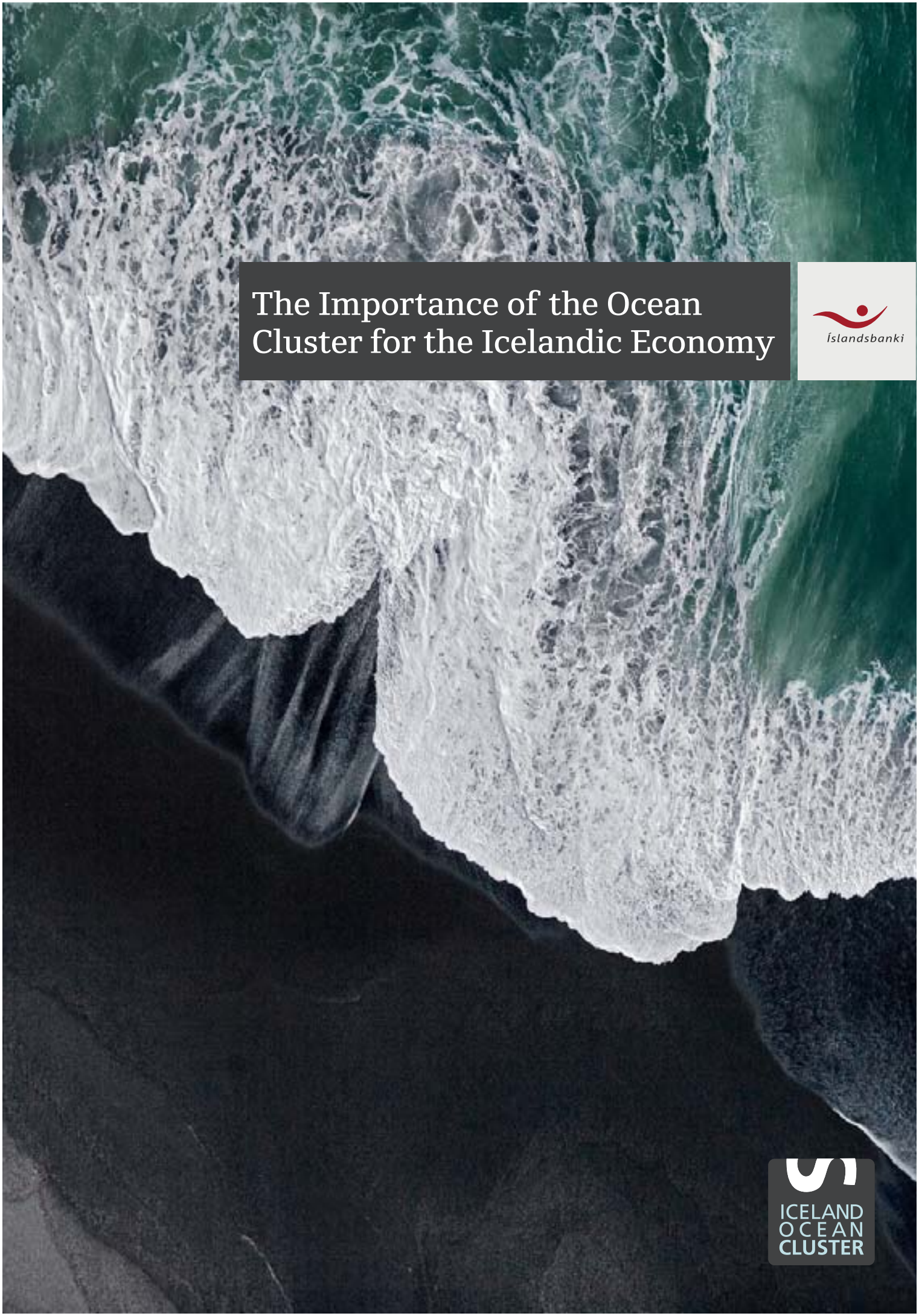
The Importance of the Ocean Cluster for the Icelandic Economy



Íslandsbanki

ICELAND OCEAN CLUSTER

Authors' introduction

This paper seeks to describe the economic importance of the ocean cluster, i.e. the fishing industry and related sectors in Iceland. The paper is based on research that has been carried out over the past two years.

The theoretical basis of this research is twofold. On the one hand it is based on scientific theories of "base industries" (North, 1955; Tiebout, 1965), i.e. industries that form the basis for, or are a prerequisite for, other industries in the region. There is every indication that the fishing industry is such an industry in Iceland. On the other hand, the paper is based on more recent ideas about cluster formation in the economic sector (Porter, 1990), where a number of companies in a particular field are economically interrelated and base their activities on each other and possibly a common base industry. There is every indication that such a cluster, which may be called the ocean cluster, has already formed around the traditional fisheries sector in Iceland.

Three lines of research have been carried out on the basis of this theoretical foundation. The first line was analysis of and empirical estimation of the macroeconomic contribution of the fishing industry and related sectors which the economists Linda Bjork Bryndisardottir and Anna Gudrun Ragnarsdottir have prepared. The second line of research aspect involved the general description and mapping of the ocean cluster, for which Vilhjalmur Jens Arnason, Project Manager was responsible. The third line of research was the preparation of a summary of the technology firms in the ocean cluster which Eva Iris Eyjolfsdottir, a marketing specialist, prepared. This paper focuses mainly on the principal conclusions of the first line of research; the assessment of the macroeconomic contribution of the ocean cluster. This work, however, has benefitted from the other lines of investigation and is partly based on them.

Experts from Statistics Iceland, particularly Gyda Thordardottir and Stefan Jansen, have given us a great deal of help in obtaining and interpreting basic data on the fishing industry and the ocean cluster for which we are very grateful. Moreover, we wish to express our gratitude to the more than 100 companies in the ocean cluster that have provided us with statistics and other information about their operations. Finally, we wish to thank the experts in the Islandsbanki fisheries industry team for their excellent partnership.

Thor Sigfusson
Director of the Icelandic Ocean Cluster

Ragnar Arnason
Professor at the University of Iceland

This report is a translated version of a report originally written in Icelandic.

