunhofer 2014c) Research activities that take place in Fraunhofer Institutes are decentralised in order to promote creative solutions. (Imbusch, Behlau 2003, 6) The main purpose is to underpin scientific work that useful innovations for society could emerge. Rosenberg (2004) sees innovation as major force in economic growth. (Rosenberg 2004, 1) Thus, Fraunhofer also tries to encourage economic growth, promote employment and structural evolution.

Fraunhofer´s position within the institutional landscape and autonomy

Each country has its specific context where organisations, businesses and public administration develop. The context sets boundaries, but at the same time depending on the level of development and timing, it may serve as a facilitator and booster. Freeman (1995) states in his paper that Germany managed to develop one of the best training and technological education systems in the world that serves as a foundation also today. Thus, in case of Germany, the context has been rather friendly and supported the development of Fraunhofer and applied research. German National Innovation System is considered to be comparatively strong within Europe and has a large number of intermediaries, including Fraunhofer. From the biggest research organisation in Germany, Fraunhofer performs the task of applied/contract research, while there are other actors like Max Planck Society and Helmholtz Association that performs basic research and Leibniz-Association that is engaged in different objectives ranging from long-term research to services for other institutes. One of the strengths of German National Innovation System is considered to be the relatively strong and clear differentiation between public and private actors and between research organisations and societies whereas in many other European countries the distinction of division of labour is not as clear. (Stehnken 2010, 16, 27) Fraunhofer has actually many roles that can indeed create confusion, but first of all it could be characterised as a research institution for R&D activities: application oriented research, also application oriented basic research and departmental research for the German Federal Ministry of Research. In addition, it carries the role of inventor because many inventions have become successful originating from Fraunhofer, e.g. mp3 music format and white LED. Last but not least, Fraunhofer is an entrepreneur with a research volume of €2 billion annually and its Institutes are working as profit centres. (Basedow 2013, 5-6) One of the important aspects concerning Fraunhofer activities is also the case that it has managed to combine two sides of R&D: scientific thoroughness and practical relevance together with implementation thus creating a balance and a symbiosis between science and entrepreneurship. (Thum, Schraivogel 2011b, 9-15)

Fraunhofer stands at an important place within the German institutional landscape acting as one of the key members of the scientific community. It has even said about itself that “Fraunhofer is a fixed element in the German research landscape.” (Fraunhofer 2014d) Fraunhofer is neutral, independent and autonomous actor who has full right to define its own strategic goals on which research activities are built. However, strategic directions are guided by national and European economic and research policies. (Fraunhofer 2014e, 6; Fraunhofer 2014d) Strategy planning takes place in a top-down as well as bottom-up manner. The corporate strategy is formed top-

down, group strategies lie in the middle and Institute strategies bottom-up. (Basedow 2013, 27-28) Institutes decide upon the research fields on the basis of information they gather from structures processes that help them to identify the demands on the market. (Fraunhofer 2014f)

Through its task of transforming scientific ideas into useful innovations and keeping its focus on practical long-term commercial results it boosts the economic growth and employment as being an engine of innovations for first of all Germany as well as for Europe. (Imbusch, Behlau 2003, 10; The long road to Fraunhofer´s success 2009, 6; Germans mobilise basic science for innovation 2004, 130-131) Usually there are not so radical innovations being introduced, rather incremental changes occur. This is not necessarily negative because unlike the case of DARPA in the USA discussed later in this paper, Fraunhofer is concentrated on widespread development. They turn attention to health, environment, security, energy and many other crucial sectors that affect everyday lives. (Fraunhofer 2014a) It is not a secret that Fraunhofer is a successful agency that has earned governments´ as well as industries´ trust. Nevertheless, it has not happened overnight, but is the development, decisions and actions that have been made for more than 60 years. (Thum, Schraivogel 2010, 16)

Autonomy also depends on funding and two thirds of Fraunhofer´s budget is made up from contracts with industry and publicly financed research programmes. (Cuhls *et al* 2012, 235) Remaining one third comes through the German Federal Ministry of Education and Research (90%) and the 15 host Länder ministries and government departments (10 %) as institutional funding in order to have the opportunity to work with the issues that will become relevant only in a longer period of time. (Thum, Schraivogel 2008, 17; Thum, Schraivogel 2011a, 25) Self-regulating financial model of the Institutes consists of a basic funding and industrial revenues. In case the contract research revenues make up 22-55% of their budget, Institutes get higher share of basic funding. Thus, it useful to operate within that corridor – it creates a certain competition between the Institutes and strengthens the competitiveness of individual Institutes. (Cuhls *et al* 2012, 235)

Structure and decision making

Some of the best practices of Fraunhofer include high level of independence of Fraunhofer´s 67 research centres meaning that each of them can establish their own strategy and priorities. Centres are also connected to one another and cooperate with many partners from business, universities and industry. Fraunhofer model allows high degree of specialisation and the centres

are divided into seven research topics standing for their area of expertise. (Fraunhofer-Gesellschaft Germany 2014) Thematically oriented research groups are the heart of Fraunhofer´s specialisation as they perform the main task, i.e. research of practical utility in close cooperation with the industry and the public sector. They provide the customers with an end–to–end system solutions coming from a single source. (Fraunhofer 2014g) Looking at the expenditure and project revenue, the largest group is Materials and Components, followed by Microelectronics, ICT, Production, Defence and Security, Life Sciences and Light and Surfaces. (Thum, Schraivogel 2011a, 22-24; Thum, Schraivogel 2013, 14, 23-26)

Fraunhofer enjoys the ability of fast and flexible networking with a focus on the market. Organisation´s activities are guided by the economy thus the skills of responding quickly to the market developments and latest technologies are essential for continuing success. (Thum, Schraivogel 2011b, 48, 52-53) Due to the decentralised nature of research activities, Fraunhofer has managed to react quickly to changes in the environment. (Imbusch, Behlau 2003, 6-7; Fraunhofer 2014f) Many leading people of Fraunhofer have stated that 2008 crisis opened a lot of new opportunities making the whole organisation even stronger. (Thum, Schraivogel 2011a, 10) Within decentralised organisational structure there is centralised control mechanism as without it managing such a big international research organisation would not be the same. (Fraunhofer 2014g)

Fraunhofer scientists are highly specialised, but at the same time have to be familiar with a broad spectrum of a research field. It is not unusual that several institutions cooperate in order to develop interdisciplinary system solutions. (Fraunhofer-Gesellschaft 2014) Fraunhofer model involves the success factor for its customers, for its staff and for the region (Germany as well as Europe on the whole) (Thum, Schraivogel 2011b, 11)

Concerning the decision making process, we have to start with the General Assembly that consists of the members of Fraunhofer (executive as well as ordinary employees) and is responsible for electing the members of the Senate and approving the Annual Report. (Fraunhofer 2014g; Statute of the Fraunhofer-Gesellschaft 2010, 10) The Senate of the Fraunhofer gathers approximately 30 eminent distinguished individuals from the world of science, business, industry and public life and their duration of service is maximally three years. Their main responsibility is connected to making decisions about basic science and research policy, also planning research activities, financial plans and establishing the budget. In addition, it is responsible for decisions concerning establishment, incorporation or devolution, merger and dissolution of research entities that belong to Fraunhofer and electing members of the Executive

