Firm Benefits from Science Investments

- *Policy myths or industry realities?*

Abstract

There is a tendency today to highlight the "societal usefulness" of scientific research rather than the scientific achievements. Even international organizations doing pure basic research are increasingly arguing for how basic research benefits society, and especially industry, in their member states. One of these benefits is knowledge transfer, which is claimed to move from science to industry.

Another trend within both regional policy (making) and social sciences research emphasizes proximity in relation to usefulness; cluster studies show that firms within certain industries benefit from both being close to each other and to research centers/universities, and industrial growth is used as an argument for regional investments.

In the southern part of Sweden, an international research facility is currently under construction. This facility is of multidisciplinary character within areas such as functional materials, molecular biotechnology, energy technology, nano-science, geology, medicine and environmental research. In addition to the groundbreaking research expected to take place within this research facility, there is a (political) focus on maximizing usefulness to society and utilizing spin-off effects from the establishment. It has been stated that there is a huge potential for the regions in southern Sweden to benefit from the research facility when it comes to new business, knowledge transfer, and an innovative climate – which in turn, it is claimed, will lead to new firms and an influx of educated people.

The aim of the paper is to investigate the alleged and perceived benefits to (local) industry from the establishment of an (international) research facility in a certain area. The empirical study focuses in the ESS facility in Lund and firms in southern Sweden. Theoretically, the study draws on the IMP network approach.

Keywords: *science-industry interaction, business networks, clusters, knowledge transfer, policy endeavours*

Introduction

There is a tendency today to highlight the "societal usefulness" of scientific research almost to the point of downplaying the scientific achievements. Even organizations doing "pure" basic research are increasingly arguing for how basic research benefits society, and not least industry, in their member states. Among these benefits are innovations which are believed to often come about through knowledge transfer; which is claimed to move from science to industry[1]. It is not only the people connected to the research organisations that promote these arguments, however. Politicians, as well as functionaries within governmental organisations, are also adhering to similar ideas. According to Jacob and Hallonsten (2012:411), there have been "*considerable efforts exerted by national (predominantly European) efforts to integrate the commercialization of science and other innovation-type activities into the everyday life of public R&D institutions*".

As research facilities grow in size and complexity, basic science is becoming increasingly expensive to fund. Therefore, many of the largest research facilities today are the outcome of international collaboration. There is an ongoing debate as to whether the localization of a research facility to a certain region/country will primarily benefit industry in close proximity to the facility. Whether geographical proximity (alone) creates business opportunities has been debated (see e.g. Markgren, 2001), but the cluster concept[2] has made inroads within several areas. According to Visser (2009:167), *"Over the past decades, researchers and policymakers around the globe have been paying attention to the concept of clusters of related firms, industries and institutions, with a view to the presumably positive effects of clustering for productivity and innovation"*.

In the southern part of Sweden, an international research facility is currently under construction[3]. The research facility will have applications of multidisciplinary character within areas such as functional materials, molecular biotechnology, energy technology, nano-science, geology, medicine and environmental research. In addition to the ground-breaking research expected to take place within this research facility, there is a (political) focus on

[1] That this way of viewing knowledge transfer is overly simplified has been shown in several studies (see e.g. Åberg, 2013). Vuola (2005) even shows that knowledge transfer may move in the opposite direction, i.e. from industry to the research facility, so-called reverse knowledge transfer.

[2] In this paper, a cluster is defined as a concentration of firms within the same or closely related industries to a certain area.

[3] This research facility is the European Spallation Source, ESS, and it will be ready to be tested in 2019, with completion estimated for 2025.

maximizing usefulness to society and utilizing spin-off effects of the establishment. It has been stated that there is a huge potential for the regions in southern Sweden to benefit from the research facility when it comes to new business, knowledge transfer, and an innovative climate – which in turn will lead to new firms and an influx of educated people (*Region Skåne* website). The European Spallation Source, ESS, is going to be an international research laboratory. So far, seventeen European countries have shown an interest in participating, but the final signatures are not yet in place.

The aim of the paper is to investigate the alleged and perceived benefits to (local) industry from the establishment of an international research facility in a certain area. This will be done through investigating *how the potential benefits to industry from the establishment of an international research facility are framed from a policy perspective* and *how the firms interacting with research facility view this interaction*. The main empirical focus is placed on ESS and the potential benefits to the surrounding areas, with a specific emphasis on interaction with industry.