Table of contents

Key highlights

1. Fisheries constitute a base industry in Iceland.
2. The fishing sector's contribution to GDP in 2010 was 10.2%.
3. The total contribution of the ocean cluster to the GDP was 26%, whereof the indirect contribution was 7.3%, demand effect was 7% and the contribution of independent exporters in connection with the fisheries industry was approximately 1.5%.
4. According to Statistics Iceland, approximately 8,600 people are directly employed by the fisheries industry or approximately 5% of Iceland's workforce.
5. The ocean cluster creates around 25,000 to 35,000 jobs in the economy, directly or indirectly. These results indicate that the ocean cluster forms the basis for more jobs in the economy than has previously been assumed.
6. The fisheries sector is responsible for 50% of the total turnover in the textile industry, which includes net making and various other fishing gear manufacture.
7. Fisheries exports in 2010 amounted to ISK 220bn.
8. 2.250 direct jobs have been created due to the operations of companies connected with the fisheries sector, the turnover of these companies was ISK 38bn in 2010 or approximately 4% of Icelandic exports that year.

1 Introduction

The fisheries sector has been regarded as one of the cornerstones of the Icelandic economic sector for quite some time. According to the national accounts, however, the direct contribution from fisheries and fish processing to the GDP has only been 7–10% over the past few years. At present, the sector employs around 8,600 people or approximately 5% of Iceland's workforce (Statistics Iceland, 2011). These statistics do not accord with the alleged fundamental role of the fisheries sector in the Icelandic economy. As a result, it could be tempting to assume that the fisheries sector's role as the foundation of the Icelandic economy has had its day, but is this in fact so? Do these statistics provide a realistic view of the importance of the fisheries sector in the Icelandic economy?

It has long been obvious that the economic effects of the fisheries industry in Iceland are much greater than as measured directly in the national accounts. Ragnar Arnason and Sveinn Agnarsson (2005) pointed out that the fisheries sector is a base industry sector and that its total contribution to GDP was higher than its direct contribution, according to the national accounts. They prepared a statistical assessment of these overall effects that indicated that they could be between 25% and 35% of GDP. Reports issued by Statistics Iceland "Sjávarútvegur sem grunnatvinnuvegur" (2003) (The fisheries industry as a base industry) and "Hlutur sjávarútvegs í þjóðarbúskapnum" (2007) (Share of the fisheries sector in the national economy) discussed similar issues and are generally in agreement. Comparable measurements of the economic importance of the fisheries sector in Newfoundland (Roy et al 2009), moreover, also point to the same conclusions.

This report describes the investigation into the scope of the fisheries industry and related industries in the Iceland ocean cluster. The term ocean cluster refers to the traditional fisheries sector and all the manufacturing activities it supports, whether directly or indirectly. This includes manufacturing operations that can be regarded as having resulted from the fisheries industry, in the sense that they initially served the domestic fisheries sector but have subsequently developed to stand on their own, and may even have started their own exports. The reason that it is considered appropriate to include such operations in the ocean cluster is that they were created because of the traditional fisheries industry, grew under its protection and would probably not exist at present if it were not for the industry's support to begin with.

Consequently, it is clear that by examining the ocean cluster as a whole, a much clearer picture of the importance of the fisheries sector in the Icelandic economy can be obtained than can be obtained by examining only the traditional fisheries and fish processing. In addition to that already mentioned, it must be kept in mind that relatively simple changes to operating arrangements in the traditional fisheries sector, such as employing contractors for more tasks (i.e. outsourcing), can significantly distort the view of the economic importance of the sector if account is only taken of the fisheries firms. These tasks may be quite substantial, such as offloading catches, maintenance work on fishing vessels and fish processing plants, as well as a variety of other services. When fisheries firms decide to purchase such services from other companies instead of performing them themselves, official figures can indicate a decrease in the number of people employed by the fisheries sector when in fact no decrease has occurred.

2 Fisheries as a base industry

The term base 'industry' has been under development for quite some time. Its origin can be traced to the research carried out by the German economic historian Werner Sombart early in the 20th century (Krumme, 1968) and subsequently to developments in regional economics in the latter part of the same century (Andrews, 1953; North, 1955). Regional economics divides economic industries into two, base economic industries on the one hand, and, on the other, the manufacturing and service sectors that are formed on that foundation and which are based on its continued existence.

Noel Roy, Ragnar Arnason and William E. Schrank (2009) set forth a definition of the term 'base industry', which is as follows:

> *The economic base is an industry or a collection of industries that is disproportionately important to a region's economy in the sense that other economic industries depend on the operation of the economic base but not vice versa, at least not to the same extent.*

One can imagine an unpopulated region that is rich in a natural resource, such as valuable minerals or fishing grounds. The technology and knowledge to exploit the resource profitably is available and, as a result, funding and workforce moves in and an industry, based on the exploitation of the resource, is created. This industry is therefore defined as the base industry. Following the establishment of the base industry, numerous other industries that serve the base industry and its employees may surface. Some of these industries may provide the base industry with resources that can be economically manufactured in the area. Such economic operations are often called the backward connection of the base industry (Kindleberger, 1965, 1989). Other industries may be established for the purpose of meeting the demands of employees for goods and services to the extent that such manufacture is feasible in the area. Such industries may include various public services. These derived industries and service operations also need a workforce and resources. This creates further demand and more industries, and so on and so forth. Overall, the scope of such derived operations can become quite large when compared with the base industry. The scope is first and foremost dependent on local ability to meet the demand for goods and services that the base industry creates, directly and indirectly.

The core of the matter is that all these derived operations are created due to the establishment of the base industry and rest on the foundations that this industry has created. Without the base industry, these other industries would never have appeared and, if the base industry leaves, e.g. because the mine of valuable minerals runs out or if fish stocks are destroyed, the risk is that the derived industries will also fail, unless the people in the region are able to find and develop a new base industry.

At the same time, it is clear that if the base industry were for some reason to shrink, this would have a chain reaction. If, for example, there were a catch failure, the base industry would have less income and would therefore lessen its business with service sectors. This would make it necessary to reduce the number of employees. The service sector would subsequently be downsized and the basis for continuing the operation of some of the businesses would fail and some would cease operations. Thereby, the economic downturn in the region as a whole would be greater than the downturn in the base industry itself. This is in fact one of the main characteristics of base industries – they have a knock-on effect on the economy. If, for example, a cinema ceases operations, this would not have the same type of effect. It is most likely that people's business with a cinema would simply be transferred to similar leisure pastimes, i.e. the closure would not have knock-on effects, at least not to the same extent.