Board. (Fraunhofer 2014g; Statute of the Fraunhofer-Gesellschaft 2010, 12-14) It could be said that the Executive Board is the most important body in the organisation. Currently consisting of a president and two senior vice presidents it stands behind the basic principles of Fraunhofer implementing its scientific and research policy, plus takes part of decisions on expansions and finances. Individual Institutes are relatively much affected by the Executive Board because it decides upon distribution of funds amongst them and appoints the directors for each Institute. (Thum, Schraivogel 2011a, 8; Fraunhofer 2014h) The Executive Board may have up to five members from whom at least two have to be qualified scientists or engineers. They are appointed for a five year term in office. Managing business activities is the main responsibility for the Executive Board together with implementing planning and policy decisions, supervising and coordinating the work of Institutes and Working Groups. (Statute of the Fraunhofer-Gesellschaft 2010, 16-20; Basedow 2013, 21)

Fraunhofer governance model is highly decentralised giving a lot of autonomous powers to individual Institutes that have the right to set strategic and scientific priorities within the budget and Fraunhofer´s general strategic scope. The corporate policy is actively shaped also by the Institutes through the steering committees as well as chairs of the groups. (Thum, Schraivogel 2012, 22) Institutes are responsible for their budgets and once they get the financing they have to manage the budget themselves. (Fraunhofer 2014g) Institutes can make their own short-term decisions about contract research activities. The Institute Management manages their own business activities, draws up plans about scientific work and concerning the budget, plus feels free to organise their own scientific projects within the planned budget. (Statute of the Fraunhofer-Gesellschaft 2010, 24-29)

Presidential Council is formed from the members of the Executive Board together with the spokesmen of the seven research areas. They have a right to be part of the Executive Board decision making processes – make proposals and recommendations. (Fraunhofer 2014g, 2014i; Statute of the Fraunhofer - Gesellschaft 2010, 21)

Scientific and Technical Council acts as an internal advisory body consisting of nine members: directors, senior management and elected representatives from staff whose tasks include providing advice to the Executive Board and other constituent bodies concerning important issues, but their advice is not mandatory to follow. Another important aspect is the task to assist the Executive Board in coordinating the Institutes´ research activities. (Statute of the Fraunhofer-Gesellschaft 2010, 22-23) Besides internal advisory bodies there are external bodies that are part of the Institutes and have representatives from science, industry, business and public life. Their

main task is to provide advice to the directors of the Institutes and the Executive Board on issues such as research orientation and structural change. (Fraunhofer 2014g)

Human Resource Management

Fraunhofer is considered to be one of the most attractive employers in the country (at Randstad Awards 2012 received 1st place as the most attractive employer amongst 150 major German companies) and some of the factors affecting the opinions include personalised career development and training, especially management training and close network as a working environment. (Thum, Schraivogel 2011, 31; Thum, Schraivogel 2013, 30) Work at Fraunhofer Institutes is different from university institutes in a sense that the research is oriented towards industry requirements and practical applications. (Thum, Schraivogel 2011b, 9)

A large amount of responsibility is delegated to workers, so they are allowed greatest possible freedom to deal with the tasks creatively and responsibly. Equal opportunities and transparency are taken into account while making decisions. (Fraunhofer 2014e, 4) Fraunhofer supports the development of its workers professional and personal skills so that they could move up concerning the positions within the Institute or in other scientific institutions. (Thum, Schraivogel 2008, 17)

Due to the growing demand of research work and need to meet the growing complexity of technology, the amount of qualified staff working for Fraunhofer has increased every year. It should be noted that the number of employees has constantly grown and since 2008 the number has changed from 15 000 people to over 23 000 by the end of 2013. (Fraunhofer 2014b) More employees stand for greater possibility to handle larger number of research projects. (Thum, Schraivogel 2013; Fraunhofer 2014i) About two thirds of the staff is made up from scientific, technical and administrative staff, one third is graduates and students, plus considerable amount of apprentices. From scientific, technical and administrative personnel that in numbers was 15 220 in 2012, 51,64 % of them were working on a fixed-term contracts. The number of staff working fixed-term has constantly been rising and one of the purposes is to facilitate the so-called brain transfer of passing technological know-how to other industries and organisations. (Basedow 2013, 8, 14 - 15) Because of Fraunhofer´s outstanding reputation people who choose to leave Fraunhofer are very highly valued in the industry because besides scientific excellence these people usually possess problem-solving skills, wide spectrum of knowledge and

experience. There is a statistics that 80% of the people who leave Fraunhofer get highly qualified jobs afterwards. (Fraunhofer 2014j)

There is also a high demand of junior research scientists thus Fraunhofer sometimes even recruits at a high school level. Young scientists are of great importance for Fraunhofer, so there are several programmes initiated in order to tackle the problem of insufficient supply of people in the fields of mathematics, IT, natural sciences and technology. For example, Fraunhofer Talent School gives an opportunity to young people to see the work of real scientist and even work with them. Another initiative is Fraunhofer Attract excellence stipend programme designed for external researchers who want to test their ideas at Fraunhofer. The stipend includes a budget of €2,5 million for five years with a group of three to five co-workers to develop market-oriented products from initial ideas. (Thum, Schraivogel 2011, 30; Fraunhofer 2014k)

Individual members of staff meet regularly with the management to discuss their development and goals. (Imbusch, Behlau 2003, 8 - 9) Each member of the staff goes through a personal assessment interview that is performed by a management staff to evaluate professional aims and personal development. Besides the formal interview, there are informal feedback mechanisms such as information exchange and progress reports. Fraunhofer´s mentoring programme is part of the personal development where senior staff offers direction and suggestion to more junior colleagues. (Fraunhofer 2014l; 2014m) As workers are Fraunhofer´s primary and most important asset, organisation tries to keep them motivated, for example, each year a selected scientist from Fraunhofer receives the Fraunhofer Prize Award. Employees at the Institutes have an opportunity to pursue postgraduate work that would eventually lead to a doctorate. (Fraunhofer 2014j; 2014n) High priority of the work-life balance creates extra flexibility for workers having part-time and teleworking agreements, plus opportunity of taking sabbatical leave. (Fraunhofer 2014m)

When searching for new people and recruiting, Fraunhofer usually tries to find them from existing staff. Thus, at first, existing members are always offered to fill in the new position and take the responsibility. However, sometimes there is a need to look from the outside, e.g. if some field has expanded and internal staff is unable to cover the position. (Fraunhofer 2014j) Recruiting and working conditions are however a challenge for Fraunhofer because first of all, Germany lacks qualified natural scientist and engineers to develop tomorrow´s new technologies. (New Jobs at Fraunhofer 2008, 5) Secondly, additional remuneration that Fraunhofer is able to offer is too low compared to other positions in the industry. Also, administrative staff has no possibility of getting any bonuses. (Thum, Schraivogel 2011a, 32;

Thum, Schraivogel 2012, 31) However, equal opportunity policies are kept in mind while recruiting new people. (Thum, Schraivogel 2012, 31) Quality of results is attained and improved by the diversity management teams that consist of well-balanced and thoughtfully chosen mix of members who complement each other by different sex, age, cultural background and scientific disciplines. (Fraunhofer 2014m)

Fraunhofer's case can be summed up as follows: first, in terms of autonomy it has very high autonomy (legally defined) and it is clearly the central applied research institution in Germany (thus a central and Weberian innovation agency); second, internal management highly decentralised between diverse institutions with clear overall institutional strategic management; third, while there is a high number of fixed-contract based staff with high turnover rate, there is strong internal and external merit based recruiting which can called a quasi-Weberian human resource management.