The structure of the paper is as follows: After this brief introduction there will be an introduction to ESS, including previous studies of the research facility. Thereafter the theoretical underpinnings will be presented. The theory section is divided into two main parts, where the first part introduces a discussion on the interaction between science and industry in general, whereas the second part focuses more on the cluster concept and contrasts this concept to IMP literature on networks. Thereafter a brief comment on method is provided, followed by a short presentation of attempts to create collaboration between ESS and industry. The paper is concluded by a discussion and some final remarks.

Presentation of ESS

What is ESS?[4]

ESS, the *European Spallation Source*, is the biggest research infrastructure project in Europe today[5] – and the biggest project ever in Sweden. ESS is a multi-disciplinary research facility which will provide the scientific community with new possibilities for research using neutrons. Once constructed, ESS will constitute the world's most powerful neutron source – about 30 times brighter than today's leading facilities. Researchers from as diverse areas as life sciences, energy, environmental technology, cultural heritage and fundamental physics will find uses for the facility. The fact that ESS is multidisciplinary, and therefore not only for physicists using neutrons, has not been fully acknowledged so far – not in Europe, and perhaps not even in Sweden. The proponents of ESS have had problems raising an interest in ESS both in Europe and in Sweden (Honeth, ESS day).

Advanced research requires advanced tools. A neutron source and its complementary detection instruments enable scientists to see and understand basic atomic structures and forces. It can be compared with a giant microscope for the study of different materials – from plastics and pharmaceuticals, to engines, and molecules. The facility design and construction includes a linear proton accelerator, a heavy-metal target station, a large array of state-of-the-art neutron instruments, a suite of laboratories, and a supercomputing data management and software development centre.

Europe's need for an advanced, high-power neutron facility was first articulated over 20 years ago. The ESS facility will be built by at least 17 European countries, with Sweden and Denmark as host nations. The neutron facility is being built in Lund, while the data management and software centre will be located in Copenhagen. Between two and three thousand guest researchers are expected to carry out experiments at ESS each year. Most of the users will be based at European universities and institutes, but some will be based within industry.

The ESS research program is being planned now. Scientists and engineers from more than 60 partner laboratories are working on updating the advanced technical design of the ESS

[4] ESS website: http://europeanspallationsource.se/european-spallation-source-0
[5] Of course ITER, which is being constructed in the south of France, is much bigger – but it is not, strictly speaking, a research facility.

facility, and at the same time are exploring and imagining how it will be used. These partner laboratories, universities and research institutes will also take part in the construction phase, contributing human resources, knowledge, equipment, and financial support. On June 12, 2014, a milestone was reached when the Swedish Environmental Court approved the ESS plans to start the construction, and in September 2014 the groundwork was officially initiated: “Big science has come to Sweden. The frozen ground near Lund, in the country’s south, is being dug out to make way for Europe’s latest megaproject” (Hallonsten, 2015:19).

The timing of the ESS construction is by no means perfect. It was decided during a very difficult financial situation (the latest financial crisis in 2008), and there are always debates as to whether big research infrastructures are the best way to spend research funding. Sweden finances about 35% of the construction, or some 2 billion euros, but this money is not taken out of the “standard” research funding.

ESS Organization and Governance[6]

More than 50 universities, research institutes and laboratories from all over the world take part in the ESS collaboration. They are involved in the technical design of, and will also take part in the construction phase. The future research at ESS is being planned in cooperation with European researchers and partners.

ESS is owned by the Swedish government and, as of December 2010, by the Danish government. The company is governed by a Board which consists of eight members appointed by the two current owners. In addition, ESS has an international “Steering Committee” which consists representatives of the 17 partner countries[7]. The Steering Committee deals with the scientific, technical and financial planning for the facility.

ESS has a dual-governance structure, made up of the ESS AB Board and the ESS Steering Committee. European Spallation Source ESS AB is responsible for planning, designing, building, owning and operating the ESS research centre in Lund. The company also takes an active role in negotiations with current and potential partners, and in particular in creating a international agreement to begin construction, which is scheduled for 2014. ESS AB is a

[6] ESS website: http://europeanspallationsource.se/ess-governance ; http://europeanspallationsource.se/ess-organisation

[7] The 17 partner countries are; Sweden, Denmark, Czech Republic, Estonia, France, Germany, Hungary, Iceland, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Spain, Switzerland, and the UK.

public company owned by the Swedish and Danish governments. All partner countries will be offered shares in the company.