It is clear that the fishing industry is a base industry in Iceland in the above sense. Iceland has valuable fishing grounds which would be exploited even though little or no services were available from land. This can be seen from the way foreigners fished in Icelandic fishing grounds for centuries, right into the 20th century, because this exploitation was generally carried out without any significant services from Icelanders. The same applies to foreign fisheries operations outside Icelandic territorial waters at the present date. The operation of the fisheries sector in Iceland, however, has called for a wide range of derived operations in the country. Such operations involve the manufacture of resources and services for the fishing industry, further processing, transportation and distribution of seafood products, and services for employees of the fishing industry and related sectors. As described in the previously mentioned research (Ragnar Arnason and Sveinn Agnarsson 2006, Agnarsson and Arnason 2007 and Statistics Iceland 2007), the fisheries industry has been a base industry in Iceland for a long time.

3 The ocean cluster

Michael E. Porter (1990), one of the principal pioneers of cluster research in the world, defines clusters in economic sectors as:

> *... a group of related companies, suppliers, service providers, companies in related sectors and public bodies ... in specialised fields that compete among themselves but also work together.*

As with the term 'base industry', cluster analysis of sectors traces its origins to regional economics. Cluster analysis, however, was developed later than the scientific theories on base industries, or in the final quarter of the last century. Cluster analysis has been used to explain the development of industries and business in specific regions. It has subsequently been used to explain the growth and development of towns, cities and even nations. The developmental history is typically as follows: a certain region has, or there arises, favourable economic conditions due to the progress of the economy and/or technology. These conditions are often based on natural resources, although this is not a prerequisite. Individual companies begin operations in the area and form a base industry. A group of companies in related fields then form around this base industry. These companies both serve the base industry and receive various forms of support from it. They are also linked to each other in numerous ways and support each other through, e.g. the development of human resources, technology and technological equipment that is of use to them all. The companies, moreover, circulate assets among themselves through transactions and transfers of employees, and at the same time, create a demand for further services and infrastructure that is also useful to all. Cluster analysis involves a detailed examination of such developments and the manner in which the cluster's industries are connected and the arrangement of their manufacturing processes.

There has been considerable international interest as regards research into clusters in business sectors and their role in the development of companies and business sectors. Many of the countries around the North Atlantic Ocean have issued detailed policy formulations on clusters connected to the ocean. Ireland, for example, has set itself the goal of becoming, by 2020, an international centre for specialisation and research into ocean related technology [Marine Institute, 2007]. Canada has introduced an ocean technology cluster that they have named Ocean's Advance (oceancesadvance.net). Moreover, Norway has systematically been working on policy formulation in connection with ocean clusters and ocean related operations (NCE.NO). Cluster research, therefore, has been carried out in nearly all the countries that have a North-Atlantic shoreline. Most of Iceland's competitors in the northern areas have established policies to be leaders in fields connected with the sea, including IT, biotechnology, continental shelf research and aquaculture. Such work has not been carried out in Iceland and policy formulation in this field is minimal.

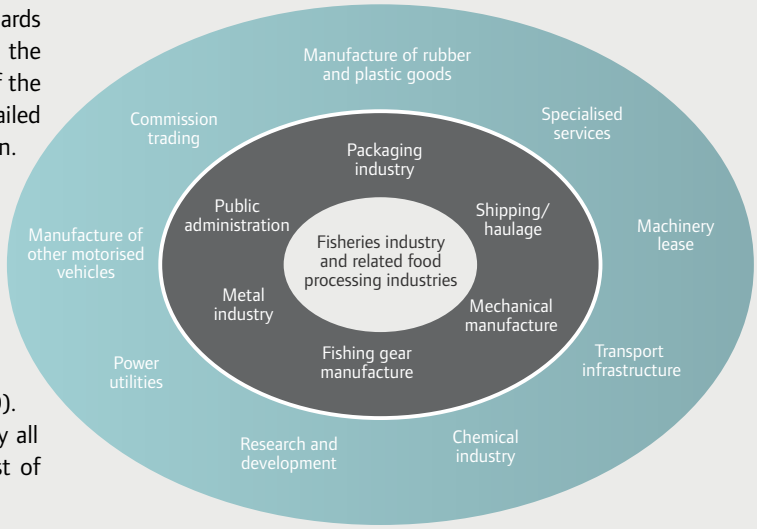
In the following figure (Figure 1) an attempt is made to draw up the outlines of the Icelandic ocean cluster as it appears in our research.

The core of the ocean cluster and the central point in Fig. 1 is the traditional fishing industry which consists of fisheries, fish processing and marketing. This is the foundation or the base around which the cluster forms. As stated previously, only the fishing industry is the actual base industry as the processing and marketing of the products hinges on actually catching the fish.

In close connection with the fisheries sector is a group of industries that provides the sector with resources and services. The industries form the inner circle around the fisheries sector in Fig. 1. These include:

(i) packaging industry
(ii) fishing gear manufacture
(iii) shipping/haulage operations
(iv) diverse mechanical manufacture
(v) metal industry
(vi) public administration

Figure 1.
The ocean cluster: Simplified presentation



All these industries have emerged due to demand from the fisheries sector or administrative requirements (public administration). Public administration includes numerous services provided to industries by the state, e.g. the operation of the Directorate of Fisheries, monitoring bodies, ministries and municipalities. These sectors emerged in the wake of the significant growth of the fisheries industry and have been developing and growing for decades. It is important to realise that the fisheries industry's demand for resources and services could have been met through importation and services from overseas. On the other hand, there was sufficient initiative and production ability in Iceland to ensure the slow but sure growth of many of these service sectors locally.

Numerous industries are more loosely connected to the fisheries sector but should nevertheless be included in the ocean cluster, at least in part. These industries have been placed in the outer circle in Fig. 1. They include:

(i) **The manufacture of rubber and plastic goods:** An important aspect in the manufacture of fishing gear, and packaging, containers and crates of various types for both fishing and processing. This industry, therefore, is partly linked to the packaging industry that is specialised for the fisheries industry.