DARPA

DARPA fits very well to the US concept of rather liberal entrepreneurial risk-taking radical innovation oriented environment. In order to briefly introduce the history of DARPA, it is essential to start with February 1958 when Advanced Research Projects Agency (ARPA) was founded under President Eisenhower in response to the orbiting of the Sputnik satellite. The Department of Defense Directive set the purpose, responsibility and authority of DARPA. (Department of Defence Directive number 1505.15, February 7, 1958) In 1958 a relatively small sized federal agency was a R&D organisation under the Secretary of Defence with obligation to report to the Director of Defence Research and Engineering. (Van Atta 2007, 4; Finkbeiner 2002, 2340; Van Atta 2008, 21) At first the focus was on three key areas: space, missile defence and nuclear test detection. (Van Atta 2007, 3) Already the 1960s defined the infrastructure and management style that has more or less stayed the same until today. Decision to stop its own research and empower programme managers who were usually scientist and engineers from academia or industry were made at that time. (Fuchs 2009, 66) More specifically, during the tenure of Dr. Jack P. Ruina (1961-1963) the management was decentralised together with empowering the Office Directors and programme managers creating almost no hierarchy as it is also today. At the same time, it was not always like that. For example, after official name change from ARPA to DARPA in 1972 and with its new director, George Heilmeier, the organisation

was led by heavy hand focusing more on deliverables and milestones. (Fuchs 2010, 1137-1138; DARPA Directors, 1958-2008 2008) Today, DARPA´s budget is about $3 billion, it has 210 government employees (95 technical managers in 2013), approximately 250 programmes running in seven technology offices and total number of contracts, grants and other agreements exceeding 2000. (DARPA 2013, 13) DARPA is merely a funding organisation, not a research facility. It does not have any labs and as stated, only about 100 programme managers who are basically experts on loans. (Talbot 2001, 44) The main task is to foster advanced technologies and systems that have potential to create revolutionary advantages. (Van Atta 2007, 10; DARPA 2014a)

DARPA´s position within the institutional landscape and autonomy

DARPA is definitely a major player in National Innovation System because it supports risky projects that actually need the support the most; also it has had staggering success (think of its role in inventing the internet). Of course it is not one of a kind in cutting-edge research. In the USA there are, for example, also National Science Foundation and National Institutes of Health, but DARPA differs in a sense that it engages in seemingly far-out research that together with interdisciplinary teams is put into practical use. (Talbot 2001, 44; Wilson 2002, 8; Bovillian, Van Atta 2011, 504)[2] It could be said that without DARPA´s support many revolutionary innovations may not had occurred or did it in another or more slowly way. DARPA performs the task of initial supporter, at the same time not being afraid of risky business that in the end likely turns out to be great radical innovation. DARPA is idea-driven and outcome-oriented and the aim is not to pursue science *per se*.

One not as formal as some other explanations behind the success is considered to be the ability to constantly re-invent itself. (Van Atta 2007, 9) The thought is also present in Albert Hirschman works where he uses the concept of exit and voice meaning (in a broader sense) finding optimal solutions and constantly switching between approaches depending on a situation in order to succeed. (Hirschman 1970) Since the (so-called) DARPA model has been operating with success, there have been many attempts to copy it. One of the successful examples include the Advanced Research Projects Agency-Energy (ARPA-E) focusing on transformational high-potential and high-impact energy technology projects. (ARPA-E 2014; Van Atta 2007, 1) Nevertheless, discussions of extending the model beyond military context have been quite

[2] Wilson (2002) brings out DARPA´s three approaches how the new technology is transferred into a real world application and Bonvillian, Van Atta (2011) as well present the pathways of launching new products.

sceptical suggesting that without the immediate high-paying market that the military in the USA provides, the model would not survive. (Fuchs 2009, 69) In addition, a mix of clearly defined goals and well-accepted mission, together with autonomy, flexibility and well-established links with the best non-governmental research groups would be essential points to fulfil in order to clone DARPA. (Alic *et al* 2003, 20) Although, some authors have written about DARPA model and brought out the main features behind its success, Richard Van Atta states that "There is not and should not be a singular answer on 'what is DARPA'—and if someone tells you that [there is], they don't understand DARPA." (Quoted in Fuchs 2010, 1135) It is even stated that in spite of all the praise of DARPA, the success has not been proven. (Roland 2010, 10)

With every new Director, DARPA as an organisation has changed and that makes it indeed difficult to bring out one and only DARPA model. For example, Anthony Tether, who was the Director of DARPA from 2001 until 2009, brought some substantial changes especially to the funding practices. During his tenure funding shifted from the university-based research to industry. Teams with the established vendors became prime contractors in that way excluding universities and small start-ups. (Fuchs 2010, 1133-1134, 1138) Nevertheless, it was not a bad development because since university professors and start-ups needed to make more contacts with already established vendors in order to get the support, those established system manufacturers became more aware of university and start-up activities encouraging collaboration between them and introducing the challenges from both sides. (Fuchs 2011, 140, 147-148)

Speaking about autonomy, then DARPA is independent from military services and has autonomy to choose high-risk R&D projects. (Van Atta 2007, 2; Van Atta 2008, 20) It would not be correct to assume that DARPA´s main role is to meet the needs of the army, navy and air force. The truth is quite opposite – DARPA comes up with ideas that the forces do not even think of or want. (DARPA Dreaming 2005, 129) DARPA occupies a unique position within the US institutional landscape and is a part of a broader innovation structure within and for Department of Defence (DoD). Acting independently under the Secretary of Defence under the DoD, it has not got specific operational mission but to serve as primary innovation engine for transformation. (Van Atta 2007, 5) Although, The Secretary of Defence and the underlying Office of the Secretary of Defence bureaucracy very rarely gets involved in DARPA´s research programmes, it has happened when their actions have shaped the mission challenges that DARPA focuses on. (Bonvillian, Van Atta 2011, 479; DARPA 2014b) Overall, the high-risk research is done independently of defined needs. (Van Atta 2007, 15)

As being a governmental institution, DARPA receives its budget from the Congress. The Director of DARPA has to report to the Director of Defense Research and Engineering, who reports to the Under Secretary of Defense for Acquisition, Technology and Logistics, who reports to the Secretary of Defense. (Van Atta *et al* 2003, 1)

Structure and decision making

As mentioned before, the structure and management style of the organisation was set in place already in the 1960s. Jordan and Koinis (2013) name DARPA as one of the most flexible public organisations and Block (2008) adds minimal bureaucracy to that. (Block 2008, 175) DARPA has seven offices that are grouped by areas of expertise. First, the Adaptive Execution Office accelerates technologies into DoD capabilities. (DARPA 2014c) Second, the Biological Technologies Office deals with breakthrough fundamental research and discoveries that are connected to life sciences as well as human-machine interfaces, microbes, ecologies and environments. (DARPA 2014d) Third, the Defense Sciences Office explores the research landscape and brings together new discoveries, new materials and new approaches. (DARPA 2014e) Fourth, the Information Innovation Office is engaged in, as the name says, information science and software. (DARPA 2014f) Fifth, the Microsystems Technology Office invests in areas like electronics, computing and biotechnology. (DARPA 2014g) Sixth, the Strategic Technology Office handles the technologies that enable fighting as a network. (DARPA 2014h) Seventh and last office is the Technical Technology Office with its main activities in preventing strategic and tactical surprise by developing revolutionary technologies. (DARPA 2014i; DARPA 2014j, 1-2) Those seven offices stand for specialisation of the organisation. Each one of the offices is run by an Office Director, Deputy Director and Assistant Director.

