



# LUND UNIVERSITY

School of Economics and Management

**Master programme in Economic Growth,  
Innovation and Spatial Dynamics**

## The Role of Large Scale Scientific Facility on the Regional Economic growth, (Case study: European Spallation Source, ESS)

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**Abstract:** This study examines what factors are behind a successful establishment of European Spallation Source in Lund, as a growth engine for the entire region in long term? This paper is also concern about how ESS, with innovation as driving force will affect the economic growth of the region (Skåne) through knowledge spillover and talent inflow. This study is also concern about how this investment contributes to Regional Innovation system and it will affect the interaction between universities, companies and other regional players thus could strengthen the Regional Innovation System. To answer the research questions, this study looks at the literatures concerning innovation, innovation system, knowledgebased economy and role of policy and university, reports on large scale scientific facilities and interviews with local players.

It is conclude that ESS will bring economic growth in the region by producing technological innovations and spinoffs within foremost materials and life sciences but to say exactly what it will be, is not possible and it will be much dependent on how good the regional players are at exploiting the opportunities that the facility would bring. ESS would employ several high educated and top scientists, thus relatively highly paid scientific and technical workers will stay in the region. It can also bring new startup companies from spinoff research. These will naturally have an impact on the local and regional economy. But overall, for the region to benefit as large as possible, preparation of local innovation system and need of ESS integration with regional innovation system is essential. However, there is need for further research to theorize the Scio-economic impacts of large scale scientific facilities, to more support the innovation based-economic growth.

*Key words:* Innovation, economic growth, large scale scientific facility

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# Chapter 1

## Introduction

### 1.1 ESS, European Spallation Source, the first completely sustainable large-scale research infrastructure

“In 2003, the European Strategy Forum for Research Infrastructure (ESFRI), set up by 31 European countries, agreed that a new European facility generating intense, low-energy neutron beams- the European Spallation Source (ESS)-was needed to advance a wide range of scientific research areas of strategic economic importance. A design for ESS was put forward that would generate neutron beams 30 times more than achieved by similar sources operational today” [9].

In May 2009, the city of Lund, Southern Sweden, was chosen to host the European project ESS - European Spallation Source. ESS, the first environmentally friendly research center in the world is now in its preparatory phase and the construction will be beginning in the next year, 2013. ESS as a materials research facility will use the neutron scattering technique for scientific researches. The first neutrons should be produced in 2019 and the ESS will be fully operational around 2025. Neutrons instead of light will be used in the installation process, a giant microscope probing into the matter, and will be an essential addition to the resource base of companies that produce everything from aeronautic parts to advanced medicine.

The work is undertaken in collaboration with a large number of Swedish and foreign universities and laboratories. At least 17 European countries supporting and participating (constructing, financing and operation) will contribute to the development of the region. Thanks to the advantages of this installation as an instrument that will provide industry with a very important tool that no single actor itself can afford and give European industry a comparative advantage over competing American and East Asian companies.

The cost of the installation is estimated to be around 1.4 Billion Euros, where the host country Sweden will provide around 35% of this figure. But according

to the estimation, the economic benefit for the host region would be much higher than investment costs, since it is hoped to attract high-tech companies to the region and create thousands of well paid jobs and the accompanying tax revenues. On the other hand, it has proved that Lund for the host facility would be the most competitive region that could harvest the most economic benefits from the installation as long with providing easy access for European companies into its well developed infrastructure, addition to the higher educated workforce.

ESS will benefit from MAX IV Laboratory, “the national laboratory located in Lund. From the mid 1980s- this facility has been responsible for a number of advances in various fields of research such as environment science, life science and nanotechnology.” The new MAXIV will be one of the most advanced synchrotron facilities in the world which could offer the ESS very powerful tool. MAXIV and ESS will be ready in 2015 and 2019 respectively and will be used for advanced materials research, a science from which the whole world will benefit. Equally interesting is the impact of ESS establishment on Sweden, Oresund Region and Skåne in general with respect to growth, jobs and business start-up [9].

What will be focused in this paper is the impacts that the establishment will have on the region. Regional development and growth as long with employment opportunities would be the result of sitting ESS in the region. Many international companies and researchers will be attracted by the facility; moreover, the employees of these companies and employee’s families will be assimilated into the region as well. Meanwhile, the region will be international market to the potential suppliers and large corporation as well as institutions. Many visitors will be attracted from all over the world and physical environment will be created for innovation and creative venues.

ESS as an innovation catalyst for trade and industry would present lots of potential for the businesses, academia and people of the Skåne. They should explore facilities’ potential to generate innovative power for the whole region. Nevertheless, it is difficult to predict how trade, industries and companies will benefit from the development opportunities that the new facilities will offer. It is essential to plan for promoting the collaboration between municipalities, businesses, trade industry and universities besides to make the relevant information available for the region’s business community.

## 1.2 Objective

What I would like to examine in this thesis is the direct and indirect regional effects of European Spallation Source as an innovative facility and the expected effects on regional development. The study carried out along a qualitative track includes:

1. Review of relevant literatures and reports,
2. Compile knowledge, experiences and lessons learned from comparable research facilities,

### 3. Analysis of interviews.

All of the mentioned points above have resulted in a proposal of how the ESS would affect the development of the region in a number of fields.

## 1.3 Research Question

The research questions based on the objectives are: What factors are behind a successful establishment of European Spallation Source in Lund, as a growth engine for the entire region in long term? Also how ESS, with innovation as driving force will affect the economic growth of the region (Skåne) through knowledge spillover and talent inflow. On the other hand, how this investment contributes to the regional innovation system in collaboration with universities, companies and other regional players.

## 1.4 Aim of the Thesis

This paper will be concerned about the role of unique European Spallation Source in the regional growth; in the significant respects of sustaining and strengthening deepening the regional innovation system. In terms of knowledge spillover and human capital inflow, it means strengthening regional innovation systems, maximizing knowledge flows and spreading the benefits of innovation throughout the entire regional economy.

One of the challenges of this study is providing the forecast information according to the expectation, therefore it is essential to write the paper without using the guessing game. To avoid the possible speculation, I looked into the relevant literatures and conducted interviews with some actors in the project as well as different regional actors regarding the effect of ESS installation into the Economic development of the region, with focus on Innovation, Innovation system, Knowledge-based Economy, role of university and policy which could stimulate growth, strengthen the innovation structure and promote accessibility and attractiveness of the region.

This study does not intend to quantify the future impact in the region as a result of the establishment of the facilities (however in the section 5.3, the quantitative impacts also has been mentioned based on the published report), while by using the qualitative approach this paper studies the role of advanced research facility in the regional development. When building large scientific facility which is literally unique, with the ambition of achieving effects not having been seen beforehand in a specific regional context, the discussion about the effects of such facilities will always be surrounded by great uncertainty and this was not ignored by the writer of current paper. However, it is recommended to develop a long-term strategy and action plan as to how the research facilities can be integrated in policymaking on industry, innovation, and university, through the very extensive network of partners. To fulfill this objective it is good to see the experience of other countries with comparable research facilities to gain a

thorough and realistic picture of challenges and opportunities related to the large scale research infrastructure.

### 1.4.1 What makes the case interesting from a theoretical point of view

Neoclassical growth theory developed by Robert Solow and T.W. Swan emphasizes that technology change has a major influence on economic growth, and that technological advances happen by opportunities. The theory argues that economic growth will not continue unless there continues to be advances in technology.

However the marginal utility of newly acquired technological knowledge decreases. For instance, in the advanced countries with high level of technology, the marginal utility of new technology seems proportionately low. Thus to preserve a given rate of growth, more concentration on the knowledge and as a result increasing amount of technology is essentially needed. Furthermore, according to the experiences in the international level, the analysis of R&D efficiency, input for knowledge economy, demonstrates that R&D suffers from decreasing returns and the main result is that R&D is less effective in the regions with the lowest knowledge endowment, witnessing that a certain degree of knowledge is required to generate new knowledge. USA, followed by Europe, and then by the two developing economies which have just started the process of investing specific resources in formal innovation activities are the countries which recognized the necessity of more concentration on the knowledge to create further knowledge in the societies. This calls for specific policies, which should target the regions, in order to support them – not only with additional knowledge but also provision of organizational and structural assistance that should enable them to exploit all the potential of their relatively abundant inputs in delivering higher levels of knowledge output, which in turn is predictable to ensure better long run economic performance [7].

It might be though ESS as an innovative scientific facility through which new technical knowledge would benefit the community. But these positives effect will not be guarantee by the ESS itself, while it should be matched with the appropriate innovation system. In fact, a competent business sector in this system can harness the knowledge produced by the ESS and converted to the new products [38, p.22]. Thus ESS as a research facility would contribute to the growth and create business in the region and surrounding but according to the Swedish Institute for Growth Policy Studies' report this is highly dependent upon collaboration with other sectors of the society. In fact, by this project the knowledge-based economy demonstrates the sign of attentiveness and it would be a kind of regional nodes which different sectors such as technology, science and entrepreneurship could meet each other [38, p.6]. Thus it is important to see the interface between the research and business sector in order to take full advantage of technological knowledge.

## Chapter 2

# Methodology and Data

This thesis is foremost a literature study, where I looked into the literature concerning big innovative scientific facility and the economic impact from various sources, as well as local studies of Lund and its surroundings. There have not been any academic research on the exact topic concerning ESS and Lund, but Region Skåne (the county authority) have together with PricewaterhouseCoopers before the decision for location of ESS in Sweden put forward a report on the matter. I will touch upon this report however since this report looks more in front of other competitors, it might be a bit biased. The paper will be started by technical introduction to the facility and the reason behind the facility that why the ESS spallation is used?

As a theoretical framework I will look into the literature concerning economic growth and innovation. Thereby a concise background of economic theory will be presented regarding endogenous growth theory and its role in the development of markets and societies. It would also be interesting to review the theory of Knowledge Economy (KE) to see, how KE could provide the required framework for understanding the role of innovation in the economy. Regional System of Innovation in cooperation with scientific facilities like the ESS would make link between such a facility performance and economic growth. Thereby, the concept of System of Innovation and more specifically, regional innovation system are the next topic of discussion.