(ii) **Machine leasing:** Connected to both shipbuilding as well as fisheries and fish processing, given that the operation and maintenance of fishing vessels and processing lines requires numerous specialised machines, that are often collected together in specialist companies that lease such equipment. Without the fisheries sector in Iceland, it is unlikely that there would have been any local shipbuilding or ship maintenance to any great extent.

(iii) **Energy production and utilities:** The fishing industry, both fishing and processing, requires considerable energy, both in the form of combustible fuel and electricity. Thus the fisheries industry is a significant customer in this business sector in Iceland, and has adapted its operations in various ways to the sector's requirements.

(iv) **Various research and development operations:** Relatively extensive research and development activities take place in connection with the fisheries sector. Some of these activities involve basic research, such as ocean and fish stock research and research into economically efficient fishing policies and a prudant fisheries management system. A growing part of these research and development activities is directed toward specialised projects for companies in, e.g. improving fishing gear, perfecting processing lines, preserving the quality of catches and fish products, developing new product types and marketing fish products in as economical manner as possible.

(v) **Various types of chemical industries:** The operations involved in obtaining the highest prices for the goods that can be produced from fish catches are increasingly based on chemical industries, chemical technology and food processing industries

Why should an Icelandic prosthetics manufacturer be included in an ocean cluster?

According to a technology company manager in the ocean cluster, sub-contractors have been becoming increasingly better equipped over the past decade: "In the metal industry 15 years ago, on a scale of 1-10, familiarity with high-tech equipment was about 4-5, while at present we have risen to between 9.5 and 10. Two companies have been responsible for this, Marel and Össur. These companies laid down stringent requirements for quality, brought in first class equipment and increased knowledge in its use. We subsequently enjoyed the benefits of the equipment being available and could use it to develop our goods." Thus, leading companies in various fields can strengthen two dissimilar industries even if there appears to be no connection between the two. It is therefore vital to keep these companies in Iceland and to not lose their headquarters to other countries through apathy. Another manager of a technology company mentioned: "There used to be considerable equipment shortages in Iceland but these are now minimal. For example, there were no laser cutters and now they are everywhere."

(vi) **Shipping/haulage operations:** Transportation of fish catches, seafood and resources for the fisheries industry, requires considerable transport services by ships and on land in Iceland.

(vii) **Commission trading:** The commercial activities taking place outside the fisheries companies themselves to meet the needs of the fisheries industry for resources and to sell the industry's products.

(viii) **Various specialised services:** These services can range from technical consultancy services to auditing, management consultancy services and financial services of various types.

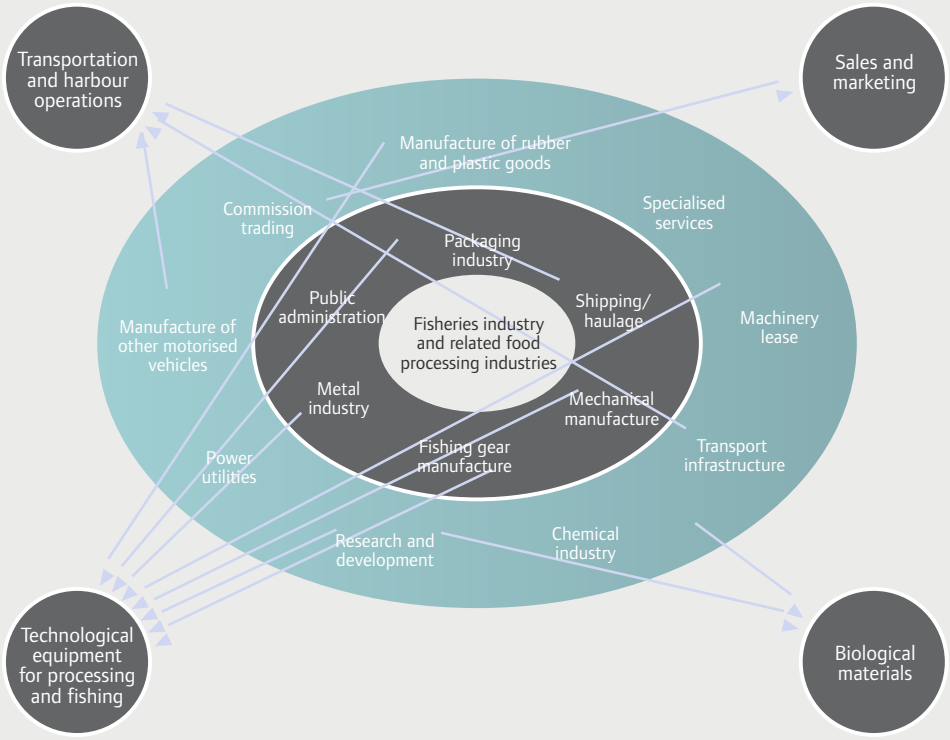
It is important to realise that the industries in the inner and outer circle of Fig. 1 are not only connected to the base industry, fisheries, but are also inter-connected among themselves, as well as being possibly connected to other industries outside the ocean cluster. Thus, for example, manufacturers of rubber and plastic goods enjoy benefits from the chemical industry, mechanical manufacturers and the metal industries. The same can be said of the fishing gear manufacturing industry, the chemical industry and the metal industry, which also support each other in various ways. All these are then connected to shipping/haulage services and specialised services, and so on and so forth. These connections are apparent in resources and products, as well as in the specialist knowledge that forms within the industries and flows between them through information exchanges and trained specialised employees. Thus all these companies and industries, listed in Fig. 1, form an industry cluster, as defined by Porter, where each enjoys benefits from the others and the whole is stronger than each individual company. All these companies and industries form the Iceland ocean cluster.

Fig. 2 has been prepared to better explain the various relations between the industries in the ocean cluster. It shows the main relations between linked sectors in the traditional fisheries sector in the cluster. Note that in addition to the connections described therein, all the sectors are connected to the core in Fig. 1, i.e. the base industry - fisheries.