Offices that are proactive in their nature are in addition comparatively small-sized, non-bureaucratic, consisting of leading scientist and engineers who have relatively high budget autonomy in order to pursue with their flexible and adaptive programmes. (Van Atta 2007, 2) Research and implementation of the programmes is done outside of DARPA by funding researchers and relying on outside contractors who are irreplaceable in terms of action. Such model of operation enables DARPA to keep its permanent staff small. (Jordan, Koinis 2013, 2) Tether has said that "We do not have an organisation. We are roughly 140 programme managers bound together by a common travel agent. It is a programme manager-centric organisation." (Wilson 2002, 8)

It has been noted that the management style at DARPA is very similar to another successful research organisation and namely the old Bell Laboratories where research was directed by managers as well. (Penman, Bates 1999, 239) Projects undertaken by DARPA are usually fixed-term, but nevertheless create lasting revolutionary change. For example, it has happened with the internet, Google Maps, GPS, aeroplanes and many more. (10 brilliant DARPA inventions 2010; DARPA 2014b)

To look at decision making, then the Director of DARPA selects and hires world-class programme managers based on their ideas. (Bonvillian, Van Atta 2011, 485) With little to no hierarchy programme managers have to convince only two people to push the programme through: respective Office Director and the Director of DARPA. (Fuchs 2009, 66; Van Atta 2008, 23)

The portfolio of programmes is created bottom-up meaning that the programme managers set the goals with defining and proposing programmes they believe will be revolutionary. First of all, a clear vision is set in place about a new technology that will be achieved through a research programme led by a programme manager. They form a good example of what is called street-level bureaucrats possessing a kind of tacit knowledge and rules that are not typical to other innovation agencies. (Bonvillian, Van Atta 2011, 471-472, 485) Doing things at grass-roots level is considered to be the best solution because programme managers are closest to the critical challenges and opportunities in his or her area of interest. (Darpa 2013, 2; DARPA 2014k)

Some describe DARPA´s decision making as a black box because funding decisions are not made based on the peer review, but solely coming from the highly motivated and results-driven programme managers. (In defence of DARPA 2003, 599) The so-called peer review where outside researcher peers make the actual final decision stands behind e.g. National Institutes of Health and National Science Foundation efforts where truly creative programmes almost never get unanimous approval. (Penman, Bates 1999, 239) Especially from letting that happen, DARPA has removed the normal checks and balances. (Shermer 2006, 1684)

The Office Directors and the Director of DARPA approve the programmes while following The Heilmeier Catechism[3], review the progress and make sure that the programmes are scrutinised.

[3] The Heilmeier Catechism (Jordan, Koinis 2013, 3)
"1 What are you trying to do? Articulate your objectives using absolutely no jargon.
2 How is it done today, and what are the limits of current practice?
3 What's new in your approach and why do you think it will be successful?
4 Who cares? If you're successful, what difference will it make?
5 What are the risks and the payoffs?

(Jordan, Koinis 2013, 2) Thus, the main decisions are made by the programme managers who after and between reviews have almost complete autonomy in their actions. The fact that a lot of the power is given to the programme managers alone can also have a negative side because some people have had trouble with "letting go" of their vision and in case the vision/project is not working, it will be continued for more than needed. (Bonvillian, Van Atta 2011, 481) As opposed to that, a system of separation of programmes and approaches is adopted meaning that if an approach fails, the programme can still be running. While there is a high bar for approving the programmes, they are designed in a way that makes them easy to try and if necessary have an opportunity to exit. (Jordan, Koinis 2013, 2-3) Negative results are ignored and if something is not working, the approach is changed over and over again. (Shermer 2006, 1684)

One of the important first questions that is asked before deciding on what to fund is if somebody else is able to tackle the problem and if yes, then DARPA will not get involved. (Talbot 2001, 45) Critics have said that many of the projects DARPA is funding are absurd with having impossible performance goals. (Jordan, Koinis 2013, 2) These are the projects that have captured the imagination of a programme manager, but have been rejected by other agencies for being too speculative to win the public funding. (In defence of DARPA 2003, 599) One programme duration yardstick is the life of one programme manager, i.e. about 3-5 years with gathering five to ten research teams to achieve the goals. Therefore, short-term thinking is being favoured and long-term projects are just passed over. (Bonvillian, Van Atta 2011, 486; Shermer 2006, 1684)

Office Directors and their deputies play a very important role within the agency as they set the technical directions for their offices. (Darpa 2013, 12) Office Directors form the intermediate stage between the programme managers and the Director of DARPA. (Bonvillian, Van Atta 2011, 489) Director of DARPA together with Deputy Director are responsible for setting agency-wide priorities and insuring a balanced investment portfolio. (Darpa 2013, 12)

Human Resource Management

DARPA´s technical staff consists of programme managers, deputy programme managers, office directors, deputy office directors, directors and deputy directors, in numbers about 120 people every year. (DARPA 2014l) Although it is a government job, there is no room for the usual merits such as long-term career and security. Annual personnel turnover rate usually stays

6 How much will it cost? How long will it take?
7 What are the "midterm exams" and "final exams" to check for success?"

around 25%. Personnel recruitment programme has been characterised as robust and a recruitment firm is used with an aim of finding programme manager candidates that DARPA is unaware of. New programme managers do not get any training, therefore they are learning by doing. (Carleton 2011, 7, 16) An ideal programme manager should have an ability to generate, integrate and accept new ideas. In addition, be highly talented, possess very good communication skills, be excellent in a given field and be able to deal with all technical, procurement and financial aspects of the projects. (DARPA 2014m; Bonvillian, Van Atta 2011, 472, 486) The ability to hire world class technical staff fast is also one of the factors behind DARPA´s success. (Fuchs 2009, 67)

Based on past experience, the programme managers tend to be midlevel people whether from the government, industry or academia who are temporarily on a leave from their permanent position. (Fuchs 2009, 67) They have past experience usually in both, academia and industry, thus having preconditions to succeed, but at the same time remain open-minded in a really uncertain working environment. Since DARPA is not a place for a long-term career development and the service periods for the programme managers are fixed for maximum of five years, programme managers are less afraid to fail. (Jordan, Koinis 2013, 2; Van Atta *et al* 2003, 63; Bonvillian, Van Atta 2011, 472, 486; Wilson 2002, 8) The three to five – year term limit is there for a reason: in that case risk-takers have to achieve a breakthrough in a comparatively short period of time and the results should be beneficial for the agency as well as on a personal level for a later career. (Jordan, Koinis 2013, 2) Fixed term also creates a constant flow of new people and fresh ideas. (DARPA 2013, 12) All people who have done a three to five – year turn at DARPA belong to the DARPA alumni. Those people usually continue to promote DARPA´s mission and research investments. Several formal events are organised to keep them informed about the latest developments, also to share contacts and new ideas. (DARPA 2014l)

Fuchs (2009) outlines the four main tasks of the programme managers. Firstly, they have to be familiar with the current and future military challenges. Second task is to identify the technologies that would be helpful in tackling the challenges. Thirdly, develop a close-knit community of researchers and last but not least is to make sure that the community operates effectively eventually leading the technologies to commercialisation. (Fuchs 2009, 67) By offering flexibility in programme definition – taking responsibility and initiative are encouraged. (Van Atta 2007, 7) Jordan and Koinis (2013) claim that there are no formal performance incentives, also no strict controls against revolving doors, capture or collusion. (Jordan, Koinis 2013, 2) Programme managers are judged by the Director of DARPA and by their own

colleagues on the basis of how well they managed the results – outcomes and impact. (Bonvillian,Van Atta 2011, 489; Penman, Bates 1999, 239)

DARPA's case can be summed up as follows: first, in terms of autonomy it has very high policy autonomy, however this autonomy has had a strong military underpinnings thus it is strongly contextualized; while it is one among many innovation agencies in the USA it enjoys high prestige (semi-central, but quasi-Weberian); second, internal management is highly decentralised between project and programme managers oriented towards high risk undertakings; thus the internal decision making rewards risk-taking above stability; third, similarly to Sitra and Fraunhofer, staff turnover is high and this is on purpose to facility flow of ideas and know-how between private and public sectors, but in DARPA's case there seems to be particularly low long-terms career prospects for staff. Thus neither internal management or staff show Weberian elements.