The role of universities and policies in this process will be also discussed in the theoretical survey. Therefore at the end, this section will result the grounds for the analysis. Introduction to ESS and then report review are topics that will be introduced in the following section respectively. Three main subjects will be covered. First of all the quantitative impact and growth forecasts will be presented. Basically the result of investment of large amount of money to establish the large research facilities on the economic growth is more indirect impact on the climate of innovation. Thereby positive long term indirect effect will be reviewed qualitatively, also a touch upon a bit quantitatively. Afterwards the international comparison will be presented which is aimed at for evaluating growth prospect of ESS. As there have been numerous reports and investigations

in Europe as well as other areas of the world regarding to the advanced technology facilities and projects which is growing in the world, it seems therefore important to do an International comparison or to review the lessons learned from similar facilities. At the end of this section, the comparative study between ESS and MAX IV will be presented. Beside the literature study that will lay the groundwork for the paper, there would be some information from reports and also gathered from conducted interviews of local actors, as it will provide crucial information about the economic impacts of facility from the views of experts involved in the project. Thus, the result will be based on general background material, reports, experiences from the same facilities, interviews and my own analysis work.



## Chapter 3

# Technical introduction to the facility

The technical side of the European Spallation Source, ESS, will be presented in the following section. It is easy to look up objects with the naked eye or a microscope if there is enough light, but in R&D departments where research is performed; the study of the smallest components, molecules and atoms needs a more intensive light. The general rule is that the materials of study cannot be detected if they are smaller than the wavelength of the light. Atoms are about 0.1 nanometers, which are much smaller than the resolution in the visible light, which account for around 450 nanometers. This is a problem for scientist who must be able to see molecules and atoms in order to be aware of the structures in the materials which is aimed to be developed for new innovative products. For instance, everything from molecules and medicines to plastics and proteins need smaller wavelength to be probed. It is necessary that the probing instrument has a wave length that is half of the material structure size which is desired to be measured.

The electron microscope is used for observation of smaller structure than one sees with visible light. However, this instrument is not sufficient for observing individual atoms; when neutrons are the tools used for this application. These give the opportunity to observe the internal structure of the material. Since neutrons do not have any charge, they penetrate easily the atoms and provide precise information about the individual atoms. The ESS has been designed to generate these neutrons and to be world leader for material research and life science where neutrons will be used to screen a wide range of materials. To apply a similar research in the past, researchers have used radioactive materials for emission of neutrons, but in this way low intensity neutrons are emitted. The ESS will instead accelerate protons with a linear accelerator (LINAC) into a heavy metal target which will emit intensive pulses of neutrons after the collision. Afterwards, they are led through beam lines to experimental stations, where research on materials is done as part of the scientific front line in energy, man-

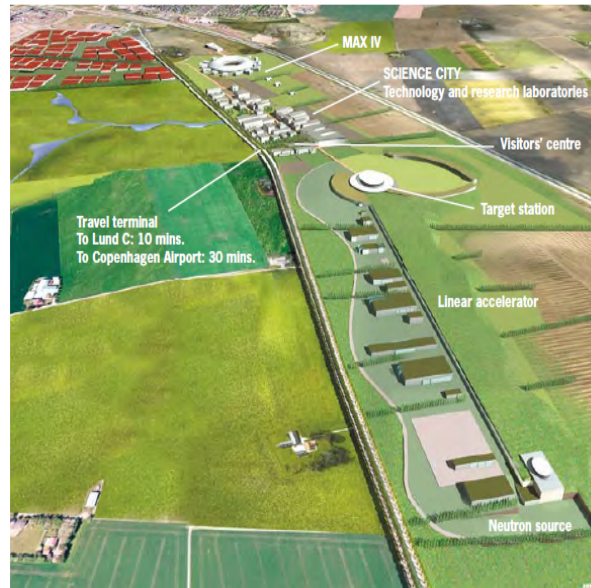


Figure 3.1: Conceptual drawing of the ESS site Source: “The ESS in Lund - its effect on regional development”, p 25.

ufacturing, telecommunications, transportation, information technology, etc.

For many years Europe has been the world leader in neutron research. Many present facilities in Europe have been in operation for several decades, and they will be out of operation by around 2020. To be realistic it has lost some of its advantages now which are basically due to newer and better facility that other countries have built in the recent decades. Considering to the large number of neutron sources in Europe, the ESS would be a good choice for European countries and they can regain their advantages and to be a world leader again, this time in material researches and life sciences to screen atoms of different materials from plastics to medicines. As it takes for the ESS around one decade to be completed it is important to be noticed by European countries that European industries should be competitive in the future while they should imagine the ESS is already built today.

## Chapter 4

# Theoretical Framework

### 4.1 General Theories

#### 4.1.1 Economic Growth

Since 1776, Adam Smith was a person who has started to contemplate the theoretical correlation between innovation and economic growth. He articulates the productivity gains from specialization through the division of labor. He also presents the productivity growth with technological developments to capital equipment and processes. Interestingly, he even recognized an early version of technology transfer from suppliers to users and the role of a distinct R&D function operating in the economy [34].

In 1957 the relationship between innovation and economic growth was introduced into formal economic growth models by Robert Solow [36]. He has defined as GDP growth per hour of labor per unit time, by measuring the fraction of this growth attributed to increases in machinery investments (capital). Previously, capital accumulation was determinant of growth which accounted for less than a quarter of growth. Solow's theory was in attributing the remainder of growth, the majority share to "technical change". Thus for the past half century, he highlighted the role of innovation in economic growth which might be though it was a sophisticated model than the later advances in this relationship.

Lucas (1988) and Romer (1986, 1990) respectively have emphasized the concepts of human capital and knowledge spillovers, developed by investments in education and training. Lucas distinguished the concept of human capital from physical capital thus they modeled human capital with constant rather than diminishing returns. In fact, through this theory the role of a highly skilled workforce for long run growth has been highlighted. On the other hand, Romer by introducing knowledge spillovers modeled the innovation as endogenous factor contributes to economic growth.

Due to the profitability of research and development in aggregate level, the firms allocate their funds to them, since returns on R&D investment at marginal level is higher than other resource allocation. In fact, R&D investment results

in the generation of two different types of knowledge. First of all, creating the knowledge for the firm that can be utilized by itself which named proprietary; the second one is non-proprietary knowledge which is non rival knowledge. This kind of knowledge is a public good since it is both non-excludable and non-rivalrous while using by one does not preclude use by another and it is not excludable likewise. Consequently, firms conduct R&D to apply human capital to the stock of knowledge and generate profits from.

This theory illustrates the role of knowledge spillover on the boost of human capital investments contributing to increase of returns to growth. In point of fact, the more human capital which exists in the economy could receive the more value from the stock of public knowledge, where this is through the R&D efforts and could raise the value of conducting R&D. This result in the economy more engaged in R&D and further contribution to the stock of public knowledge. This process and R&D engagement is not just due the selfish reasons and profit seeking firms, while it could be also as a role for the public funding of some types of R&D. In the first state the single firms could appropriate some of the knowledge value that they have created. On the second state, some types of researches are hard for the single firms to appropriate, and it would lead to the knowledge spillovers which are valuable for the entire economy, thus public funding would be active in R&D investment to avoid under investment. After all, one could draw the conclusion that the concept of knowledge spillovers as a public good is central to the thinking about the relation between innovation and growth. While there is a lot of questions in this regards, one could mention to the concept of knowledge spillover as public good and tendency of nations to produce it and its' inconsistent with the some economies evidences such as growth rate . Due to publicity and freely availability of the knowledge spill over, the convergence towards equal prosperity in the global economy might be expected. It is while this ambition has not covered thus it seems there are different dependency reasons which surpass this process.

### 4.1.2 Knowledge Economy (KE)

Innovation concept is comprehensible by emerging through the interactions of different actors. Universities, firms and governmental players have particular roles in the process of knowledge creation, adaptation, diffusion and incorporation into a specific good and service. This would provide tools for science, technology and innovation improvement. Thus, in order to cover the robust analysis of the Innovation role in the economic growth, it is essential to discuss a Knowledge Economy approach integrated with the Innovation system of the countries towards economic growth.

The knowledge economy framework describes the trust of economy on the knowledge and is powered for growth. The role of knowledge in the economy is increasingly crucial in the process of creation and implication to enhance economic development. Thus, knowledge economy emphasizes on the protagonist role of knowledge in the economy by recognizing it as other economic resources. Apparently KE concentrates on the appropriate policies to apply this resource

in the global economic context [15]. From the Knowledge economy approach, applicable knowledge is produced and flowing within the society which is crucial for rise of economic output.

### 4.1.3 Role of Innovation

Since the industrial revolution the role of science and technology has become significant, going from an economy which was based on craftsmen and draft animals, to a machine based economy. Innovation has been important for the economic and social growth in many aspects, such as; the productivity, the education level, the life expectancy, and the living standard etc. The world would not experience the steam engine, trains, electricity, or the internet without the implementation of technologies and inventions, which have had a fundamental impact on the modern economic growth as well as the current economic growth. One has to distinguish between the terms invention and innovation, and according to Fagerberg: "Invention is the first occurrence of an idea for a new product or process while innovation is the first attempt to carry it out into practice" [31, p.4]. In another word, without invention, innovation would not have occurred. Thus, to make the innovation process sustainable, the supports from complementary knowledge, financial resources, and appropriate institutions are necessary.

Relationship between Innovation and economic growth has been well studied by many scholars in the recent decades. A key driver of the growth has been innovation. In fact, the major engine of economic expansion is a creation, dissemination and application of knowledge. Most sectors and industries have realized the crucial role of innovation in effective competition, of economic development and the transformation of societies which interprets the significance of "Schumpeterian renaissance" in the industries and sectors' activities[41].

It has known by the economies beside the increscent of inputs that goes to the productivity, the other wised way of gaining the larger number of output from the same number of inputs is Innovation. After Second World War the estimation of inputs and outputs has occurred for the American economy, although the size of residual affected the reliability of the results but Solow with different methodology has examined this relationship and persuaded most economists that technological innovation have a major force in the increscent of output. However, it is not easy to agree on the single definition for innovation, one could mention to the following definitions which have proved from the economical point of view: an efficient stimulant for building world leading organization for instance Microsoft and Apple, the other classification is a message that reinforces a cooperate ambition such as Toyota the last one is a discipline of creativity that motivate the best people could take an examples of Google. In the global level, industrialized countries have shaped their economy based on ideas (technological innovations) as well as labor and capital [26].