Promoting ESS

A few studies have been made concerning the public debate around ESS and, considering how big an undertaking ESS is for a small country, there has been very little debate about the construction in Swedish press (Hallonsten, 2012). It has been stated that "Research policy is always a game of priorities, but big-science projects carry complex risks that must be properly prepared for and managed" (Hallonsten, 2015:19) ant that "ESS as a large European research facility must be regarded as a phenomenon without obvious predecessors in Swedish research policy and public debate" (Agrell, 2012:431). Despite the general risks of big-science projects, however, and the fact that ESS is a massive endeavour for Sweden, there has been no real media controversy concerning the facility.

Having perhaps expected a more negative reception, there is a number of promotional documents about ESS. Agrell (2012) divides the promotion of ESS into two main categories; the offensive strategy, outlining the positive effects, and the defensive strategy, downplaying the potential negative responses. The author summarizes the offensive strategy in four different themes; utility (science for society), uniqueness (the "city of light"), the "win-win-win-win situation", and visualization of the science in question ("the 'beautiful' neutrons and the endless frontier") (Agrell, 2012: 433-4). As the focus of this paper is primarily the connection between science and industry, the focus will be on the aspects of utility and the win-win-win-win situation.

When it comes to aspects of utility, Agrell (2012:433) notes that this is the main theme in many of the presentations of ESS: "The facility is described as not just a source of abstract scientific data, but of important new knowledge with practical implications in fields like energy, climate, environment, chemical products for everyday life, materials and health" (ibid). In addition to the references made to usefulness for areas connected to "traditional physics", such as materials and technological systems; there is also a special focus on usefulness to life sciences (Agrell, 2012: 433).

With the win-win-win-win situation is, Agrell (2012:434) refers to the fact that the ESS promotion material only presents the positive impacts from the facility. From a usefulness point of view, the most interesting winners presented are, on the one hand, industry with the potential for technological spin-offs; and on the other hand the local and regional society. A document published by the ESS Scandinavia secretariat highlights, among other things "the positive impact of new and existing research in the region, on scientific clusters, spin-off companies and the local community and labour market" (Agrell, 2012:434).

In the presentations of the ESS, two major benefits can thus be identified. The first one concerns the utility for society, including knowledge transfer from science to industry, and the second benefit relates to the usefulness to the local industry.

Theoretical Underpinnings

Interaction between Science and Industry

The concept "Big Science" became widespread in the 1960s and refers to scientific research needing big investments, big laboratories, big machines and many people involved. One of the early references describes these large-scale research organizations in the following way;

> "*Not only are the manifestations of modern scientific hardware so monumental that they have been usefully compared with the pyramids of Egypt and the great cathedrals of medieval Europe, but the national expenditures of manpower and money on it have suddenly made science a major segment of our national economy. The large-scale character of modern science, new and shining an all-powerful, is so apparent that the happy term 'Big Science' has been coined to describe it*" (de Solla Price, 1963:2)

In many cases the usefulness of big science is considered a given, and the trick is simply a matter of making people aware of it; "*The awareness of the potential of big science centres in industrial development is continuously increasing*" (Autio et al., 1996:307). From this perspective, the management of these science centres has a role to fulfil, because with the help of "*well-designed industrial collaboration policies, a big science centre can increase its attractiveness in the eyes of national policy-makers*" (Autio et al., 1996:307).

That large-scale research organizations are important for national policy-makers today is highlighted by other researchers as well; Hackett et al. (2004), state, for instance, that these science endeavours position science on the maps of politicians and policy makers. Jacob and Hallonsten (2012:412) develop this argument further, claiming that "*large-scale research infrastructure represents a route through which science and technology policy-making (alternatively known as research and innovation policy) may be understood*".

What needs to be considered, however, is that scientific research does not necessarily lead directly to technical innovations. According to Basalla (1988:91-92),

> "*Proponents of scientific research have exaggerated the importance of science by claiming it to be the root of virtually all major technological changes. A more realistic and historically accurate assessment of the influence of science on technological change is that it is one of several, interacting sources of novelty*".