Fig. 2 shows that these connections are both considerable and varied and also indicates that the sectors in the cluster from sub-clusters. For instance, shipbuilding (which is a part of a sector named "Manufacture of other transport equipment" in the Statistics Iceland classification system), shipping/haulage and transportation are industries that form a range of interactive connections and form a sub-cluster. Moreover, the metal industry, packaging industry, rubber and plastic goods manufacturers and fishing gear manufacturers have considerable internal connections, so these industries can be said to form a sub-cluster in connection with technology and equipment for processing and fishing. Within this sub-cluster are dozens of companies manufacturing goods for the fisheries industry, aquaculture industry, etc. which they offer on the international market.

Power utilities, public administration, research, commission trading, transportation and shipping/haulage and specialised services are industries that are at the periphery of the ocean cluster and provide it with services but do not use resources from the cluster to any great extent.

Figure 2.
Examples of connections between industries in the ocean cluster



4 The fisheries sector's contribution to GDP

In this section, an attempt will be made to assess the fishing industry's contribution to the GDP, taking into account that the fisheries sector is a base industry (for more detailed information, see Appendix 1).

The fishing sector's contribution to the GDP can be divided into three parts.

(i) **Direct contribution,** the added value that forms in the fishing industry itself.

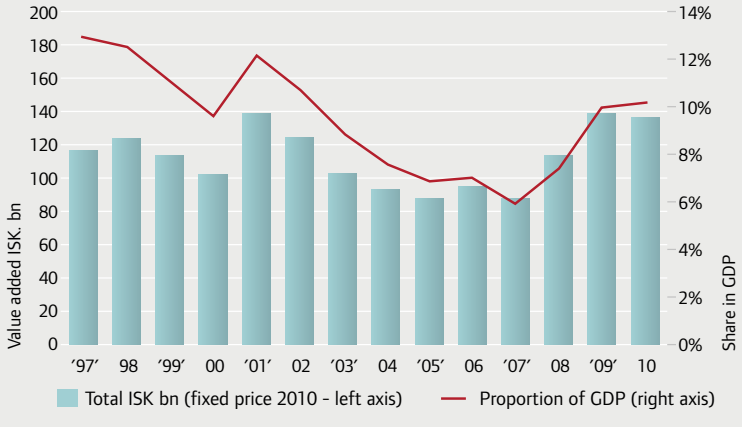
(ii) **Indirect contribution,** the added value that forms in the industries that are responsible for supplying the fishing industry with resources (backward connections) or for further processing the industry's products (forward connections).

(iii) **Demand effect,** the added value that forms in sectors that provide the employees of the fishing industry and related industries (backward and forward connections) with goods and services. This is explained further in Appendix 1.

4.1 Direct contribution

The fishing sector's direct contribution to the GDP is the added value that forms in the fishing industry in the form of wage payments and profits. These are compiled by Statistics Iceland. According to these statistics, the fishing sector's contribution to the GDP measured at a fixed price, has been growing since 1997. As a proportion of the GDP however, this contribution has decreased. The reason is that the GDP has grown faster than the added value in the fishing sector. Since 2008, however, this trend has reversed and the present direct proportional contribution of the fisheries sector to the GDP has increased substantially. This progress is shown in Figure 3. Final figures on the direct contribution of the fisheries sector to the GDP in 2010 are not yet available from Statistics Iceland. Available preliminary figures, however, indicate that the total contribution of the fisheries sector (i.e. fishing and processing) was approximately 10.2% in that year. Thereof, the contribution of fishing was 5.7% and processing 4.5%. According to Figure 3, this proportional contribution is similar to what it was in 2009 while being considerably higher than in the years between 2004 and 2008.

Figure 3.
Direct contribution of the fisheries sector to the gross domestic product (at factor cost)



4.2 Indirect contribution

The fisheries sector's indirect contribution to the GDP is the added value that forms in other industries within the ocean cluster and which can be traced to their business dealings with the fisheries sector. This indirect contribution is not calculated

by Statistics Iceland. However, it is possible to estimate the contribution as a multiple of the added value that forms in the industries, which Statistics Iceland does compile, and the share of the fisheries sector in their turnover. A prerequisite for this estimate is that the added value from business dealings with the fisheries sector is generally the same as in the industries' other business dealings.

Extensive data acquisition work was carried out in many places on this basis. A range of large and small companies in the fisheries sector, together controlling more than 20% of the total catch quota in Icelandic fishing waters, were contacted. Detailed information was obtained on all purchases made by these companies from other companies which may be considered within the ocean cluster in Iceland. These companies were then classified according to the company classification system used by Statistics Iceland (ÍSAT 95). Thereafter well over a hundred companies in the company categories were contacted and information obtained on their turnover, human resources use and scope of operation in general. On this basis it was possible to estimate the total turnover in these sectors and thereby the share of their turnover that can be traced to business dealings with the traditional fisheries sector. The main conclusions of this investigation are shown in Table 1.

One of the industries that relies heavily on providing services to the fisheries sector is the textile industry, as it includes net making and various other forms of fishing gear manufacture. Approximately half of the industry's total turnover can be traced to the fisheries sector.

The fishing sector's share in the turnover of public administration, particularly in the category of public administration on behalf of industries, amounts to just under 36% of its total turnover.

The fisheries sector is also dominant in sectors involving the activities of membership organisations (n.e.e.). This high share is misleading as it is largely attributable to the fisheries sector's business dealings with the Federation of Icelandic Fishing Vessel Owners (LÍÚ), which has been responsible for common insurance issues and various other services for the sector. It would, therefore, be more reasonable to categorise this part of its business with the fisheries sector under insurance activities rather than the activities of membership organisations.

Approximately 30% of metal-working and repair can be traced to business relations with the fisheries sector. Metal-working

includes both general metal-working services and flashing work. Both, although particularly the former, play an important part in the building and maintenance of fishing vessels and fish processing plants.

Closely related to metal-working and repairs are mechanical manufacture and machine repairs. The scope of business these industries had with the fisheries sector was approximately 12% of the sector's total turnover.