#### 4.1.4 Innovation System

Innovation system is the concept in the field of economics which stresses the role of technology and innovation, according to [14] it provides a specific role for government policy towards the technological catch-up process. The association among the actors in the innovation system is a requirement for innovation and technology development. Thus it contains interaction between innovation researchers, policy makers, enterprises, institutions, and people to turn the idea to a product or service on the market. There is also an explanation that innovation system labels a planned innovation environment. Freeman (1995)[12] mentioned to the concept of “National system of innovation” which has applied to the regions and sectors. According to his definition, the national innovation system is the networks of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies. He mentioned to the successful development of Japan with high level of R&D spending which has widely used national innovation system approach thereby knowledge has produced and applied in the country. In this regards, one could mention to the significant role of R&D expenditure on the success of innovation as long with the links between firms and other institutions. Thus the importance of linkage within the innovation system would be noticeable; as the impact of technological innovations in society depends on how suitable these linkages are for domestic business, combined with the efforts developed by firms[12].

## 4.2 Specific Theories

### 4.2.1 Role of Policy

We cannot ignore the role of government to promote the production, diffusion, and use of scientific and technological knowledge (according to the national objectives) which have named Innovation policy. From [31] point of view, Innovation policy covers a wide range of initiatives which make it essential to classify this complex concept. The distinction that they used is between science policy, technology and innovation policy. In fact, by passing from one historical stage to another is required passing from science policy to technology policy and then innovation policy.

There are two different versions of innovation policy; the first type of innovation policy refers to the basic research and general education which they are representative of the only legitimate public activities. Also it refers to the intellectual property right protection as the only legitimate field for government regulation. In the more moderate versions of innovation policies, public initiatives intend to foster “entrepreneurship” and promote a positive approach towards science and technology. On the other hand, the second version is the systemic approach of innovation policy which refers to the concept of innovation system. In this approach, the most major policy fields require to be considered in the light of contribution to innovation [31].

Metcalfe and Georghiou (1998) [30] believe that the theoretical foundations

of these two versions of innovation policy are seen as following: first, the application of standard neoclassical economics on innovation. The second one is a long-term outcome of research on innovation and economic evolution. It might be thought, the innovation system approach would provide the most important stylized facts of innovation together and accordingly it relies on the empirical material and analytical models developed in innovation research, as long with evolutionary and institutional economics [29]. According to [31], the major objectives of innovation policy are economic growth and international competitiveness. Innovation might also be seen as a way to find solutions for central problems connecting to urbanism, pollution, energy and poverty. But significantly, it highlights the creation of economic wealth.

It is interesting to mention to the experience of OECD expert group —Freeman, Svenilsson, and others — in 1961. They have presented a manual for science policy creation in such a way that it became integrated with economic policy and provided a real impact on economic growth. They believe that to generate effective national innovation policies, there is no way without analyzing the domestic innovation system. It contains the way it produces knowledge and competence, and comparing it with others. Moreover, size of the respective economy as well as the stage of development will affect the ensuing plan of action. Recommendation for the small countries as long with developing countries is that, they have to be more focus on the structures and institutions that affect absorption and efficient use of technology. Thus they could understand and act upon than those promoting the production of the technologies at the front. But for the big countries, the production of the new technologies is more important, they also through the absorption and efficient use of innovations and new knowledge would have much to gain [31].

### 4.2.2 Role of University

The role of universities is very important in the “knowledge-based” economies of modern industrial and industrializing states and are considered as sources of trained “knowledge workers” and ideas flowing from both basic and more applied research activities. But for several reasons, conventional economic approaches to the analysis of institutions are difficult to apply to universities. First of all, there is no interuniversity “competition” in most national systems of higher education, with the exceptions of the US and British university systems. This “selection environment” was a very important historical influence on the evolution of US universities and their links with industry. Secondly, to analyze universities as economic institutions, it is required some definition of the pursued objectives by individual universities. The reason is that universities perform multiple roles in many national systems and that the internal structure of most universities resembles that of a co-operative organization rather than the hierarchical structure associated with industrial firms. The modern university arises from middle Ages, rather than the Industrial Revolution, and its origins are still influencing its organization and operation [31].

The development of universities is a significant issue to understand the con-

sequences for academic research of government policies (that seek acceleration of research transfer), results to industrial firms. The intensified demands from governments to raise the (measurable) economic returns to their substantial investments in academic research and education makes the development of better tools. Thereby according to [31], there are tensions to put pressure from policy makers and others on universities to accelerate their production and transfer to commercial interests of measurable research outputs. It might be though should more emphasis on the important aspects of university–industry interactions which could have consequences for innovation policy in the industrial and industrializing world.

There is a conceptual framework for analyzing the changing position of universities within national innovation systems which is the “Triple Helix”. This has popularized by Etzkowitz and Leytesdorff (1997) [10] emphasizes the increased interaction among the institutional actors in industrial economies’ innovation systems. They state that in addition to linkages among institutional spheres, each sphere takes the role of the other. Therefore, universities presume entrepreneurial tasks such as marketing knowledge and generating companies even as firms take on an academic dimension, sharing knowledge among each other and training at ever-higher skill levels [10, p.6].

However, the “triple helix” studies devote slight attention to the “transformations” in industry and government that are asserted to complement those in universities. The helix’s highlights a more “industrial” role for universities, although it exaggerates the extent to which these “industrial” activities are taking place throughout universities. According to the “Triple Helix” framework, larger interactions are associated with change in the internal culture and norms of universities (as noted, this framework much less informing about the change in the characteristics of industrial and governmental research institutions). What is lacking in this framework is a clear set of criteria by which to assess the strength of such linkages and a set of indicators[14].

Overall, the absence of broad longitudinal and cross-nationally comparable indicators of university–industry interaction reflects the lack of a stronger analytical framework for understanding the roles of universities within national innovation systems. More comparative institutional work on the evolution and roles of research universities, including the contrasting “division of labor” among universities and other publicly a supported research institution is a crucial initiative for analysis of the research university position within national innovation systems [31].

### 4.2.3 Regional Innovation System

#### 4.2.3.1 Overview

Innovation is a complicated phenomenon, and often refer to an environment where “all important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovations” [5, p.14]. Innovation consists of intensive interactions between both public and



private actors. This phenomenon is generated and diffused based on a systematic nature, with inevitable communication among the participants, like firms, universities, research agencies, government and institutions [11, 27, 28, 31, 5, 24]. The interactions between the participants in an innovation system are of major importance. This group of participants or actors includes firms, producer groups, governments, etc. The core of the institution set up is those actors that produce, adapt and diffuse new knowledge; and on the other hand, the institutional setting up affects the interacting mechanism. Further, the institutional setting up influences the technical changing, firm and market.

#### 4.2.3.2 Regional Approach

The emergence of region is an essential principle in the theories of economic growth and innovation. Regionally variations are noted in the quality and types of systems along with different ways through which these processes and systems are sustained and developed. Innovation is linked with the regional clustering of activities and resources. Innovation and advances levels of productivity along with wealth and competitive power are a result of regional clustering. The center of attention on regions as the most excellent geographical extent for an innovation grounded culture economy stresses the significance of regional capital in motivating the competitiveness of companies and innovation capability [23].

Kallio A., et al, (2009)[25] mentioned to the definition of the regional innovation systems which consist on human relations set of connections with different social associations mainly in the shape of social set of connections. This could affect economic outcomes as set of connections influence the quality and flow of information. He believes that there are strong and weak ties in social networks which both are important to innovation [25].

Regional innovation systems could be explain as public and private organizations which function through organizational configurations and associations, they are favorable to the creation, utilization and diffusion of knowledge [4].

According to [13] in his knowledge production function approach, regional innovation systems could be described through collaboration and competition among knowledge generating and knowledge diffusing. He points out for instance universities, R&D organizations, firms, training organizations and technology transfer agencies are among significant players in these systems. Culture is also another dynamic which could support innovation and enables regional innovation systems to develop. In general, regional innovation system encourages innovative activities in two different ways: Firstly, innovation projects would be possibly accomplished or even not started in a presence of region, inputs or other resources but from the Second approach, effectiveness and productivity of innovation development can happen in local atmospheres where a high level of labor distribution is stimulated [13]. According to [4], there are three key features of regional innovation systems:

1. Innovation capabilities are continued through regional communities and innovation in a geographical process. Localized resources and common

knowledge bases such as local traditions for cooperating and specialized labor market are shared between these regional communities.

2. Social associations there innovation has its roots, grow with the passage of time with culturally determined lines. The set of rules, conventions and standards which form expectations and stipulate behavioral roles are subsequent by regional framework. Frequently there are casual social associations which could establish a particular version to increase the local capability of innovativeness through cooperative and synergic learning practice.
3. Innovation occurs in the presence of geographical proximity and awareness. Globalization changes both the extent of innovation and notion of proximity. Technology, knowledge and industry are diffusing worldwide with agglomeration to make intense handfuls of particular clusters. International connections emerge to be an important thing to sustain development of an enterprises cluster. Jerome L. W., (1999)[23] mentioned “Technology transfer, financial flow, interpenetration of business activities and information flow, partnership presents prolonged opportunities for them”. Furthermore it is observed that international associations and connections increase the regional movements through opportunities for worldwide knowledge sourcing [23].