The quote above points at some important aspects of the relation between science and technology: firstly, that there are other factors besides scientific research that are important for technological development, and secondly, that technological development is a result of interaction rather than a linear outcome of scientific research. Therefore, *in what way* the technological advances that improve society emerge from science is also a much debated question. According to Nowotny (2005:3), the fact that since

> "*science and technology are rightly seen to be the major driving forces of wealth creation and economic growth, some of the latter's governing principles are now expected to work as well in the production of scientific and technological knowledge. The efficiency of markets, competition, and intellectual property rights are to prove themselves by increasing the productivity and output of scientific knowledge […] and technological artefacts, all of which constitute the potential of science and technology*."

In other words, there is a belief that increased market-driven efficiency will also increase the outcome of the investments in science, thereby "making business out of science". Concepts from business are also introduced in order to describe this "new" efficiency, and to, in a way, legitimise scientific research.

There is a small problem with these developments within science, though. Not with the developments in themselves, but in the ideas that they entail. According to Rosenberg (1994:10);

> "*The findings of scientific research, and their economic consequences, remain shrouded in uncertainty. They reflect certain properties of the physical universe that are uncovered by the search, and not the economic goals that were in the mind of decision-makers who allocated resources to the research process in the first place*" (Rosenberg, 1994:10).

What is certain, however, is that an increased demand for results from investments in science will result in an increased number of attempts to influence the outcome of those investments, thus leading to policy changes.

More recently, there has been an increased (policy) interest in not just the outcome of science organisations, but also in the input. The concept *public procurement of innovation* has been minted to describe "*purchasing activities carried out by public agencies that lead to innovation*" (Rolfstam, 2012:303). Science organisations can, through procurement of for instance technology, help create innovation:

> "*Innovation is crucial to achieve sustainable jobs in European regions. New products and services strengthen the competitiveness of European enterprises and create jobs. Public procurement accounts for nearly 20% of GDP in Europe. The way in which this public money is spent has a clear and important impact on the economy. This is why public procurement of innovation can create huge opportunities*" (European Commission, 2014).

Thus, it is acknowledged that spin-offs from science organisations can come from industry *input* into science, rather than the other way around.

Clusters and Networks

If investments in large-scale science infrastructure are justified by the potential benefits to (national) industries; then the idea of creating dynamic and innovative areas is another policy dream. In addition, by investing in a facility for scientific research, there is always the potential of creating an innovative area around the facility, i.e. creating a cluster. According to Porter (1998:78), "*Clusters are geographic concentrations of interconnected companies and institutions in a particular field*". Furthermore, it has been claimed that *"Over the past decades, economic and innovation policy across Europe moved in the direction of creating regional clusters of related firms and institutions. Creating clusters through public policy is risky, complex and costly, however"* (Visser & Atzema, 2008:1169).

Within the cluster literature, there seem to be rather fuzzy boundaries between different kinds of clusters, and different definitions of clusters. On the one hand, there are clusters that have existed for a long time (e.g. the Italian industrial districts). These clusters are also the kind that Porter refers to when he talks about "enduring competitive advantages"; "*Clusters are not unique, however; they are highly typical – and therein lies a paradox: the enduring competitive advantages in a global economy lie increasingly in local things – knowledge, relationships, motivation – that distant rivals cannot match*" (Porter, 1998:78). A firm located within such a cluster has many advantages over an isolated competitor when it comes to innovation. Some of the advantages include access to sophisticated buyers; possibilities to learn more quickly about customer needs, trends, evolving technologies etc.; and easier access to resources needed (Porter, 1998:83). On the other hand, there seems to be, if not a strong belief in, then at least a strong wish for the possibilities to create a cluster through policy measures.

So far, we have mainly focused on the effects that clusters are considered to have on innovation, but IMP literature would rather focus on network dynamics and their role in innovation. There are a few researchers, however, that try to combine the two concepts. Visser (2009:167) claims that "*clusters and networks are two separate concepts that both merit attention, especially—albeit not exclusively—with a view to learning, knowledge development and innovation*". The differences, according to Visser (2009), between clusters and networks are the following:

> "[…] *clusters refer to spatial concentration processes involving a set of related activities in which context firms may, but need not, cooperate, for example, to achieve dynamic purposes, whereas networks refer to dynamic cooperation in the form of knowledge exchange between firms and other actors that may, but need not, develop these links at the local or regional level*" (Visser, 2009:168-9).