The fisheries sector's share in shipping/haulage operations is large. Just under 21% of the total turnover of transport and distribution can be traced to business relations with the Icelandic fisheries sector. In addition, 8% for transport on land and 7% for water transport have been measured as resulting from business dealings with the fisheries sector. According to information from the transport companies, however, there appears to be some underestimation in this respect. This can be attributed to the fact that seafood buyers, agents, or others, are often responsible for transport. Information from major transport companies in Iceland indicates that the fisheries sector's share in international shipping and domestic haulage may be much higher, maybe as much as a third of turnover.

Table 1. Assessment of the fisheries sector's share of the total turnover of industries - Business sector (ÍSAT 95)

Name	Share in total turnover
Manufacture of textiles	49.59%
Public administration; excluding compulsory social security activities	35.77%
Activities of membership organisations n.e.e.	34.54%
Manufacture of fabricated metal products, except machinery and equipment	29.73%
Transport and agency services	20.97%
Manufacture of other transport equipment	16.29%
Manufacture of wood	13.34%
Manufacture of machinery and equipment n.e.c.	12.04%
Land transport	7.76%
Water transport	7.30%
Commission trading without vehicles	5.64%
The manufacture of rubber and plastic products	3.39%
Research and development	2.96%
Real estate activities	2.38%
Manufacture of chemicals and chemical products	2.07%
Other business activities	1.84%
Electricity, gas steam and hot water supply	1.35%
Post and telecommunications	1.02%
Sale, maintenance and repair of motor vehicles and motorcycles, retail sail of automotive fuel	1.02%
Computer and related activities	0.92%

Year 2010. Data on turnover in industries: Statistics Iceland. Data on the turnover that can be traced to transactions with the fisheries sector: own research, see text.

The manufacture of other vehicles covers the sub-category boat building and repairs. It is estimated that approximately 16.3% of the total turnover of the industry can be attributed to business dealings with the Icelandic fisheries sector. It proved impossible to obtain information on the total turnover of the sub-categories of the industrial sector classification system for 2010. Unfortunately, therefore, it is impossible to estimate how much of the total turnover of boat building and vessel repairs can be traced to business with the fisheries sector.

The fisheries sector's business dealings with the wood manufacturing industry is also considerable, or over 13% of the sector's turnover. Wood manufacturing refers for the most part to two aspects; containers made from wood fibres and the manufacture of materials for building construction. The fishing industry is a large user of the former.

The fisheries sector's share in the turnover of commission trading, not including vehicles and motorcycles, is considerable, or 5.6%. This sector includes, among other things, the importation and sale of fishing gear, machines, tools, clothing and packaging.

Finally, Table 1 contains a number of other industries with which the fisheries sector does business, although this business is a rather small proportion of the industries' turnover. Such industries include the manufacture of rubber and plastic products, research and development activities, real estate activities, chemical industries, power and heating utilities, post and telecommunications services, etc.

As stated earlier, Statistics Iceland assesses the direct contribution of individual industries to the GDP. To estimate the fisheries sector's indirect contribution to the GDP, account is taken on the one hand of the contribution of industries to the GDP according to the assessment of Statistics Iceland and, on the other, of the share in the turnover of the industries that can be traced to business dealings with the fisheries sector, as stated in Table 1. The prerequisite for these calculations is that the added value that is created in these industries, due to business dealings with the fisheries sector, is generally the same as that which is due to other business.

The summarised results of this estimate may be found in Table 2. In addition to the indirect contribution, the table also

contains an assessment of the direct contribution of the fisheries sector in 2010, as discussed in Section 4.1. The table is arranged in accordance with the industry classification system of Statistics Iceland, ÍSAT95. This system contains six main categories for industries which then contain various smaller sub-categories.

The fisheries industry's direct contribution to the GDP is due to industrial fishing and seafood processing. This direct contribution was 10.2% of the GDP in 2010. This is similar to the contribution in 2009 and substantially higher than it was during the years from 2004 to 2008. Of this direct contribution, the share of the fishing industry is estimated to be 5.7% and that of the seafood processing industry 4.5%.

The fisheries sector's indirect contribution to the GDP is, in Table 2, estimated to be 7.3% of the GDP. The largest proportion of this contribution can be attributed to various types of services and industries outside the fisheries sector. Indirect added value due to business dealings with the fisheries sector is also substantial in the retail sector and the transport sector.

Consequently, the sum of direct and indirect added value, which can be traced to the activities of the fisheries sector, is approximately 17.5% of the GDP. Thereof, direct contribution is just under 60% and indirect just over 40%. It should be reiterated that the reason for calculating the indirect added value of the fisheries sector is the fact that it is a base industry. This means that without the fisheries sector these activities would hardly have existed and that nothing would have replaced them.

Finally, it should be noted that these direct and indirect contributions are not the total contributions made by the fisheries sector to the GDP. We have yet to take account of the demand that the direct and indirect added value, traceable to the fisheries sector, creates in the economy and which is likely to encourage substantial production increases, as opposed to what would have been the case otherwise. Section 4.3 deals with this issue.

Moreover, the above calculations do not take account of the further processing of seafood products in Iceland, such as fish oil processing, enzyme processing and the utilisation of fish skins. Such processing is categorised under general industries in the classification system of Statistics Iceland and not under the fisheries industry. We have not specifically examined the scope of these activities or their contribution to the GDP. In this respect, the assessed contribution of the fisheries sector is also underestimated.

4.3 Demand effect

In addition to the direct and indirect contribution of the fisheries sector to the GDP, it may be assumed that the added value created directly and indirectly, and which appears in the form of wages and profits, will be used to purchase consumer goods and services. Thereby the sector has an even greater effect towards increasing manufacture in the economy. These effects are sometimes called multiplier effects (see e.g. Branson, 1972 and Stynes and Propst, 1992). We, however, choose to call such effects demand effect in this report (see Appendix 1).

Table 2. Direct and indirect contribution of the fisheries sector to the GDP in 2010
Added value as a proportion of the GDP

No.	Name:	% of GDP	Direct	Indirect
1.	Agriculture, forestry, hunting and fishing	6,7%	5,7%	
2.	Mining, industry and utilities	21,4%	4,5%	1,6%
3.	Building and construction	4,0%		0,1%
4.	Retail, transport and tourism services	18,4%		1,0%
5.	Financial, real estate and specialised services	25,3%		0,4%
6.	Other services (including public services)	24,2%		4,3%
		100,0%	10,2%	7,3%

Sources: Statistics Iceland. Linda Bryndisardottir (2011) and own calculations.