## Chapter 5

# Introduction to European Spallation Source (ESS)

### 5.1 Background

The use of neutrons from reactors or so-called spallation sources is considered as an experimental resource for material science. The reactor based experiment for this purpose has been in operation since early 1970s at the Institute Laue-Langevin (ILL) in Grenoble [42]. The European neutron source user community, has claimed that the great world-leading role of the ILL in neutron based science will be lost if the next generation neutron source, the ESS is made reality [40]. The plans for the ESS were drafted in early 1990s, but these got political leverage almost a decade later, when made part of recommendations for large-scale scientific projects by the

Organization for Economic Cooperation and Development (OECD) together with similar projects in Japan and the USA (ESS 2002). The Japanese and American facilities were completed seven years later, but Europe still had not even reached any decisions. The issue was taken up again at the end of 2008 by the Competitiveness Council of the Council of the European Union, a cabinet-level EU body for issues of research, industry, and the internal market. Three sites for the facility were considered - Lund in Sweden, Bilbao in Spain, and the Debrecen in Hungary - and the political lobbying of the three was intense. The European Strategy Forum for Research Infrastructures (ESFRI) undertook an 'independent' review of the three sites, and the review did in a sense 'approve' all three sites and pointed out their relative strengths and weaknesses [3]. A meeting was summoned in Prague on 29 May 2009 with representatives of countries that had declared interest to participate in the ESS. A majority of the present delegations expressed support for the Lund site, although no formal agreements were made [6]. There is an argument that the decision from Prague in May 2009 and the written statements from the supporting countries, means nothing more than an agreement that the ESS will be built in Lund, if it is build. There

is no decision made by the EU on the matter, and the build of ESS in Lund is still a negotiation matter between interested countries, some of who have shown their intent to the Swedish government, without no specified formal pledges of support or any future financial contributions. A final decision is to be made in the current year, 2012, by the collaborating partners, including Sweden, by which the current overhaul of the technical design, the scientific case, and the cost estimates is expected to be concluded. Very detailed cost estimations and schedules for commissioning and construction are available, although the ESS is by no means finished. The estimated cost in 2008 prices is 1,478 M€, excluding built-in flexibility such as opportunity for upgrades [8]. On top of this, some developments have been done for a number of alternative contributions, which will be a negotiation subject between the collaborating countries. The construction at Lund is set to begin in 2013, and if the proposed 'basic design' is eventually implemented, the ESS expects to be fully operational in 2025, with 22 instruments [1, 2]. The mentioned estimations are based on the assumption that an agreement regarding the financing of the ESS is reached before the finalization of the technical design. Currently, further countries are involved in the project; Denmark, Estonia, France, Germany, Hungary, Iceland, Italy, Latvia, Lithuania, Norway, Poland, Spain, Sweden, and Switzerland [1]. The pledged contribution from Sweden and Denmark approaches 50 percent of the construction cost, 12.5 contributed from Denmark and the rest by Sweden. The project costs are reportedly covered to 90-92 percent of the total cost, although the assurances from the other collaborating partners are collected.

## 5.2 ESS and Innovation

The competition between science and nature has been always one of the challenges in development process of the countries. To build the research facilities using clean energy and integrating sustainable ecology into the research and technology has been the desired ambition of politics as well as the economists during the recent decades. In the past 4 years, European project- ESS- European Spallation Source, initiated to offer innovative energy solutions to the first fully sustainable research facility in the world. ESS as an example of "triple helix" model cooperates with E. ON and Lunds Energy to provide sustainable energy. For building the society, there is need for materials. To build a sustainable society, sustainable materials will be used; hence, material research is science for society and ESS is a significant large facility to dedicate these contributions to the society.

It can liaise with European governments and EU to establish a 10-20 year neutron road-map for Europe. This European project the most probably could be a remarkable model for future research facilities and a significant contribution to the overall climate change and Energy Efficiency challenges. Therefore, ESS as a climate neutral research facility by offering the innovative energy solutions would affect the region (Skåne) and surroundings. This innovation and exchange of idea make the facility effective and different, while new opportunities will be

opened up; it will be followed by imitators, interacting together with other actors in the region, such as institutions, entrepreneurs, companies and universities. Thereby after the certain of time the economy will affect in terms of employment rate, service industries, talent inflow, and knowledge spill over. It is therefore reasonable to make the assumption that this innovation is the driving factor of the regional development and growth of economy as well as the society growth.

Material science and research at ESS will lead to improvements and constructions of new, more sustainable materials for a sustainable society. Based on this, the ESS would become the first carbon dioxide neutral research facility in the world and create the most environmentally smart grand scale work place in Lund. In some extend this facility might be seen as different perspective on innovation. In this case, non-material forms of technological progress are surveyed, but it will contribute to the quality improvements, reductions of environmental damages and reductions of energy consumption. It supposed that in the case of ESS there is spatial concentration on this soft form of innovation with particularly high values in which is a first completely sustainable large-scale scientific infrastructure in the world. The ESS could reveal the secrets of materials at the atomic level and enabling research centers and industries to modify and tailor their properties and performance to satisfy the demands to an increasingly technological society. Where the major benefits will be transfer to transport, electronics, medicine, energy production, manufacturing and the environment.

This is a major science facility that will provide the world's most intense beams of neutrons for the study of the structure and dynamics of materials at the atomic level. [9] states "It will be one of the most important and prestigious scientific research facilities in the world, enabling developments as diverse and as significant as drug design, new magnetic materials for data storage, super strong, super light ceramics for engineering, biocompatible materials for repairing our fragile bodies, hydrogen fuel for clean transport, innovative processes for capturing carbon, the list is endless" [9].

This facility will be used by around 1000 of international scientists every year, thus top class science and top class scientists will come to the region, better health, more efficient technology and so many other positive effects will be contributed to the region. Likewise, Skane and Oresund region will be developed into the best place to work and live [9].

It has predicted during 2011-2018 is about delivering the added value of ESS performance at all levels that were promised in earlier plans, programs and visions which is basically in the form of research result as long with the benefits for society. In fact, one could argue this is representative of capability to present the science-based society of the future which is significantly a dynamic creator of growth [33].

Total resource in the territory is one of the crucial bases to discuss concept of growth contributed by a project. According to the classical growth theory, financial capital is one of the significant factors for the growth [21]. We cannot ignore the necessity of variety types of resources in order to achieve balanced growth. Environmental and natural resource capital, intellectual capital, in-

Infrastructure capitals are all equally important for the sustainable growth and development in the region. However, there is no doubt for the weight of financial capital which is basic premise for the other type of resources. In fact, the other types of capital are the creators of the conditions for economic and financial growth. Fig. 5.1 demonstrates the reasoning behind this while other types of capital are in the frame for the financial capital.

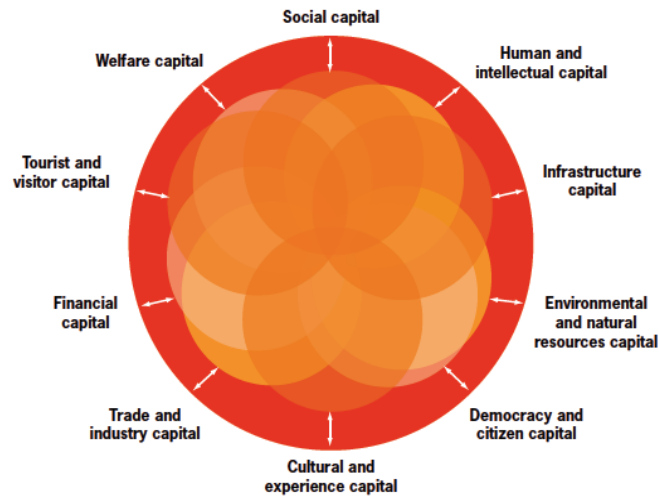


Figure 5.1: Variety of resources. Source: “The ESS in Lund - its effect on regional development”, p 19.

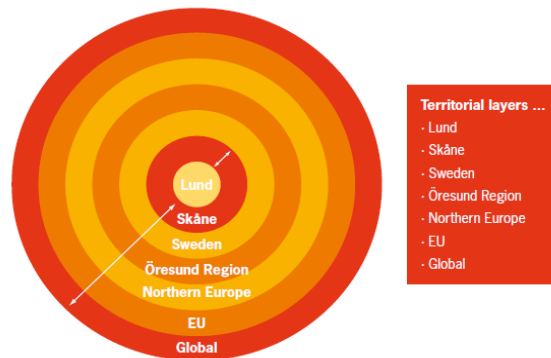


Figure 5.2: Geographical perspective. Source: “The ESS in Lund - its effect on regional development”, p 20.

The common regional effect is on the Skåne region while it is more suitable to

take a wider look at the geographical layers which are affected by ESS facility. Thus to see the context should see a deeper perspective in the international Öresunds Region with Denmark and in wider extend Northern Germany as natural points of contact. Fig5.2 illustrate s that ESS located in Lund in the heart of model and then it comes to Skåne afterwards Sweden and so on. It is clear that inside layers create conditions for the next layer thus it might be thought, geographical perspective forms a number of interactive layers. The principle studies about the effect of innovation on the economic growth will be discussed in the following (with respect to ESS).

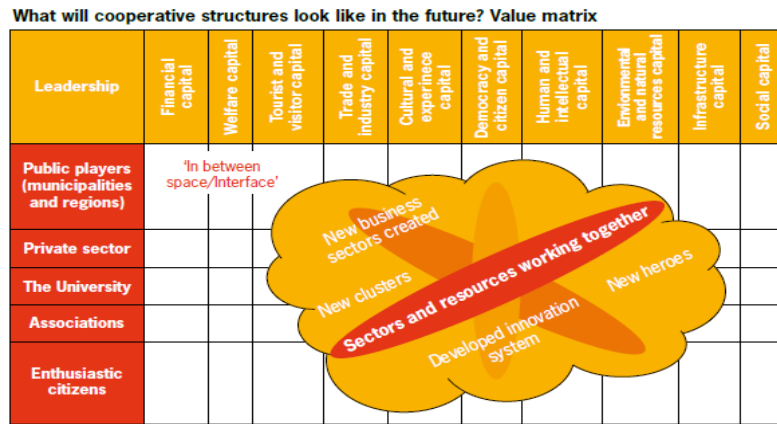


Figure 5.3: Cooperation between Sectors and resource. Source: Pricewaterhousecoopers.

According to new growth theory besides the classical input factors capital and labor, Innovation is often regarded to play a significant role in economic growth. European Spallation Source is an advanced research facility resulted from the recent policy actions undertaken in European community with centralization of Sweden to support innovation. As mentioned before in general theories, all development assumes changes but each changes doesn't necessarily guarantee development and growth. What make it different and effective is renewal, exchange of idea and innovations. However, the long complex process from idea to commercialized 'reality' requires interaction between many different players. Thus ongoing and open processes between the actors in the society who are involved from the variety types of resources (Fig. 5.1) are decisive. Considering to the different layer from geographical perspective (Fig. 5.2) involve in the project as well as different players from various strategic types of resources, could draw attention to Fig. 5.3, which is flexible matrix integration of Fig. 5.1 and 5.2. It generates a suitable state for the open and ongoing process of renewal.