Thus, the basic differences between networks and clusters are that clusters refer to similar activities in a specific area, while networks always involve some sort of interaction. It is likely that the effects sought after by policy makers are the network effects, while, at the same time, the policies are intended to benefit cluster formation. When Waluszewski (2004) studied the so-called Uppsala biotech cluster, what the author found was that;

> "*Instead of being the result of an overnight success and events taking place within a spatial cluster, technological and economic effects appears [sic!] as due to combinatory efforts that stretch over at least seven decades and over the borders of many regions and nations. Taking place within and between companies and organisations of different size and age, with different technologic and economic logic, and not least, located at different places, these processes show the power of interaction and the encountering of resources"* (Waluszewski, 2004:146).

Concluding Remarks on Theory

The theoretical part of the paper has broadly focused on two different aspects; first it recapitulated some of the discussion on the interplay between scientific research and industrial activities, thereafter it focused on the cluster concept and how it differs from industrial networks. The purpose of presenting these strains of literature is that both spending on scientific research and cluster creation are often justified by potential usefulness to industry, through increased innovativeness, and therefore usefulness to society.

Methodological Considerations

This paper introduces a research project that was initiated during the autumn of 2014. So far, the data collection carried out has been limited to Internet searches, participation in a whole-day seminar; *The European Spallation Source ESS – An Opportunity for Swedish Organisations and Companies* (held at The Royal School of Technology, Stockholm, Sweden on June 10, 2014) and a one-day conference in Stockholm concerning the possibilities for Swedish firms to become big-science suppliers (*Business for Billions*, April 29, 2015). Furthermore one interview has been conducted in a firm that has delivered to ESS (as well as to CERN and MAX IV) and one interview with the person responsible for the CATE-project (see the empirical part below).

During previous Internet searches and the seminars in Stockholm, some 20 firms with contacts with ESS have been identified. A first interview with the CEO of one of the firms identified (Mats Ohlsson, Examec AB) was carried out in January 2015. The remaning firms are being contacted and interviews will be carried out during summer/autumn 2015. The type of questions will focus on ESS-firm interaction and will partly build on a previous study of CERN-firm interaction (see Åberg, 2013) where some 100 interviews were carried out. In addition to interviews in the firms, interviews with people at *Region Skåne*, the local government in the area where ESS is situated, will be carried out; as well as interviews with people working within the research facility itself.

Creating Collaboration

> *"ESS will be a different kind of scientific facility: different in the way it engages with the user community; different in the way in which it deals with innovation; and different in its goal to be the first sustainable large-scale scientific facility."* (ESS website)[8]

ESS and its Counterparts

The expectations on the investments in ESS are huge and it is believed that research done will result in major research findings within life science and material science. In addition, there are also great expectations on what the research facilities will mean for the development of the industry in the surrounding areas (Region Skåne website)[9]. Since the regional government of the area where ESS is built – *Region Skåne* – hosts ESS and contributes with substantial funding, its representatives claim that they have a responsibility that the knowledge production and usefulness to society which can be derived from the facilities are taken advantage of as much as possible areas (Region Skåne)[10]. Furthermore, they state that there is great potential for Skåne and Blekinge to take advantage of the establishment of ESS. The construction alone, as well as the future running of the facilities, provides the local firms with potential business opportunities and technology diffusion. From a broader perspective, there are even greater regional opportunities since the establishment may entail further spin-off effects when it comes to an innovative climate and increased competitiveness for business, as well as a strengthened research community. These aspects may entail, in turn, creation of new businesses as well as an influx of skilled labour (Region Skåne)[11].

As with many international research infrastructure projects, most firms will be able to come in contact with the ESS through the facility's procurement. Procurement for the ESS will be carried out as a restricted procedure in two steps. Stage one will be an open procedure, with a call for expression of interest, and during this stage firms will be short-listed. Stage two will be restricted, and only firms that were short-listed during stage one will be welcome to tender. Many of the future partner countries will contribute in-kind (perhaps with as much as 70% of their total contributions), while the host countries (Sweden and Denmark) will make their

[8] ESS website: http://europeanspallationsource.se/ess-organisation
[9] Region Skåne: http://www.skane.se/sv/Skanes-utveckling/Ansvarsomraden/Regional-mobilisering-kring-ESS-och-MAX-IV/.
[10] Region Skåne: http://www.skane.se/sv/Skanes-utveckling/Ansvarsomraden/Regional-mobilisering-kring-ESS-och-MAX-IV/.
[11] Region Skåne: http://www.skane.se/sv/Skanes-utveckling/Ansvarsomraden/Regional-mobilisering-kring-ESS-och-MAX-IV/.

contributions in cash. This has already been a bone of contention in Sweden, where actors wanting to contribute to the construction feel that they compete on unequal terms (Ekelöf, ESS Day).