To further explain what the concept involves, it is useful to take an example. Added value is the sum of wages and profit. Let us imagine an employee in the fisheries sector or related sectors in the ocean cluster who receives a specific wage. He uses these wages to purchase goods and services, to pay public levies, and as savings. Purchases of goods and services are equivalent to the demand on the markets in question. The proportion of this demand directed toward domestic goods and services encourages and creates conditions for more domestic manufacture. The proportion of the added value that is spent on savings and public levies also leads to domestic demand, albeit indirectly. The state spends tax income in some manner to purchase goods and services. Savings are used, through the mediation of the financial system, for investments which also involve the purchase of goods and services. The same principles apply to this demand as to the demands of the wage earner. The proportion that is directed at domestic goods and services also creates conditions for increased domestic manufacture. This increased manufacture forms wages and profits for others, and so on and so forth. Thus this demand effect leads to a chain reaction throughout the economy. When everything is taken into account, this demand effect can be quite substantial. Investments, moreover, are by their nature, likely to increase the economy's manufacturing capacity and thereby lead to economic growth in the future.

No reliable investigations into the scope of this demand effect are available in Iceland. They are first and foremost limited to the part of the demand that is directed toward importation and (in the short term) to domestic manufacturing capacity. Based on importation trends and other limitations, it is quite likely that they are between 50-100% of the direct and indirect contribution of the fisheries sector. This is in tune with available investigations into the total contribution of the fisheries sector to the GDP in Iceland (Agnarsson and Arnason, 2007). It is, moreover, in reasonable accordance with existing assessments of macroeconomic wage multipliers in the fisheries sector in Canada (GSGislason & Associates Ltd. 2007). This is however considerably under the economic multipliers that are often mentioned for domestic industries (cf. KPMG, 2010).

No independent research has been performed on this issue and the uncertainties are significant. As a result, the decision was made to be somewhat below the lower limits of the above range and consider the demand effect to be 40% of the direct and indirect added value of the fisheries sector. As previously stated, this added value was estimated to be 17.5% of the GDP in 2010. This means that the demand effect is approximately 7% of the GDP.

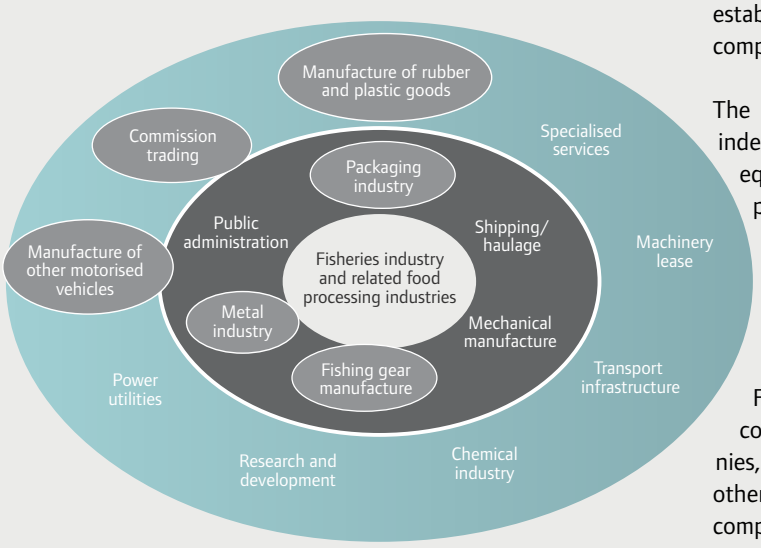
5 Other activities in the ocean cluster

As described in the foregoing text, a range of concerns linked to the traditional fisheries sector has thrived and initiated its own export of goods and services connected to the ocean in one way or another. On the basis of their services to the fishing industry, the companies in question have managed to obtain the knowledge, technology and manufacturing capacity that has enabled them to gain a foothold in overseas markets. Specifically, these companies are technology companies, companies in the chemical industry, transport companies, sales companies and service companies of various types. The exports of these companies are of course not included in the figures on resource purchases of the fisheries sector in Section 4 above. In order to obtain a more comprehensive view of the importance of the ocean cluster in the national economy, this section will discuss these activities in greater detail and attempt to roughly measure their scope.

5.1 Export activities in the ocean cluster

In addition to the export of traditional seafood products, a number of industries in the ocean cluster have begun their own exportations. Figure 4 is an attempt to show what industries these are. The following is a short discussion of some of the industries that have been significant in these new export activities and the scope of their operations.