In general, for innovation and renewal process to work properly is essential

to provide the integrated system where the various parts are linked to get-  
 ter. For instance, one could mention to the proper connection of idea, service,  
 production, market, development and financing which are working together. In-  
 tegration of various sectors within territorial visions as well as creativity and  
 transparency is desired to create good conditions for the renewal process. More-  
 over, great knowledge and relationship capital in the form of intelligent risk  
 capital and capital with skills should be provided and last but not least, leader-  
 ship should be more under consideration. Internally and externally leadership  
 as long with nationally and internationally leadership dare to work together in  
 new constellations.

It might be thought, Region Skåne commission in its report does not pay  
 attention to the origins and development of innovation systems extensively. But  
 it is rather more discussion on significance of upgrading and renewing existing  
 innovation systems by this commission. Available discussion with in system has  
 been technically practice of great consensus around the approach of Triple Helix  
 as long with Helix Lund and consequently enhanced functionality with growth  
 at the end [20].

## 5.3 Quantitative Impact and Growth Forecast

### 5.3.1 Quantitative Impact

In 2009, a report “The ESS in Lund - its effects on regional development” car-  
 ried out by PricewaterhouseCoopers in cooperation with Region Skåne. It was  
 published regarding to what the impact of placing the ESS might be on Lund  
 and the broader region. The contents was technically divided into two sections,  
 a quantitative and a qualitative parts, where so much information was gathered  
 to make a qualified guesstimation on how the future in the region will turn out  
 with sitting ESS in Lund.

In the quantitative analysis [32, 33] state that achieving growth and devel-  
 opment in the region depends on how well the regional actors are working to  
 getter to create the right conditions for that. The direct effect of sitting ESS  
 in Lund and 500 employment opportunities would not be higher than invested  
 costs, but its spinoff effects on the region can be enormous. Explaining this  
 view point, the estimation of the regional impact in the report has classified  
 into three different scenarios: Base, Vision and Max. The base scenario just  
 accounts the direct effects of the facility for instance salaries and building costs,  
 then the Max scenario foresees a future where the regional actors have taken  
 the opportunities that the ESS brings, and where the spinoff effects have been  
 remarkable. Last but not least, the Scenario Vision is somewhere in between,  
 and might be seen as the most plausible one.

There are number of trends for the region; one is that southern Sweden and  
 the Copenhagen areas are getting more unified, particularly as the opening of  
 the Öresund Bridge. The growth in one part of this channel would thereby  
 benefits the other side respectively. Growth of population and employment rate



in the region will thus be distributed between these sides. Employment and economic growth for the Swedish side has been higher than the Swedish average for the last decade, and is thought to be at least in par with the Swedish national growth average in the coming decades. The growth rate for Denmark has predicated to be roughly the same in the next years, with a highly positive trend. This signifies that this region is an attractive and net-expanding region by now, even without sitting ESS in Lund [32, 33].

### 5.3.2 Growth Forecast

There is a study carried out by Swedish institute for Growth policy which has examined the long term economic effects from investments on research infrastructure. PricewaterhouseCoopers report has cited this study in their report. Copenhagen business school also has conducted a report on what might be the result of sitting ESS in terms of growth. Both institutions conclude that the direct effect may be negligible compared to the indirect effects that may happen if it leads to technical developments and high-tech business opportunities[32]. They were cautious that these effects are very difficult to forecast and measured, and highly dependent on competent regional innovation systems. Based on another report about the elasticity estimates for R&D and how it relates to the total productivity factor, it was estimated that the ESS will increase the R&D capital by one percent a year. Or 1 billion SEK added to the total of 96 Billion SEK invested in Swedish R&D each year. Translated to Total Factor Productivity (TFP), this would mean an increase of 0,17 percent of TFP per annum.

There are however three phases that will influence in different ways, there is the pre construction phase that goes between 2008 and 2012. In this phase there might be a lot of economic activity concerning land acquisition in the area. The land around ESS will than become more valuable, and may trigger land purchases in the attractive area surrounding the site. The second phase, the construction period, will go on from 2012 to 2018. This phase will be of much value to the region in terms of direct wages to construction workers, their secondary spending and so on. The building cost has estimated to 13 Billion SEK, that can be put into perspective where the gross regional product 2005 was 312 Billion SEK. Some of the money spent will not benefit the region since much equipment are bought in an international market, but around 30 percent are estimated to be spent locally.

The long term effects, defined as 2018 to 2040 are a big deal to quantify. The running costs each year for the facility will be in the order of 1 Billion SEK, which is substantial in respect to the Total national expenditure of 96 Billion SEK.<sup>12</sup> Shown in Fig. 5.4 below, is the projected investments costs for the installation over time, where it levels out to around one Billion over time as the cost to fund the facility.

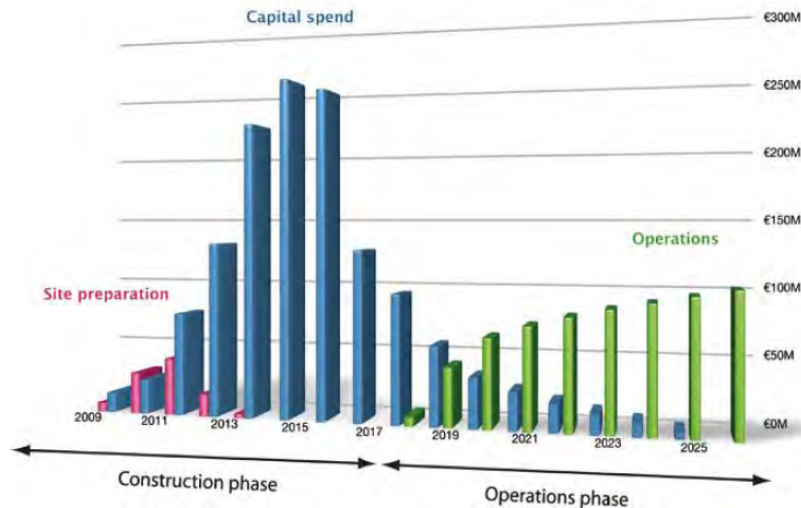


Figure 5.4: Capital Spend on the ESS installation. Source: The ESS in Lund - its effect on regional development, Ch 5.

### 5.3.3 Qualitative impact, comparison with similar facilities

In the qualitative part of Region Skåne's report comparable facilities around the world are introduced. A pure scientific need for these facilities not only was the reasoning to establish big research installations in the regions, but rather to act a springboard towards economic growth and to rise of regions attractiveness and to put the region on the map. The global competition for talents and business opportunities contributes to the regions' desire to raise their status. This provides the situation for regions to be on the forefront of technology and opportunities, and one way to do this is to support and finance big research installations. These facilities are usually surrounded by business cluster that can take part and exploit the opportunities and research that takes place there. In Japan for instance where the J-park neutron source has built, there is already a business cluster surrounding it that can do just this. And the Japanese government has stated as a condition for them to finance the facility that at least 25% of the machine time must be given to industry for their applied R&D.

There are also parallels drawn to the ILL in France, where the facility have been sponsored by a number of countries, just as the ESS will be, in contrast to the J-park that is only financed by the Japanese. The problem with these types of facilities is that they can be a cut off from society, and become an International enclave that does not benefit the surrounding in a significant way. For the region to benefit from sitting ESS as much as possible, there have to be an active regional innovation system in place to make use of the opportunities.

Another science facility with surrounding Research Park that is used as an example is the ISIS in England. It was built in 1985 close proximity to Oxford University. Around it there is a large business and science park called Milton Park, where thousands of workers are producing internationally competitive companies and innovations. The ISIS in this context is seen as a catalyst for this science park and business cluster surrounding it, both in providing qualified labor and expertise to the region, but also as a monument that are putting Milton park on the map. Other parts of the qualitative section in the report that lay out visions for the ESS, but they are largely speculative and does not so much say what the effect of the ESS will be, but rather what they wish them to be.

### 5.3.4 Remarks

Overall, the report states that the ESS will bring economic benefits in many types to the region. Some of the data is speculative, but might still hold substance since they refer to other installation as well as basing their data on other investments. There are however big differences in the three scenarios that are laid out, and there is also reason to be a bit skeptic since the report was produced before the decision to locate the ESS in Lund had taken place, and may be seen as a bit biased since the purpose of the report may have been to give a positive viewpoint of the whole project. In forecast of employment growth rate which has cited in report seems there is an exaggeration, also in the indirect economic effects on the service industries, since the visitor and researchers are so timid and focus on their experiment. Hence, it is weird to estimate that they go to theater cinema or playing golf and etc which all have been included in their calculations. Thus we can't ignore that in some cases there are strange calculations. One could mention to the figure proximate and extrapolation in some part of their estimation which run the research to the risk. But from qualitative points, this report seems more reliable and applicable.

Hence, on the whole it seems that most of the published reports are largely towards the pretend ESS as perfect facility for the region. Their conclusions are in some extend theoretically oriented, very generalized and speculative, and limit themselves to extrapolation of the experiences from the international case studies.

## 5.4 Growth Prospects of ESS

### 5.4.1 International Comparison

There are several case studies across Europe reviewing the experience of scientific facilities. In this respects, it is reasonable to take a look at the international cases and make an attempt to transfer experiences to the Lund region and the ESS case. In the quick review of the results of relevant reports issued through the years, one could return to some points below:

In general, it seems that there is a sort of unpredictability and contingency to conceive and establish the similar research facility. Likewise, governments and policy makers have this problem in order to form the coherent policymaking on supranational level. In addition, construction, planning, and out comes evaluation are largely unpredictable and contingent for a large scientific facility to be built. On the other hand, there is lack of sufficient historical cases to be compare and utilized in the new experiment, nonetheless there are limited numbers of similar research facility which all have conceived and established under the specific circumstances. These research facilities are different in size, in contrast to the ESS as a first large spallation facility in Europe where is going to be built through collaboration with several countries. On the contrary, individual European countries have experienced modest size of research facilities. For instance, France, Germany, and the UK – have maintained some competitive domestic large scientific facilities in modest size which are dissimilar with ESS as a large intergovernmental collaboration based facility. These previous experiences have been basically based on the ad hoc agreements between two or a number of European countries rather than coherent policy making in international level. This is mostly due to the reluctant of European Union to collaborate in basic science and create long-term institutional frameworks in this area. Faced with Strong competition from North America, European scientific communities have been forced to agree and pay on the collective efforts regardless of lack of strong structure or precedent. Likewise, it has created a dynamic system untouched by institutional inertia; hence it has had strong impact on organizational structures and the principles for procurement, scientific utilization, and relative contributions of member states[20].