Increasing the Utility from ESS

Despite the fairly recent start-up of ESS procurement, there have been a number of projects initiated in the southern part of Sweden in order to improve the output from ESS to the surrounding area. The ones that will be presented here are TITA, CATE and The Big-Science Suppliers Network.

TITA[12]

From October 2007 to June 2009 a collaboration project, named TITA, was carried out in the southern parts of Sweden. Among others, the city of Malmö, the regional Council of Lund, the city of Helsingborg, the Council of Skåne, Lund University and *Region Skåne* were involved. The project was partly financed by EU money, partly financed by 44 local organisations, and its aim was to get a better picture of how to make use of the development possibilities created from the establishment of ESS in Lund. The project resulted in a report[13] outlining possible strategies. Out of the 20 companies involved in the collaboration project, 17 were qualified as suppliers to ESS which was considered to be a great achievement. There was no specific type of company involved in the project, however, and the only criterion was that the company was located in the region. In that respect the TITA project differed substantially from another project, which is presented below, and which focused on companies being able to become suppliers within accelerator technology.

CATE

Cluster for Accelerator Technology (CATE)[14] was an interreg (EU) project placed in the region of Öresund-Kattegat-Skagerrak. The purpose of CATE was to strengthen the high-technology competence in the region's businesses and to utilise the potential which the large research investments ESS and MAX IV may render. It ran between 1 January 2011 and 30 October 2014 and it involved several universities, regions and business organisations in

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[12] The acronym TITA is short for "Tillväxt, Innovation, Tillgänglighet och Attraktivitet", i.e. "Growth, Innovation, Availability and Attractiveness", the keywords of the project (http://essmax4tita.skane.org/content/vad-star-tita).

[13] The report was called "*ESS i Lund – effekter på regional utveckling*" ("ESS in Lund – Effects on regional development").

[14] http://www.cateproject.org/about-the-project , http://www.cateproject.org/

Sweden, Denmark and Norway as well as ESS.[15] The budget of the project was approximately 1.8 million euros.

The project had four main goals, out of which three goals were directly related to the industry in the region, i.e. 1) added knowledge about the companies in the region, 2) creating lasting business collaborations across borders, and 3) giving companies the opportunity of competence development with respect to how they can contribute to design, production and maintenance of the planned research facilities.

With the project the universities invited existing companies in the region to participate in tailor-made courses and a competence development programme within accelerator technology. The competence development improved the companies' opportunities of getting contracts for design, construction and maintenance of research facilities that demand advanced accelerator technology equipment. The project was highly valued and received an award as one of the most innovative projects in Europe by RegioStars in 2014.

The Big-Science Suppliers Network

Officially created on April 28, 2015, the big-science suppliers network is the most recent collaboration project with a focus to increase the possibilities for small- and medium-sized Swedish companies to become suppliers of big-science organisations (Eirefelt, 2015). By increasing the big-science suppliers' knowledge about each other, the network aims to create coalitions and increase sharing of competences between the suppliers that participate in the network (Ohlsson, 150504). The network is open to existing big-science suppliers, but also to companies that want to become big-science suppliers. The aim is to create a national network and that all companies have some sort of connection to Sweden, but in the future it could also be opened for firms with competencies that cannot be found within Sweden (ibid.).

[15] The following organisations participated in the project; The Physics Department at Lund University, Chalmers School of Technology, The European Spallation Source, Aarhus University, Oslo University, Lund University Commissioned Education, Force Technology, Risø DTU, *Region Sjælland*, *Region Hovedstaden*, *Region Skåne*, Lund University Procurement, *Västra Götalandsregionen*, *Væksthus Midtjylland*, AU Center for Enterpreneurship and Innovation, Southern Sweden Chamber of Commerce, Oslo Teknopol, *Dansk Industri* as well as *Svenskt Näringsliv* (http://www.cateproject.org/about-the-project).