BNDES

BNDES was founded during the presidency of Getúlio Vargas who was committed to development and economic growth so that Brazil could become a part of the developed world. He believed that development bank is the most important instrument of industrialisation policy and thus BNDES was the chosen one for creation of the modern economy. (De Castro 1999, 187-189; Interviews 2002, 2) José Roberto Mendonça de Barros who is a noted Brazilian economist and consultant has said that BNDES together with Petrobras have played a major if not the main role in industrialisation process in Brazil. (Interviews 2002, 5)

The Brazilian Economic Development Bank (*Banco Nacional de Desenvolvimento Econômico e Social* – BNDES) history starts in June 20, 1952 when it was established by the then Treasury Minister, Horácio Lafer, as a government agency with a mission to develop and implement national economic development policies. In June 21, 1971, it was transformed into a fully state-owned company under the private law that enables more flexibility and less political interference. From 1952 until 1982 the Bank carried the name of BNDE (The Brazilian Economic Development Bank) and only since 1982 it has been called BNDES (The Brazilian Economic and Social Development Bank). (BNDES 2014a)

The priorities of the Bank have changed over time, for example, at first it financed rather large development projects as in infrastructure and heavy industry. (Hochstetler, Montero 2013, 1488)

In the end of 1980s focus turned to exports, privatisation programmes and urban and social development. In the 2000s the topics such as innovation, sustainability and small businesses prevailed and actually are there also today. (De Araujo Jr 2013, 2; De Carvalho 2013, 5) In order to be more precise, now the main support is focused on micro, small and medium-sized companies, especially concerning internationalisation and export activities. (Martins 2013, 4) Despite the notion that the Bank´s initial objective was to guide rural-based economy towards industrial growth, the mission has always been the same: to stimulate the private initiative in order to face country´s developmental, economic and social challenges. (Martins 2013, 4; De Carvalho 2013, 7; De Araujo Jr 2013, 1) However, the range of activities is expanding. For example, during the years 2003-2010 BNDES got two new roles: supporting and promoting internationalisation of Brazilian companies and supporting firms´ outward foreign investment. (De Araujo Jr 2013, 5)

BNDES´s position within the institutional landscape and autonomy

BNDES has traditionally played a central role in structural changes in the country by successfully lending in major industrial projects thus stimulating the expansion of industry and infrastructure. (Goldstein 1999, 683; BNDES 2014c) The Director of BNDES, Cleantho De Paiva Leite, declared in his interview (2002) that BNDES made a huge difference already in the early years. It was the first centre of rational analysis of economic problems, it created awareness of national problems and contributed to the development and emergence of think-tanks and research centres. (Interviews 2002, 3-4) Since the beginning, it has played an important role, if not even the main role in implementing Federal Government´s investment policies and being the main source for long-term private and public financing. (Martins 2013, 4; KPMG Auditores Independentes 2013, 14) BNDES actions and operations are in compliance with public policies and other governmental initiatives and support various programmes, projects and services that should have a positive contribution to the country´s economic and social development. (BNDES 2012a, 55; BNDES 2011, 17)

BNDES plays a significant role also in formulation and promotion of national policies. (KPMG Auditores Independentes 2013, 14) Hochstetler and Montero (2013) bring forward three ways how BNDES promotes innovation and technological development. Firstly, of course, lending to firms is the way the companies can upgrade their technology and come up with new solutions. Secondly, innovation in its own lending practices and thirdly, cooperation with other innovation agencies within and outside the Brazilian Government, notably with Finep, in order to fund

R&D. (Hochstetler, Montero 2013, 1494-1495) Today, BNDES is the third largest national development bank in the world when assessed on the basis of assets ($ 700 billion). (BNDES 2012a, 31) However, in terms of standard indicators on credit performance it is number one most efficient development bank in the world. (De Araujo Jr 2013, 1) It would be interesting to note that during the post-Lehman period the size of the Bank has doubled meaning also increases in lending. (Park 2012, 13, 17; IMF 2012, 48)

Therefore, BNDES has occupied a solid position within the Brazilian institutional landscape and has been one of the core agents of industrial policy since 1985 standing next to Finep. (Hochstetler, Montero 2013, 1488) Finep and BNDES became officially partners in 2005 in aspects of promoting innovation and technology. As usually with the success stories, many countries have tried to copy the so-called BNDES model. For example, in 2009 Argentine Government announced its intentions of creating a national development bank based on the BNDES system. (Lazzarini *et al* 2011, 9)

The Bank has a quite peculiar structure of its funding sources. At the end of 2012, 77,4 % of funding was received through returns on operations. (BNDES 2014e) To support long-term investment projects, as until very recently the Bank received its financial resources mainly from collection of labour charges, i.e. the FAT and the PIS-Pasep[4], then today the major partner is Brazilian National Treasury (total 15,6 %) (De Araujo Jr 2013, 13; BNDES 2014e) Such funding scheme has raised some concerns because the debt that is issued under the auspices of the Brazilian Government made up 52% of total resources for long-term investments and since the government borrows at one rate and lends to BNDES at a lower rate, it is raising the net debt of the public sector. (De Araujo Jr 2013, 13) Walsh *et al* (2011) have pointed out the distortion of Brazilian financial system and that such a heavy reliance on government funding can pose a risk to Brazil´s fiscal stability. (Walsh *et al* 2011, 10; BNDES Burden a Threat to Fiscal Stability 2010, 9) There are some other possibilities as well, namely to re-invest payments or lend from international banks. However, the very last source has declined and been used only occasionally. (Hochstetler, Montero 2013, 1489)

[4] The Federal Constitution of 1988 created funds that by law are sources for BNDES. FAT is short of Fundo de Amparo ao Trabalhador or Workers Assistance Fund and is independent of Federal Budget. At least 40% of FAT annual revenues are channelled to BNDES investments that are targeted towards employment and income generation. (Carvalho 2013, 47; de Araujo Jr 2013, 4) PIS-Pasep stands for Social Integration Program (PIS) and the Savings Program for Public Servants (PASEP) from which 60% is allocated to BNDES funds to finance unemployment insurance and salary. (BNDES Management Report 2013, 6)

From the autonomy perspective, BNDES is fully controlled by the government, more specifically, appears in the executive branch and is bound to the Ministry of Development, Industry and Foreign Trade. (Martins 2013, 4; KPMG Auditores Independentes 2013, 14, 124; OECD 2007, 18; De Carvalho 2013, 8) Although the Bank depends on the government, it is functionally still independent. (Goldstein 1999, 683) Federal Government of Brazil sets the long-term goals for the Bank. (De Araujo Jr 2013, 2) Those democratically established priorities formed into government policies guide BNDES daily operations. (BNDES 2014d) Since it is a publicly owned company, collegiate groups inspect its operations, balance sheets and management policies. These collegiate groups are made up of representatives from the government, outside entities and civil society. (BNDES 2012a, 19) BNDES management is controlled by the BNDES Fiscal Council and the BNDES Advisory Board. Brazil´s Central Bank and National Monetary Council are obliged to conduct inspections. Accounts inspections are made by the Federal Court of Accounts and process is audited by the Office of the Comptroller General. (BNDES 2014g)

Structure and decision making

BNDES is a multisectoral development bank. In the literature of development banks it has been said that such type of banks can be ineffective and unfocused, have problems of corporate governance, transparency and political interference. However, BNDES belongs to the ones that are successful and one of the main reasons for that has been considered its strong management. (Thorne, du Toit 2009, 683, 686)