Besides the above critical discuss should be underscored that it is essential to review the experience of similar facilities and their impacts on the surrounding communities from both constructive and critical view point to have the realistic prediction of economic impacts of ESS facility. Countries such as the U.S., Switzerland, France, Great Britain and Japan are among the interesting cases. This is a review of comparative analysis between these similar facilities. American Oak-ridge, Japans J-Park and science parks in Europe such will be highlighted since they are very similar to ESS.

European facilities, the American Oak-ridge and Japans J-Park are among the research facilities which attracted smart people to cutting edge science. Oak ridge facility very similar to ESS employs Europeans staffs to reassure future competitiveness in a globalised world. In order to be a consensus and attract talented people governments should notice to reassure future competitiveness in a globalised world thus could remain in the lead. Others facilities such as science parks in Europe, there is MiltonPark in Oxford shire and Minatech in Grenoble which are key components to the respective economies. However the exact economic effect is hard to be measured from the spinoffs and the knowledge creation point of view.

In all countries under consideration, it is very hard to attract young people into the natural sciences and qualified labor force seems to be not sufficient in the developed nations. Interestingly, these facilities and science parks are

seen as a way to motivate the qualified labors from abroad and also inside the countries could inspire young people to the natural sciences and may alleviate a part of the expected shortages.

#### 5.4.2 ESS and MAX IV Differences and Determinant

The MAX laboratory, commonly referred to as MAX-lab, is a national synchrotron radiation and nuclear physics, located in Lund in southern Sweden. First established as a small-scale university project in the late 1970s and then gradually developed into a national and international user facility, nowadays it has expanded by approximately 600 synchrotron radiation users annually. It has recently renamed to MAXIV laboratory (to prepare experiments for the ongoing ESS.).

The laboratory is located on the campus of the Lund Institute of Technology (part of Lund University, LU) and has a dual organizational status: it is a Swedish National Research Facility, under supervision of the Swedish Research Council (Vetenskapsrådet, VR), and it is affiliated with LU, as a department under the Office of the Vice-Chancellor. Among the many incremental upgrades in the laboratory's history, the MAX II project stands out as the largest and most important to date. On the other hand, the European Spallation source is a partnership of 17 European nations committed to the goal of collectively building and operating the world's leading facility for research using neutrons by the 2nd quarter of 21st Century.

MAX IV has grown to its current size and shape through a series of incremental steps and the work of skilled and ambitious individuals in and around the laboratory, rather than by discontinuous funding or policy decisions. It might be thought; one could more account for the history of MAX IV and argues that the dynamic and modular character of synchrotron radiation laboratories makes such a gradual expansion possible.

MAX-lab (IV) research facility has suffered from decentralized character of the Swedish science policy system and especially its lack of aggregation mechanisms for strategically important initiatives such as the establishment of large research infrastructures. While ESS, in the period of 2009-2012 the work has consisted of strategic development between the players in Skåne and Öresunds Region from the following perspective:

First of all, process of upgrading the infrastructure and services essential for the ESS structure have been arranged between ESS, the public sector and various partners. Secondly, the strategic business planning and implementation between ESS and its customers and partners have been negotiated, it was basically in the form of scientists from other universities and the business community.

Swedish science policy system and its weaknesses have influenced MAX-lab negatively. Decentralization, indecision, and lack of strategic priority are among the disadvantages of the system. Because it has been the result of maneuvering by its proponents and advocates through the seemingly unfavorable Swedish science policy system rather than the consequence of deliberate and coherent

policymaking, MAX-lab is remarkable when compared to other facilities of its kind outside of Sweden[19].

Hallonsten (2011) [19] mentioned to the lack of strong central governance structures which have made Swedish science policy pluralistic and driven from the bottom up thus it becomes decentralized. Therefore MAX-lab has grown from the bottom up and step by step and thus it has managed to become a respected national and international user facility despite the unfavorable conditions of this facility.

One could mention to its MAX-lab's patchy funding model and lack of coherent policymaking which has led to underfunding and an opaque organizational structure. However, we cannot ignore high quality users and ingenuity of people involved in this laboratory. According to [19] states determination and adaptively as well as Patience of the laboratory users have compensated for systematic short comings. Thereby there are experiences and lessons from MAX-Lab experiences to be learned by ESS spallation which could serve as inspiration for further work regarding to ESS in Skåne and surroundings.

# Chapter 6

## Interview

### 6.1 Set up

The interviews set up in a similar manner, while the interviewees asked a number of questions. They encouraged to response rather freely, thereby it is representative of a semi-structured interview, the same questions to Interviewees, but diverse fairly according to the positions that they represented.

### 6.2 Scope

**ESS** European Spallation Source, Different positions in the organization with different insight were asked about the probable effect of ESS on the region. Interviews conducted with Public Relation and Industrial Liason.

**LTH, Engineering Faculty Lund University** Interviewee was a PhD candidate in the organization with nuclear-conductor insight. He was asked what he thought that the ESS would mean for the University, and LTH, as well as thought on the regional impact.

**Research Policy Institute** A part of Lund University, has investigated the role of big research installations. Interviewee gave a political viewpoint on the project, a PhD who was well informed and conducted research of similar themes.

**CIRCLE Lund University** Centre for Innovation, Research and Competence in the Learning Economy. A Post-Doctoral researcher who works on the project concerns social factors of ESS was interviewed.

**Region Skåne** The county authority, provided a lot of information concerning infrastructure and initiatives to reap the benefits that the ESS would bring to the region. Two leaders were interviewed, one in charge of a project to

attract foreign direct investment to the region, and other leader with a vital role concerning the ESS.

### **6.3 Results**

All the interviewees were asked about the possible impacts of ESS facility on the region. Among the interviewees there was a consensus that ESS is beneficial for the region especially in long term. However, there were different views for its level of effectiveness. A general trend was that the interviewees who were directly involved in ESS, were more optimistic about the prospects for regional growth as well as international investments in the region. Details of interviews have presented in Appendix B.



# Chapter 7

## Analysis

Analysis of empirical data from the international case studies and conducted interviews as well as theories is presented below. The results are based on four thematic areas: ESS with direct and indirect effects, the issue of the knowledge spillover, and need of ESS integration with Regional Innovation system and Preparation of the local innovation system. This section has started by the effect of ESS on the region, direct and indirect impacts and has continued by the importance of knowledge spillover to make the most of ESS. Then the need of ESS integration for inducing knowledge spillover has discussed. At the end, it has come up with policy suggestions for integrating ESS in order to make the most of ESS through knowledge spillover.

By emergence of evolutionary growth theory, innovation has turned to the new approach in economics and politics (policy making). Thereby, technology and innovation are recognized as the most important factors which generate economic growth. In this regards, in the recent decades, there is a general trend in global research and innovation policy towards strategic initiatives and profiling, to reach the performance assessment schemes. Investment on scientific facilities is one of the recent policies towards producing technological innovations and spinoffs within foremost materials and life sciences.

To fulfill the requirement of Europe for research scattering facility and to be the world leader in this field, in 2009 Sweden as the modern globalized knowledge-based economy showed its tendencies of concentration to be a hot region for sitting European Spallation Source in Lund. After the negotiation it was decided to construct ESS in Lund, in essence meaning that if the ESS is to be built, it will be built in Lund. Hence according to the plan, in early 2013, it will be clear whether the ESS is going to be built at all, on the basis of new cost estimation and technical design. The decision to construct this large scientific facility being made with the aim of developing region by bringing large employers and consumers (both in terms of goods and services) to the region[20].

**ESS with Direct and indirect effects** In the similar scientific facilities around Europe, there is acknowledgment of fair return and functionality, and so

in principle the normal case is that the host country reaps the greatest, direct and indirect benefits, from the facility. According to the international experiences, DESY in Hamburg, Germany and ILL in Grenoble, France, the dynamics of long and short run effect is expected (in some quantifiable extent). By operation of the ESS in the region, direct effects could diminish or cover its entire cost of the investment in the facility. “There will be increased tax revenue”, states the interviewee, which “makes the multiplication effects significant”.

On the other hand, indirect effect would occur through increased investments in Sweden as a result of the ESS project’s realization. The ESS will lead to increased knowledge and technological development which will show in, an increase of the total factor productivity (TFP) at national level. TFP represents a boost of productivity that has an impact on the productivity of all production factors and the rise of TFP could be translated to the GDP growth. Besides, ESS project will mean, interviewee said, a “net increase of the R&D investments in Sweden”. Thanks to the 4.3 billion SEK investments by Swede could correspond to “Swedish GDP growth and the creation of several new jobs”, interviewee said. According to [33], it is assumed that a multiplier effect will also move toward; for instance wages will be paid and benefit the economies of other parts of the region. “The later means that the effect of the investment in the facility will be greater than the actual investment sum.”

Hence, European Spallation Source; in general will create opportunities for the local economic development. There is the potential attraction force of a future ESS facility in the region which relates to the possibility of a growing innovation based economy in the region that could counterbalance negative globalization effects, but it should be underscored that it is impossible at present to make a precise estimation and there are difficulties to assess and concretize quantitatively the direct and indirect Economic effects of the facility. Thus to avoid speculations, it is supposed to focus on qualifying the effects rather than quantifying.