Firms Delivering to ESS

> *"Going to the US and meeting customers there after the announcement that ESS was to be placed in Sweden, everybody came up to me and congratulated me. When I asked why, they said that now when ESS is going to be located in Sweden, you are certain to get orders from them. They were very surprised when I told them that Sweden is the only country when you have a 'home country disadvantage'"* (CEO of Omnisys, "Business for Billions" conference, April 2015)

As the construction of ESS has only recently started, there are not that many firms that have had the opportunity to deliver to ESS yet. The estimated building cost of ESS is approximately 1.84 billion Euros, of which 25-30% of the costs will be related to the construction. In February 2014, it was announced that Skanska, as one of six contenders, had won the construction contract for ESS (*Sydsvenskan*, 2014; *Fastighetsvärlden*, 2014). The difficulty for Danish companies to become sub-suppliers of ESS, through Skanska, has already (February, 2015) become a big bone of contention between the two host states Sweden and Denmark (www.rapidus.se).

Apart from the big construction contracts, there are also prototypes for parts of the accelerator being built, and some small- and medium sized companies have already delivered parts. Examec, a mechanical engineering from the small town of Tomelilla, has won ESS's first procurement of mechanical production which has led to the order of a Neutron Chopper Test Enclosure. Examec took part in both TITA and CATE projects; the latter leading to Examec also winning orders from CERN. The CEO of Examec claims that delivering to big science is high-risk, because of the copious demands on accuracy of the products; but that it pays off if the company is successful, because delivering to science organisations pushes the knowledge- and skill sets of the employees of the firm (Ohlsson, 2015). He also states, however, that is important to know when to not make an offer, as the marginal are small and it is very expensive to fail (ibid.).

So far, the Swedish companies that have won orders at ESS are very few, and most of the firms even interested in delivering to ESS seem to be located in the southern part of Sweden. If nothing else, the regional projects aimed at improving (local) utility from ESS seem to at least have increased the awareness of the facility.

Concluding Discussion

It has been stated that the ESS is the biggest science investment ever in Scandinavia. Lindroos (ESS Day) confirms that this is true, but only if you consider modern time investments. Tycho Brahe's observatory Stjärneborg, however, is claimed to ha cost the Danish king 1% of the state budget in 1580.

Is ESS a case of "build it, and they will come", or what does it take for a science organization to be useful to society? Being early days yet, any discussion on ESS's usefulness to society has to include some part speculation, but it is already possible to see differences in the activities carried out to make use of ESS. If we compare the projects TITA and CATE, which are both regional projects, there are major differences between them. TITA was well financed, but assembled all kinds of firms, and there are few reports of any real positive outcomes. CATE, on the other hand, was relatively conservatively financed, but the focus on a particular type of firms (potential accelerator suppliers) meant that they had skills interesting for research facilities; and the focus on building an actual prototype for CERN meant that there was a natural focus on interaction; both between the participating firms and between scientists, science organisations and firms. The focus on networking thus seems to increase the likelihood of positive outcomes; more than the more general regional focus (where the project administrators also talk about clusters).

As the construction phase of the ESS has only just been initiated, there are so far very few direct benefits to industry. It is interesting to see, however, what the justifications for investing in a research infrastructure project. Going back to the two main assumptions about science organisations, that 1) "science is beneficial to society in general", and 2) "the location matters/clusters matter", both are present in the argumentation for ESS. According to Agrell (2012), the ESS consortium had to run a public campaign with the dual purpose to both win the bid in the European context and gain legitimacy for the project from the Swedish public. The arguments for the ESS project definitely include potential industry collaboration (Jacob & Hallonsten, 2012), and thus ideas of usefulness to society. The regional organisations (such as for instance *Region Skåne*), on the other hand, seem to be directing their efforts at creating clusters of firms to make use of ESS. So far, however, it seems like it is actual interaction between firms, like the one exemplified in the CATE project, that leads to both knowledge transfer and contracts won. It is therefore no coincidence that the chairman of the newly started big-science suppliers network was also an active participant in the CATE project.

So far, this paper is a work-in-progress, and all parts of it need to clarified and extended. There is a lot more empirical material that needs to be added, both concerning the firms involved and the discussions concerning the localisation of ESS (on a regional level as well as a national level). I am looking forward to any comments that may help improve the paper.

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