BNDES System is made up of four entities: BNDES and its three fully-owned integral subsidiaries. FINAME is managed by its Administrative Board and finances purchase of locally manufactured machinery and equipment, plus supports exports of products and services. (BNDES 2014f; BNDES Management Report 2012, 3) BNDESPAR is a business corporation created by merger of three BNDES subsidiaries in 1982. Its main objective is to carry out capitalisation operations of undertakings controlled by private groups in order to strengthen and modernise Brazilian securities market. (BNDES 2014a; 2014f; BNDES Management Report 2012, 3) The third subsidiary, BNDES Limited is operating from London that is considered one of the most important financial centres. (BNDES 2014b)

BNDES has divisions that are further sub-divided into operational departments and support departments. Operational departments are the core entities that bring together multidisciplinary

teams in order to perform broad and effective analyses that are specialised in financial support and follow-up activities. Support departments, as the name is saying, focus on corporate support activities. (BNDES 2012a, 20) BNDES has a high degree of corporate governance and has six corporate Boards of Directors in charge of various areas. (BNDES 2014g) Each Board of Directors used to have ten members until April 2013 when the composition of the Board was amended and now has nine members: the president, the vice-president and seven managing directors who are all appointed by the President of the Republic of Brazil. (BNDES Management Report 2013, 17) Members of the Boards of Directors are carefully chosen from Brazilians who have outstanding knowledge and experience for at least three years. They are responsible for most of the decisions concerning proposals made by divisions. In addition, tasks include giving opinion on special issues to the Minister of Development, Industry and Foreign Trade and advising the President of BNDES. (BNDES Management Report 2012, 19-20)

Advisory Board is placed as the highest entity in the structure scheme and has currently 14 members. Their main function is to forward the opinions of the Minister for Development, Industry and Foreign Trade to BNDES. Also advise the President of BNDES, examine audit reports, approve balance sheets and long-term plans. The President of BNDES proposes long-term general policies and programmes that have to be approved by the Advisory Board. Operational policies are discussed and formulated in partnership with Production Arrangement, Regional Development, Innovation and Environment Committee, also with private sector and civil society. (BNDES 2011, 70, 101, 118)

The decisions of funding are made very carefully by conducting an analysis and selecting proper support. Not one but several people are responsible for the final decision based on objective criteria. The first step is consultation with the company, receiving the request for support from their side and verifying it according to BNDES priorities at the Department of Priorities. Next, the Planning, Credit and Operational Divisions step in to conduct the pre-assessment. In case the financing is approved, the client receives a letter to contact specific department. After sending additional information and presenting the final version of the project, it is analysed and Project Analysis Report is eventually sent to the Managing Director of the Operational Division for evaluation. If everything is still fine, it is sent forward to BNDES Board of Directors for final assessment and approval. Again, if all the necessary conditions are met, BNDES contacts the company and signing of contract follows. The average time of the process is 180 days. (BNDES 2014h)

Human Resource Management

Ordinance Nº 9 of April 2010 limited the maximum number of employees of BNDES staff to 2840, but by Ordinance 16 of April 2011 added extraordinary re-admission of 93. The year 2013 ended with 2716 employees that was 4,8% less than in 2012. (BNDES Management Report 2013, 16) Staff turnover is usually relatively low because of remuneration policy and very good working environment, thus was only 3,6% in 2012 and majority of them just retired. BNDES values its workers and tries to offer them benefits like health and retirement plans, life insurance, travel, food and educational allowances. (BNDES 2012a, 28-29) Intense development and trainings take place (different language and other courses) that totalled in approximately 43 hours of training for higher level worker. (BNDES Management Report 2012, 27) Official employees have a full right to associate and join the labour unions. (BNDES 2011, 22)

Strategic People Management project serves as a development and performance assessment model for workers at BNDES. It is based on four pillars: mapping of the technical competencies, career management, performance evaluation and training. (BNDES 2011, 223) There is yet another instrument named the Employee Agenda that supports the relations between managers and employees by sharing action plans for further development that in turn serves as a basis for performance measurement. (BNDES Management Report 2013, 25)

Public Selection

BNDES employees are hired under Brazilian labour law and work under private sector labour laws. (OECD 2007, 19) It is interesting to note that they are hired through public selection via public recruitment exams. (BNDES 2012a; BNDES Management Report 2012, 26) In June 2013 the results of the 2012 Public Selection were published. It was announced that over 137 000 candidates wished to fill in a position at BNDES and from which only 80 candidates were chosen. (BNDES Management Report 2013, 17)

For the 50th anniversary, BNDES conducted interviews with the key people who have had direct connections with the Bank over the years. It was interesting to see that many of BNDES directors have joined the organisation also through public competitive examinations. For example, Affonso José Guerreiro who was the Director of BNDES since 1972 until 1978 shared his experience: “The BNDES civil-service examination was the first I sat for. There was some financial incentive, but not much, since I was already earning the salary BNDES was paying. …” (Interviews 2002, 15-16) Also José Clemente who was the Director of BNDES in 1981-1984

said: “I joined BNDES in 1963, after sitting a competitive examination, and was allocated to the Economics Department.“ (Interviews 2002, 12-18) Romero (2013) dares to argue that Brazil´s Civil Service is envied for its professionalism as rigorous exams most likely weed out unprepared applicants. (Romero 2013; Freitas 2012)

The public selection is conducted through the Department of Human Resource Management and is performed by Foundation Cesgranrio that takes full responsibility and control. The public selection process starts with BNDES announcement for available positions. While announcing open positions, BNDES provides a summary of assignments – describes the roles and responsibilities in details, also all of the requirements with possible salary. All information on public selection is available on Foundation Cesgranrio webpage www.cesgranrio.org.br. Registrations for open positions are managed only via their internet site and application fee applies depending on a position - $64 for a top level position and $35 for medium level position. Each applicant can submit one application. Once registered, an exam follows held in different cities with questions about general knowledge as well as specific knowledge. (BNDES 2012b)

Exam for a top level position has two phases. First one is objective evaluation with 30 questions of basic skills (20 questions in English and 10 questions in foreign language) and 40 questions on specific knowledge. Total of 70 questions in phase one have to be answered by choosing one correct answer from five possible answers. 100 points is maximum result for this part. Those who get less than 60% and also candidates who do not obtain a minimum of 3 points in the proof of foreign language, 10 points in the proof of Portuguese and 35 points in specific knowledge are eliminated and do not get through to phase two. Phase two is discursive evaluation with five questions totalling in 50 points maximum. Again, those who obtain less than 60% will be eliminated. Ability of clarity, accuracy, consistency and objectivity are tested together with skills of analysis, synthesis and grammar. Afterwards, applicants will be ranked depending on the points. The duration of the exam is 4 + 4 hours. (BNDES 2012b)

Exam for a mid level position has also two phases – objective evaluation and proof of writing skills. In the first phase there are 25 question on English language, 25 question on mathematics, 8 question on foreign language, 6 questions on specific knowledge and 6 questions on general knowledge. Total of 70 questions worth 100 points where one correct answer has to be chosen from 5. Candidates who get less than 50 % will be eliminated. Also those who get 0 points in any of the sections. Phase two is about writing skills (objectivity, clarity, accuracy) and is worth 40 points. Again, candidates with lower scores than 50 % will be eliminated. Exam for a mid level position lasts for 5 hours. (BNDES 2012b)

In both exams 660 best candidates make it to the second phase. (BNDES 2012b) Completing the both phases of the exam successfully does not automatically guarantee a position that a person applied for. BNDES takes ethical aspects into account when hiring as a specially formed work group composes an action plan for diversity and against discrimination. (BNDES Management Report 2012, 29)

From the agencies studies in this thesis, BNDES is clearly the most Weberian agency in all aspects: it has strong autonomy and it has a central role among Brazilian innovation agencies, it is clearly one of the key economic policy actors in the country; it has in internal management and in particular in human resource management classical Weberian features (hierarchical decision making, exam based selection, merit based career system).