### **Significance of Knowledge spillover**

**Need of ESS integration with regional innovation system** ESS as user facility will provide high-tech instrumentation and experimental opportunities to researchers in competition. Private and public users will have access to the instruments of the facility and is normally granted through a classic peer review process on basis of open calls. For public users this access is normally free of charge and provided that results are openly published. On the other hand, private users may pay for access in order to retain confidentiality around experiments and results[18]. Hence, this would provide the opportunity of business sector development in the region. Meanwhile, creation of new firms and companies will have a favorable impact on the regional growth. It might be thought here that the ESS can bring new startup companies from spinoff research already during the building phase when they try to solve the numerous problems that lies before them. But they must be made sure to have close contact with

their suppliers and get them as interwoven as possible in order to get the latest science out to market through these channels.

However, there is an opposite view point that companies would not settle down in the region to use the ESS instruments, where the located had to do with other factors. One of the interviewee stated, if the companies wanted to use the ESS for some experiments, they could just send persons there when they needed. I believe that this could be probably the case, despite that a few said, otherwise. In this regards, the interviewee made an example of how LTH cooperation with industry were conducted; they were contacted a few times a year, and only when there was a problem, and were pretty much left to themselves to figure it out (for compensations of course). If this is the case, there would be no reason for industry to locate near the facility; they could just contact the ESS staff whenever they would need help with looking into a sample, or something else. It would also be hard for companies to employ staffs, which were confident in using the ESS instruments since they would not have much to train on. There might however be other reasons why companies would like to locate near the ESS, such as numbers of top class scientists and qualified labor forces that will be stayed and/or educated in the region. This resource of human capital is a scarce and for the same reason that industry wants to cluster around Universities, they might choose to locate in the proximity to the ESS as well.

Interviewee explicitly mentioned these effects “will not be realized by themselves” but require the incorporation of the ESS in a “suitable innovation system”. Likewise, a key factor for ESS profitability and the probable economic impacts on the region is “integration with regional innovation system”. Supposing it strengthens the innovation structure and promote accessibility and attractiveness in the region as long with contribution to the regional growth.

This would lead to interactions between partners and companies in ESS construction, as a part of the local innovation system. Likewise, this cooperation would affect the other clusters in the region such as Food cluster and Medicon Valley Biotech, to influence and interact in the face of such a big facility and they can make use of ESS installation experiments. Hence, overall, positive economic effects of the ESS is very much dependent on how well it managed to market and integrate it into the regional innovation system and how this investment contributes to the regional innovation system in collaboration with industry, universities, companies and other regional players. Incidentally, policy is “designed so that it facilitates the emergence of the necessary interface between research, industry, university, companies and etc” cited in [33]. On the other hand, strategic initiatives and the decisions of various regional and national stakeholders will be crucial for the region to take advantage of the opportunities that the presence of world-class research facility offers.

**Preparation of the local innovation system** The indirect, long term effects on the economy of the region are so important; thus comprehensive preparatory work in the region to reap the benefits is required. Since 2009, ESS is situated in the preparatory phase; during this time comprehensive work

has been carried out both by the ESS project secretariat as well as by regional and national government. But there is need for further regional preparation. For instance to promote companies to locate in the region is essential to train expertise for the companies to apply relevant researches (conducted in ESS) in their industries.

In the preparation phase it is essential to recognize and provide the skills initiatives which are needed for users and suppliers. Furthermore, it should include initiatives to increase the reception capacity of research results among knowledge-intensive industries, and to increase their chances of supplying goods and services to the facilities. Likewise, in the preparation phase, the region has the responsibility of enhancing the direct and indirect effects of the facilities, and of “ensuring that the investments contribute to the whole innovation system over the long term”, for which there is great potential, interviewee said. Thus, in the preparation phase several regional players should be involved. On the governmental level, region Skåne, municipality and other relevant own state organization should inform the local companies and public about the opportunities that the facility can bring to them, as well as provide sufficient infrastructure (both physical and intellectual). Hence, if they will be involved in initiatives to inform local enterprises of how they could be part of the ESS and regional success then the benefits to the region could be a lot greater than if they just sat back and hoped that the facility would bring economic prosperity by itself, as interviewee said.

In this regards, regional actors agreed that they need to act in order to get as much benefit out from the ESS as possible. And at least some actors are working actively on getting their plans into the action. But it seems there is a gap at university’s staff, and a little bit of skepticism on how the cooperation will look like with the ESS. This is something that the administration at the ESS needs to assure that the universities will be well integrated into the technical faculty with co-shared employment opportunities. To do so there is a need to get the university staff involved in the facility.

**Remarks** As mentioned before, uncertainty is one of the characteristics of large research facilities and cutting edge scientific project; thereby there is a self multiplying effect of creating contingencies in the most elements of ESS. For instance this study could mention to its competitiveness in the global level which could intensify or alleviate according to the level of investment on the financial capital and its expenditure. Meanwhile, it seems there is a need for more discussion about the crucial issues of sufficient funding to prepare for scientific and technical contingency.

After all, it should be mentioned that there is a major worry about the other priority that Sweden has rather than spallation source. Numbers of scientists in Sweden agreed on this, and are afraid that it would drain away resources from other fields where Sweden had a comparative advantage, something they currently not have internationally on spallation science. Thus the money dedi-

cated to it could be wiser spent somewhere else in science, as interviewee said. However, it might be thought a basic idea of this critical thought comes from the lack of sufficient investigation about the nature and performance, effects, opportunities as well as difficulties of such a large scientific facility. Likewise, there is a scientific vague spot which is theorization of socio-economic effects of large scale scientific facilities to more support the innovation based-economic growth. Thus it is recommended that further research should be undertaken in this area thanks to some scholars such as [18, 20], who has already paved the way.



## Chapter 8

# Conclusion

Much evidence points to that the ESS will bring economic growth in the region and this large scientific facility would play the significant role to make practical contributions to the economy by producing technological innovations and spinoffs within foremost materials and life sciences but to say exactly what it will be is not possible and depends to a large extent on how well the facility is managed to the market and integrated into the regional innovation system. While it makes tight connections between researches, industry, university, and companies, regional actors should devote more attention on the preparation of the local innovation system to create reception capacity. Both within the walls of the laboratory and outside it, significant efforts are needed to establish the desired links between technology, science, economy and society.

ESS would employ several dozen of highly educated and top scientists, and thus relatively highly paid scientific and technical workers. These will naturally have an impact on the local and regional economy. Also where the external users, will have access to top-class scientific users facility and they will stay in the region and will have interaction with the local economy; thus the physical environment will be created for innovation and creative venues. Besides, private and public users will have access to the instruments of the facility. Many international companies and researchers will be attracted by the facility, while the employees of these companies and employee's families will be assimilated into the region as well. Hence, the ESS can bring new startup companies from spinoff research already during the building phase which will have a favorable impact on the regional growth and will create particularly favorable opportunities for firms to agglomerate.

Direct effects could diminish or cover its entire cost of the investment in the facility and there will be increased tax revenue, which makes the multiplication effects significant. Beside, indirect effects would occur through increased investments in the region. Moreover, the ESS leads to increased knowledge and technological development which shows in, an increase of the total factor productivity at national level and this could be translated to the GDP growth. Furthermore, ESS project will mean, net increase of the R&D investments in

the region which it could be corresponded to the GDP growth and the creation of several new job opportunities in the region. A multiplier effect will also move toward, where wages will be paid and benefit the economies of other parts of the region.



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# Appendix A

## Sample of Interview

The following questions have been asked in interviews, differed somewhat to better fit the organization that they represented:

1. How do you believe that the siting of the ESS will affect the Lund region in the future?
2. Do you believe that the siting of the ESS will be a factor for companies' decision to establish themselves in Lund?
3. Do you think that Companies in the region are well prepared for the opportunities that the siting of the ESS brings?
4. Was the siting of the ESS in Lund having a factor in AstraZeneca's decision to shut down their operations in Lund?
5. Do you believe that the siting of the ESS will have an impact for universities (LU,LTH ) to conduct cutting edge research, and to attracts international talents!
6. Do you think that the ESS can be useful for your research, and if yes, how?
7. Do you think that the siting of the ESS will mean an expansion of LU and/or LTH?
8. From economic geographer pint of view, How ESS will affect regional economic development?
9. How could get more than 'just research' from ESS facility?
10. What will be the direct effects of the ESS on the region? (Impact of direct investments)
11. What will be the multiplier effects?

12. What will be the spill-over effects?
13. What indirect and dynamic effects can be expected to be seen in a more general growth perspective?
14. What is required in the future in the coming process?
15. (The conditions could be included the localization and extent of the work as well as detailed questions)
16. Questions concerning the environment, cooperation, leadership and service
17. What are the possible and likely effects on regional development of the building of the ESS given certain strategic and visionary aims?
18. How surrounding (the Öresund Region) can be strategically included in the regional process and the impacts?

## Appendix B

# Result of Conducted Interviews

**The research policy institute** The interviewee at the research policy institute was a bit more critical than the other respondents in the view of ESS and the benefits it may bring for the region. He skeptically thought that although the installation would bring spillover effects to the region (e.g. flow of scientists to the region), its effects are limited comparing to the estimations existed in the available reports. He did think that there is an expectation that Lund University and LTH would focus on the neutron research and it might become a boost to the nano-science research conducted at LTH and Lund University. According to him, the other spillover effects in terms of technology would be much dependent on how good the regional players were at exploiting the opportunities that the facility would bring.

He thought there is an exaggeration for the direct impact of the facility, for instance big companies will not necessarily locate in the region. That is because they conducted mostly too basic researches in ESS, and not many companies would have expertise to apply that in their industry. (Circuitously he mentioned that neither companies nor other players in the region are prepared enough for the opportunities that ESS brings.) He mentioned sitting of ESS in short term won't be a factor for companies to establish themselves in Lund since they have the other priority, but in some extent in long term companies will be establish and expand in the region. However, he thought this is highly dependents on the establishment of science city around the facility to support new companies. He brought LTH and its interaction with companies in the region as an example. He stated that companies only contacted in small projects where they had a problem that could not be solved by them. He argued that if the same kind of interaction would occur with the ESS, it would be much limited and not a big part of the beam time would be devoted to it.

To response the question regarding to the profitability of ESS and the probable economic impacts of this facility on the region, he mentioned that the

positive economic effects of the ESS is very much dependent on how well it managed to market and integrate it into the regional innovation system and how much money will be invested and how well the money really will be spent. He pointed out that the project plan must have a financial post that will deal with uncertainties and new events that could come up well into the building process, and that actors in charge must be able to change the plan accordingly.