Discussion

So far the cases of Sitra, Fraunhofer, DARPA and BNDES have been described and analysed leading us closer to answering posed research questions. To try to find the answer to the first question "Is autonomy as specialisation important factor why innovation agencies are successful; that is, is autonomy in specialisation more important than central-peripheral location of innovation agencies?" all of the cases are once again briefly summarised below revealing the aspects related to the question.

To begin with Sitra, a fund that was founded in conjunction with and under supervision of the Bank of Finland in 1967 and later in 1991 transferred into an independent policy foundation under the Finnish Parliament, it could be said that although it is under the direct supervision of the Finnish Parliament, then at the same time it is free from direct governmental control and can make its own investment and other strategic decisions. Sitra has a complete independence and autonomy in creating and delivering new activities, setting concrete policy goals and deciding how they will be implemented. From the funding point of view, the organisation is autonomous as well since operations are funded with endowment capital and operative financing activities, thus not depending on the government. It could be stated that Sitra has a comparatively high degree of autonomy in specialisation with freedom of internal decision making and choosing its course of action. However, despite being an important actor it is located not in the centre of the public sector and it is even said that Sitra is also not the central actor in Finnish National System of Innovation. Such semi-peripheral position is actually positive for facilitating policy innovation

because in that case it is less exposed to political interference and less vulnerable to lobbying leaving more room for experimenting, independent thinking and partnerships with non-traditional actors that encourage and lead Sitra in ways that are different from the ruling paradigm. At the same time, Sitra has become more successful over the years and has captured the attention of policy makers despite rather peripheral location. (Breznitz, Ornston 2013, 1226, 1229) Annual report of 2012 confirmed that Sitra´s role in the society and economy has been constantly growing and by year 2012 it was more important than ever before. (Sitra 2013b) Sitra´s power of influence cannot be underestimated because, for example, many of the main ideas in Finland´s own innovation strategy come from Sitra´s innovation programme. Overall, Sitra is thought of as an important organisation through adding diversity to the system especially with policy experimentation. (Taloustieto Oy 2009, 25 - 26)

The second agency, Fraunhofer, whose history dates back to 1949 when it was established as a non-profit organisation and three years later gained research funding ability, is today the largest application-oriented research organisation in Europe with complete autonomy in specialisation – it defines its own strategic orientation and research activities. As some have said about Sitra that political influence cannot be ignored, then Fraunhofer has a neutral stance concerning individual interests groups in politics, industry and society. Of course, national and European economic and research policies play a role in defining Fraunhofer´s own strategic directions. Fraunhofer is the biggest of the chosen cases with over 23 000 employees in 80 research centres. The research centres have also considerable autonomy is defining their strategic and scientific priorities within the allocated budget and Fraunhofer´s general strategic scope. From the funding point of view, two thirds of the organisation´s budget is made up from contracts with industry and publicly financed research programmes, thus industrial R&D is funded mostly by private enterprise. Remaining one third comes through the German Federal Ministry of Education and Research and Länder ministries and government departments standing for the fact that basic research is financed by public grants. From the central-peripheral point of view, Fraunhofer is more of a central actor standing at important place within the German institutional landscape and acting as one of the key members of the scientific community.

Third case, DARPA, is again different from the two previously discussed agencies because at first it was a federal R&D agency under the Secretary of Defence with obligation to report to the Director of Defence Research and Engineering. With history of over 56 years, today, it is not performing R&D activities itself anymore, but is engaged in funding high-risk high-payoff projects. Being a governmental institution under the Secretary of Defence under the Department

of Defence, DARPA receives its budget from the Congress. However, it is independent of military services and has autonomy to choose its own projects. Although, there have been a few cases where The Secretary of Defence and the underlying Office of the Secretary of Defence got involved in DARPA´s research programmes, then the overall high-risk research is done independently of defined needs. From the central-peripheral aspect, DARPA is definitely a major player in National Innovation System because supports risky projects that actually need the support the most, but it is not a centrally located agency. Therefore, it has managed to remain one of the most flexible public organisations and very innovative at the same time while having relatively low political profile. (Whitford & Schrank 2011, 279)

The last case, BNDES, is probably the most distinguishable from the four cases. Clearly, there is a developmental context involved since according to United Nations country classification (2013) Finland, Germany and the USA all belong to the most developed countries while Brazil is considered a developing economy. [5] Also, BNDES is not a typical innovation agency, but is a development bank funded in 1952 when it was established as a government agency with a mission to develop and implement national economic development policies. In 1971 a major change took place and the bank was transformed into a fully state-owned company under the private law that now enables more flexibility and less political interference. Therefore, BNDES is fully controlled by the government, BNDES Advisory Board as the highest entity forwards the opinions of the Minister for Development, Industry and Foreign Trade and thus government policies guide the Bank´s daily operations. It could be stated that BNDES has relatively low degree of autonomy in specialisation since it cannot choose its own strategic directions and set independent goals. Funding is similar to mostly Fraunhofer as BNDES receives about three-quarters of its funding through returns on operations. The remaining one-fourth is received from collection of labour charges. Again, more similar to Fraunhofer then to Sitra and DARPA, BNDES has a central position in the institutional landscape. Probably the most central one because is (one of) the main organisations implementing Federal Government´s investment policies and being the main source for long-term private and public financing.

As it is clear, there is no single answer to the first research question. All of the four cases represent very different practices in terms of autonomy. High degree of autonomy in specialisation appeared in case of Sitra, Fraunhofer and also DARPA, but not so much in the case of BNDES where the strategic goals and directions are in advance decided on the

[5]United Nations country classification (2013) Statistical annex, 143-152. Available: http://www.un.org/en/development/desa/policy/wesp/wesp_current/2013country_class.pdf

government level and the Bank further follows the established priorities. Nevertheless, BNDES is functionally also independent and can make decisions on funding itself. From the central-peripheral location stance there is again no single best solution because Sitra and DARPA are rather peripheral, but at the same time, Fraunhofer and BNDES more centrally located in the public administration system. Thence, it can be assumed that autonomy in specialisation is more important than central-peripheral location of innovation agencies. Although, the argument by Breznitz and Ornston (2013) on peripheral agencies that are more likely to engage in radical innovation type activities proves to be right as well because DARPA is sometimes considered semi-peripheral and from the four analysed cases is engaged in radical innovation. Remaining three cases are rather engaged in incremental innovation, also Sitra because it has been noted that Sitra has been moving away from peripheral location to more central one and therefore has become less innovative. Nevertheless, it is not a straightforward basis to define the success of the innovation agencies.

Thus, it can be argued that Weberian autonomy is still important for innovation agencies, however this autonomy is defined on a rather high policy and legal level, leaving internal processes more fluid and in cases of DARPA and Sitra actually very fluid. But it is important to stress that this internal fluidity functions within higher level and relatively classical Weberian autonomy. Equally importantly, it seems that innovation agencies can be anywhere on center-periphery axis; their position depends on domestic institutional features of the innovation system (how many other agencies, how well they function, etc).

The answer to the second question "How much do changes in nature of technological advances – changes in techno-economic paradigms – matter in terms of internal management structures and human resource development of successful innovation agencies?" is much clearer and more concrete.

To answer the first part of the question about internal management structures, then once again to start with Sitra, internal management structures are highly decentralised and all of the employees have large degree of autonomy concerning their actions. It cannot be categorised as tall hierarchical organisation because first of all it is a matrix organisation with rather flat hierarchy where horizontal differentiation is more important and more evident than vertical differentiation. Project– and theme based organisational model leads to higher specialisation and faster reaction to changes. Within the ICT paradigm that stands for uncertainty and hastily changing environment, Sitra needs to be flexible and leave room for rapid response.

In case of Fraunhofer, the authority is as well not concentrated at the top, but distributed to all of the 80 research centres. Such decentralised management structure and decision making structure allow high degree of specialisation. Since the research activities are guided by the economy, it is necessary for Fraunhofer to be flexible and respond quickly to the market developments and decentralised structure supports this objective. Of course, the most important decisions, e.g. basic science and research policy, research and financial planning are formed in a top-down manner, but other strategies like group and Institute strategies are mainly formed bottom-up. Individual institutes have high degree of freedom in setting their scientific and strategic priorities within the budget.

DARPA considers itself an organisation without hierarchy. Obviously, there is some hierarchy, but very lean and it consists of three primary levels: the Director of DARPA, Office Directors and programme managers. (Carleton 2011, 5) Such structure is possible due to a small number of employees and has been in place already since the 1960s where a lot of powers were allocated to the programme manager level. Specialisation is indicated through seven offices, each of them with separate area of expertise, that are small-sized, non-bureaucratic and have high degree of autonomy in their operations. Programme managers perform the main task of DARPA, i.e. proposing and implementing projects, in a street-level bureaucrat manner on the grass-roots level.

The last innovation agency, BNDES, is as other chosen organisations, also highly decentralised because the power to initiate projects and make important decision is distributed to managers at all levels of hierarchy. BNDES has divisional structure with divisions and sub-divisions that perform organisational tasks. The decisions on Bank´s main activity, that is funding, are made in a decentralised manner because there is not one but many people behind the final decision. Such operational model fosters flexibility and responsiveness and allows BNDES to perform the tasks with high quality and in an up-to-date way.

From the four successful innovation agency cases it became evident that changes in techno-economic paradigms have had a great effect and in order to be successful it is important to act in some degree of compliance with the current ICT paradigm that follows the principles of e.g. decentralised integration, adaptability, globalisation, diversity and knowledge as capital. (Perez 2002, 18) Techno-economic paradigm stands for the best practice model with most effective use of new technologies and best organisational practices. Current paradigm has transformed the way organisations are managed and organised, thus the strategies are modified to be more compatible with the logic of the ICT paradigm and proved to be more successful. (Perez 2009, 9-17) Perez

(2009) adds that those practices are imitated by others and that is exactly the case also with four chosen innovation agencies as they carry the logic of the current paradigm and other countries or companies are trying to copy the models. Thus, on the basis of four agencies, changes in technological advances play substantial role in defining internal management structures. All of the organisations under discussion have understood the nature of innovative activities and the surrounding environment that is highly unstable and rapidly changing. Breznitz (2007) statements that more flexible structure is needed and that the ideal type Weberian bureaucracy with fixed rules, norms, clearly stated instructions and rigidly differentiated vertical hierarchy may not be best fit with ICT hold true for the current paradigm. Such organisations as described by Johnson (1975, 1982; 1999), Evans (1992; 1995), Wade (2003) seem to no longer fit to dynamic environment, but is a rather good option for an organisation in a more static mass-production environment. Also Burns and Stalker found that firms with organic structure perform more effectively in unstable, changing environments than companies with a mechanistic structure. Activities and decisions connected to innovation and research activities cannot be highly bureaucratised because clearly stated rules and instructions would just limit the freedom of activities and suppress creativity. Giving more powers to lower levels keeps the employees motivated and encouraged to make new moves and take responsibility. (Jones 2004, 109-110, 121-122)

To answer the second part of the research question about human resource development practices it becomes relatively clear that Sitra, Fraunhofer and DARPA are Non-Weberian organisations. In Sitra about 40% of the employees are employed under a fixed-term contract and personnel turnover is more than 30%. In Fraunhofer, over 50% of the workers are there on a fixed-term employment contract making up similarly very high personnel turnover percentage. The most important people in DARPA, the programme managers, are hired for a service period for maximum of five years and annual personnel turnover rate usually stays around 25%. Thus, the common features of the three named agencies include fixed-term contracts and high personnel turnover that are the opposite of Weberian principles of long-term career and security. Another aspect is part-time jobs that all of the agencies are offering, but the principle is again at variance with Weberian ideas. The purpose of such practices is to facilitate the so-called brain transfer of passing technological know-how to other industries and organisations, plus to encourage the movement of people and ideas between the public and the private sector. With a fixed-term contract employees are less afraid to fail and eager to take more risks. Wade (2003) described bureaucrats as risk-averse people who avoid being connected to failure. (Wade 2003, 299) At the

same time, it is not the case with those three organisations since what matters is the success and failures are taken as a natural part of the process. A fixed time frame pushes also people more to achieve in a short period of time. In addition, all of the organisations first try to find a new employee from the inside of the organisation. Only in case nobody is available or found an open competition is announced for an open position. Again, such behaviour is inconsistent with Weberian principles where people are hired based on merit.

From the cases described in this paper, the most Weberian by human resource management is BNDES with clear career path and public examination standing for meritocratic selection. (Evans 1992, 168) Thus BNDES is an exception and differs from the other cases with annual staff turnover of less than 4%. BNDES offers a so-called career for life with comparatively good remuneration policy and very good working environment. Another important aspect, as already mentioned, is meritocratic recruitment that takes place as a public selection that BNDES announces annually. Recruitment and promotion practices on the basis of merit are one of the main principles of Weberian bureaucracy. So, although, there was not one and only practice in human resource development, then three out of four cases did not follow Weberian logic and have proven to be very successful despite of that. Overall, it could be said that there is not one single best solution or answer how to be a successful innovation agency. A lot depends on historical aspects and institutional aspects, also on surrounding environment and prevailing paradigm.

Conclusion

The current paper analysed the cases of Sitra, Fraunhofer, DARPA and BNDES from the point of view of autonomy, internal management structures and human resource development. These case studies were especially chosen because they represent widely discussed and outstanding success stories. In the beginning of the paper it was argued that classical innovation agencies are strong powerful Weberian organisations that are located in the centre of a public administration system.

Based on that, two research questions were raised and relying on the cases it was possible to make some implications. There was no single answer to the first question because all of the cases analysed represent very different practices in terms of autonomy in specialisation and autonomy concerning central-peripheral position. High degree of autonomy in specialisation appeared in

case of Sitra, Fraunhofer and also DARPA, but not so much in the case of BNDES where the strategic goals and directions are in advance decided on the government level and the Bank further follows the established priorities. From the central-peripheral location stance there was again no single best solution because Sitra and DARPA are rather peripheral, but at the same time, Fraunhofer and BNDES more centrally located in the public administration system. Thence, it can be assumed that autonomy in specialisation is more important than central-peripheral location of innovation agencies. This indicates that the Weberian feature of policy autonomy is still important for well-functioning innovation agencies, however this autonomy is defined on a relatively high policy and political (legal) level.

The answer to the second research question concerning the effects of techno-economic paradigms on internal management structures and human resource development was more evident. Namely, internal management structures showed similarities in all four cases in terms of high degree of decentralisation and flexibility. Changes in techno-economic paradigms have had a great effect all of the organisations under discussion have understood the nature of innovative activities and the surrounding environment that is highly unstable and rapidly changing. Human resource management and development showed clear trend towards Non-Weberian practices (excluding BNDES that has a clear career path and meritocratic selection). Other three agencies have fixed-term contracts and high personnel turnover in order to facilitate the movement of people between different sectors and encourage risk taking.

Although the results are specific to particular cases, they can serve as a starting point for further analyses and as best practices that might prove to be helpful also for other innovation agencies.

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