To take the advantage of opportunities that presence of ESS offers, he highlighted the role of policy and the strategic initiatives and decisions of national and regional stakeholders which will be crucial for the region. He suggested developing a long-term strategic action plan to work on how the research facility can be integrated in policy making in industry, innovation, and education.

Other recommendation was about the use of the experience of international comparable scientific facilities in every level, for instance to know what role have regional actors played in the construction phase of other research facilities, how has the distribution of purchasing contracts been, what role has the supply of skills played? How they act in the administration level? Which leadership characteristics they have had? Thus according to him through the study of these issues, it would be obvious what they did right and what they did wrong and what could be copied from their experience. However, he said that the road for Lund is longer since there was no preparation from the early experience.

He believed, it is not that simple to plan this project since it is not clear what the exact nature of ESS is, or what they mean by producing science in 2025 or when they can deliver the expectation? or how much money will be invested by the each partner countries, for instance we know there is interest from Germany and France but there is not clear in what extent each country would provide financial resources. From his view point, ESS is big and Sweden is small for this project, sitting the ESS in Lund will stop further resource allocation to Skåne county. Sweden has other strategic priority and by this huge amount of financial resources could do something else more beneficial for Sweden.

**ESS: (Public Relation)** The interviewee believed that the main economic benefits for Lund would be in the direct economic form and the trickle down effects. Companies will be established in the region and produce goods and services for the facility and thereby hire more people and raise wages. The people, in turn, will have more money to spend in the economy. Hence, numbers of people working in the region Skåne and the visiting researchers will be increased due to the ESS and their salaries would be the main benefit to the region. They would in turn use their money in the region and multiply the economic effect by around five times, which is the best way to stimulate the economy.

She believed (vision to the years 2019-2022) companies and service industry will be expanded to provide the services and equipments for the facility, and therefore service market will grow in the region. For instance, the local sausage and fast-food vendor around the corner could well be among the beneficiaries in the region. This since it was the only one close by that offered food 24 hours a day, and scientists were creatures that saw time as relative, especially regarding



earthly concepts such as day and night, while conducting their experiments.

She added ESS as multi disciplinary research centre based on the most powerful neutron source, would bring the research opportunities in a variety of areas, such as new materials, biotechnology, medicine, engineering, physics, energy and environmental technology. Interviewee mentioned to the automobile industry such as Rolls Royce, drug and medicine industries, Electronic companies and airplane industry who could study the necessary materials and own products via ESS spallation. She mentioned to IMB and Philips companies that have already gauged their interest to invest in Lund. Thereby ESS will attract many international companies and researchers in the coming years. It means the establishment of new companies, assimilation of their employers, employees and their families all come into the region.

Interviewee in the public relation (in ESS) believed that the establishment of the facility would result in a boost of demand for land in the region, as some companies already demonstrated their interest for a land registry over available land for businesses and are looking for the best available geographic locations for their needs. She also mentioned to land for dwellings, in which the increase of housing price and some modification in land market in the recent month is a result of pre-construction of ESS in Lund.

As an end quote, interviewee emphasized on the importance of more collaboration between ESS, MAXIV, University and Region Skåne which could be conceived as an expectation of the facility to the local players. Facilitating and promoting the collaboration between the municipalities, businesses and trade and industry players is essentially needed also making relevant information available to the region's business community.

**ESS: (Industry)** Interviewee believed that ESS would be very beneficial for the region and that it would definitely mean that more companies would be attracted, and set up operations in its proximity. It would also be easier to get venture capital to the companies that currently resided at the science park, with the ESS acting as an icon for investors. The companies would both be attracted by the influx of talented people to the installation, and the direct economic effects that will trickle down from the facility.

He did not know of any other big facility being considered for the moment in Lund beside MAX-lab IV and the ESS, but thought that smaller facilities and research labs like the nanometer laboratory might be built in increasing numbers because of the facilities. What was emphasized though were the other science centers being build in Hamburg, such as PETRA and the XFEL, that would strengthen the science corridor stretching from Northern Germany to Sweden and Norway, and that these would raise the regional advantage and perhaps laid the groundwork for even more science investments in the future.

He mentioned to "Invest in skåne" project which has already used the ESS as a marketing tool internationally to show off the region as a hub for science and cutting edge industries, to attract international companies to the region. They had already attracted the large Chinese ICT company Huawei (The main com-

petitor to Ericsson), and had a few other large International corporations that were looking into the possibility to put up operations in the region. This could not be directly attributed to the ESS, but it was rather part of a larger web of attractive resources that resided in the region, such as the well educated workforce and infrastructure. Furthermore he believed that companies that needed spallation sources to conduct their research and now did this at the current neutron sources would now have incentives to move some or all of their operations to Lund instead since it offered a superior source for many experiments. In this regards, a number of events have been planed such as a road show in Germany, and a special venue at the Shanghai world Expo. Thereby ESS would be an indicator of the region attractiveness that it is really competitive in a European perspective since it beat other regions for the location.

**CIRCLE** Interviewee believed that companies might be created as spin-offs from the research, but that it not necessary meant that these spin-off companies would locate in the region around Lund. The same reasoning went for large corporations that needed to use the facility, they might not need to have branches in the region to do this, but could rather come and use it whenever they liked from another location. What could happen though was that large corporations would move close to the ESS just to be near the qualified labor pool that were “produced” there. This could be seen at other sites around the globe, where branches were set up where the talents were, if talent could be attracted that is. The ESS is only one of a myriad of reasons that a person might consider moving to Lund or its surrounding, and other factors such as the generous welfare state privileges for maternity leave, and the quality of living in the region and environment might be as, or even more important than that the ESS provided a world class research facility to work at. She said that one of the most important uses for the facility could be, not the science made there, but as an icon, a visible sign for optimism and future prospects in the region, just as the Öresund Bridge. The benefits from incoming talents and other things were believed to be much in the hands of the regional actors, and it was up to them to build the infrastructure and institutions needed to reap as much benefits from the ESS as possible.

**LTH** The research made at the ESS, could bring spinoff effects and startup companies. The facility would also be an important icon for the region, where LTH benefits as well as it gains higher status and stature as a centre for science and research. As a result, the recruitment of top scientists as long with international students to the LTH and the university could be easier, and become a boost to the Nano-science research conducted at LTH. The interviewee believes that the establishment of the ESS would bring a new engineering track, and that a new program would be devoted to material research and biology with special focus on how to use spallation. Further, the interviewee added the ESS would be a boost and a buildup of the Nanometer-consortium in Lund, as well as it could mean an influx of material research companies. The importance of the

MAX IV facility that lies in conjunction to the ESS, is another thing that was pointed out by him, but he mentioned that it would be open for operation a lot sooner. He recognized that Lund had a world leading expertise in synchrotron light facilities such as the MAX IV Laboratory, but they did not have the same international stature in spallation sources. The interviewee felt that this new expertise could be built up by bringing world class scientists to the University, and also set up educational programs for students and post docs that catered the new field. He also pointed out that hands on training at the facility itself should also be considered. This is something similar to what they already had in Lund at the MAX IV Laboratory, and they want to have something similar setup with the ESS in the future. At the moment in Lund, beside the MAX IV Laboratory and the ESS, there are no other big facilities being considered, but smaller facilities and research labs such as the nanometer laboratory might be built. Moreover, he thought that the construction of ESS would raise the status of the University, and also recruitment of world leading researchers would become easier. The interviewee means that in order for the University to benefit from the establishment, it is important that bridges be built from the University to the ESS. He believed that if they are unsuccessful in this, other Universities with branches set up in Lund would out-compete them in recruiting the skilled labor. For instance, with the professorship of the ESS secretariat director Colin Carlile at the University, these bridges have already started to form. Even though the time-frame for the facilities completion lies almost a decade away, further efforts are needed to plan ahead of building more bridges between the partners.

**Region Skåne (In charge of a project to attract FDI to region)** Interviewee mentioned to the new agenda for TITA project to concentrate on the moving the companies to the Southern Sweden and invest in Skåne. In cooperation with international actors there is a goal to make a region as a European leader in material science, life science and ICT and to put the region in the map. Invest in skåne had already used the ESS as a marketing tool internationally to show off the region as a hub for science and cutting edge industries, to attract international companies to the region. But she said ESS and MAXIV are just a part of great opportunities to attract the investors, companies and great small business to the region. She argued the regional growth and development will generally depend not only on the ESS and its benefits to the region, but also on the several different factors such as competence and infrastructure.

The interviewee in Region Skåne believed still in national level companies particularly large companies are not well informed about the opportunities which ESS will bring to the region. She said in Sweden, for the companies such as Volvo the opportunities should be translated since the facility is not in the region yet so the job is tougher. She emphasized on the collaboration between different actors in the region and she believed for ESS to contribute growth in the regional level, requires the municipality and universities to work very closely with government.

**Region Skåne (Leader with a vital role concerning the ESS)** Interviewee mentioned ESS will contribute to growth in the region and to strengthening the research and development brand of the Skåne Region. It makes great demands on the community in general to supply the facility with highly skilled scientists. Since Sweden has a problem in recruiting students to graduate engineering courses, thus it is essential to increase the interest in mathematics, science, technology and information and communication technology among young people. She believed that ESS is of great importance to rise the interest in technical education and that the country's universities turn out an adequately large number of engineers and natural scientists. She noted the effects of the new small companies, delivering services and good to the facility which leads to the increase of high educated labors in the region and higher competences. She added population growth will be another effect of sitting ESS in the region in long term. She was aware of insufficient efforts in the national level to prepare the region for the opportunities which ESS will bring. So she believed Sweden is not well prepared at all in compare to Danish actors, which are well prepared and informed about the nature of the facility and what it is and it means for the region.

The interviewee noted the significance of making collaboration within the innovation system, between facility, universities and companies. However she mentioned to their attempts in Skåne region (for example TITA project and its sub projects in Region Skåne) which have been initiated since 2008. Analysis of the similar international facilities experiment and initiation of number of projects and sub projects are among the large efforts of this organization. She believed this indicates a significant feature of their efforts, since they are thinking to solve the problems before they come out. Also after all efforts to have better cooperation with government, they have better dialog with Swedish government now.