Figure 4.
Independent export activities in the ocean cluster



5.1.1 Technological equipment for vessels, processing and fishing

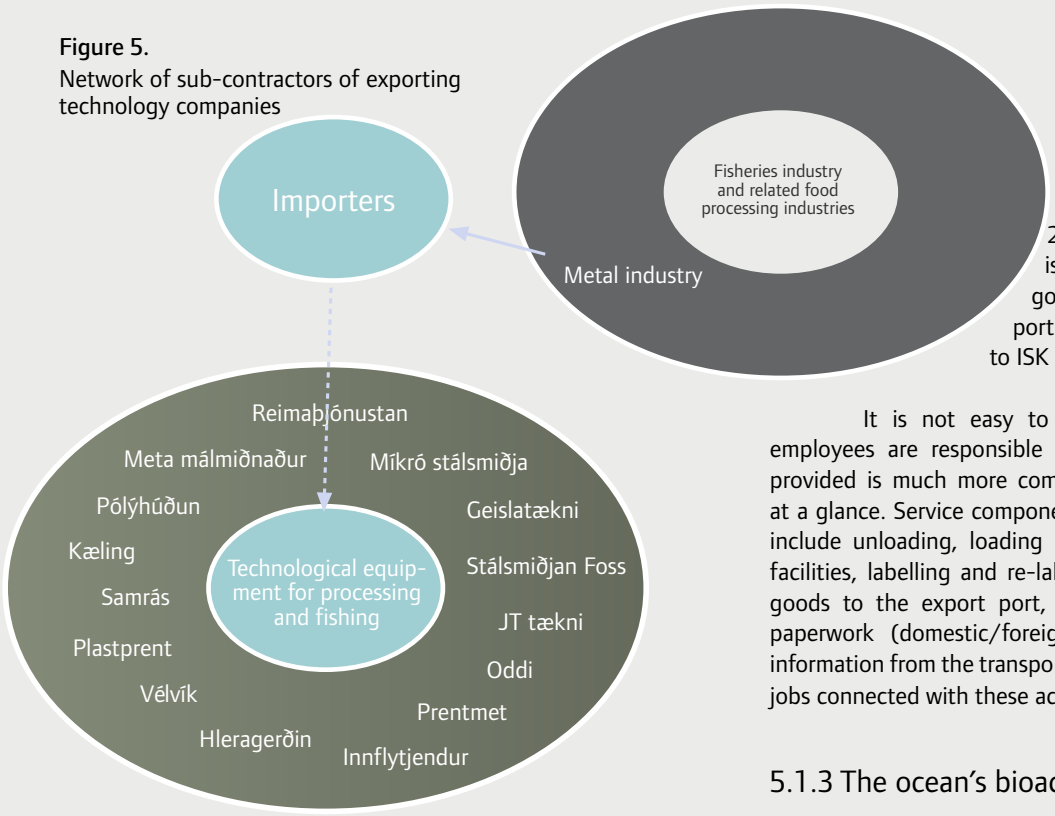
There are currently almost 70 companies operating in Iceland that manufacture and export, under their own trademarks, equipment and services for industries connected with the ocean. The technology companies design and manufacture fishing gear, fish processing equipment, telecommunications equipment, sensor equipment, packaging, cooling machines and cooling systems and IT systems, to mention a few. Employees in these companies, working on projects linked to the ocean cluster, currently number approximately 1,000. (Arnason and Sigfusson, 2011).

Despite their substantial scope, this diverse range of companies, located in various parts of Iceland, has not been prominent and no comprehensive statistics have been compiled on its activities. According to information obtained from the companies themselves, the turnover of technology companies in the ocean cluster was approximately ISK 26.9bn in 2010. Of this amount, exports accounted for ISK 16.2bn. If the turnover of Marel's subsidiaries (those connected with the fishing industry) and Hampidjan's subsidiaries outside Iceland are included, this amount increases substantially.

Figure 5 uses an example from the metal industry to show how technology companies that were initially based on business with the fishing industry can create for themselves an independent platform through exports and, at the same time, establish their own net of sub-contractors, i.e. a cluster of companies, here in Iceland.

The Icelandic metal working sector has in part created an independent existence through the export of technological equipment with connections to the fisheries sector. At present, there are approximately 40 companies in the metal working sector that export their own fisheries sector linked goods. These include companies such as Marel, Hedinn, Slippurinn, 3X, Volka, Traust, Mode Slurry Ice, Optimar, Skaginn, Formax, Velfag, Baader, Brimvor, Pola, Malmey, Martak, Style, Beitir, A.M.Sigurdsson, Fiskvelar og Frost, to mention a few. Surrounding these companies is a large group of Icelandic support companies, such as metal working companies, design companies and others that undertake sub-contracting work for the exporting companies. These support companies play a very important role and may subsequently become independent exporting companies in their speciality field, in the same manner that the exporting companies in the metal working sector developed from the services they provided for the fisheries sector and became independent.

Figure 5.
Network of sub-contractors of exporting technology companies



5.1.2 Transport activities

In transport, Icelandic transport companies have utilised their expert knowledge of transporting fish for the Icelandic fisheries sector to strengthen their competitive position in transporting seafood products for foreign entities. According to information from transport companies, mainly in shipping, 2/3rd of their foreign operations is due to transporting seafood goods and their turnover in transporting for foreign entities amounted to ISK 8-9bn in 2010.

It is not easy to estimate how many Icelandic employees are responsible for these tasks as the service provided is much more complicated than one would think at a glance. Service components in these transport activities include unloading, loading into containers or into storage facilities, labelling and re-labelling if necessary, driving the goods to the export port, loading containers on vessels, paperwork (domestic/foreign) and so on. According to information from the transport companies, it is estimated that jobs connected with these activities are approximately 450.

5.1.3 The ocean's bioactive compounds

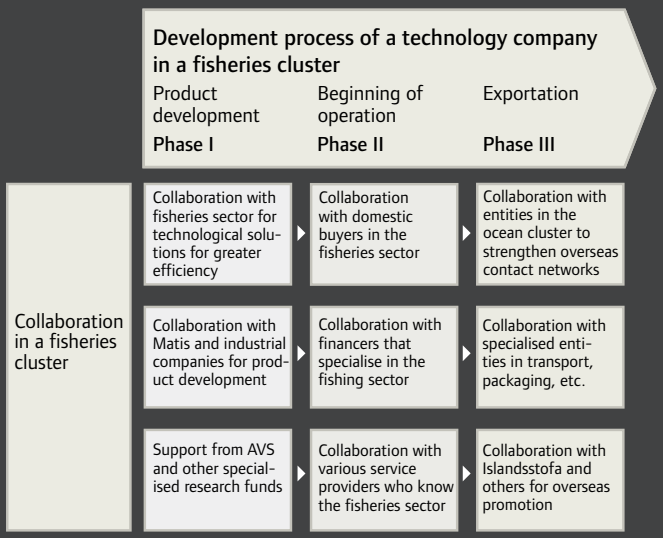
As the fishing sector companies have either been the shareholders or close collaborators of start-up companies in marine biotechnology, it was considered reasonable to include that sector in this analysis. Obtaining information on the turnover of companies involved in marine biotechnology has proved difficult. However numerous such companies have been established in recent years. These companies are often based on the close co-operation of fisheries companies, marine biologists and chemists. Many are small. However, according

Development process of a technology company in a fisheries cluster

The following figure describes the manner in which technology companies in the ocean cluster have typically formed and established. The figure also shows how various companies and public bodies within the ocean cluster help to strengthen exports in this field.

In Phase 1, the product is being developed. At this stage technicians usually work in close co-operation with well-established fisheries companies. In some cases this also involves co-operation with Matis, with a software company, and/or a metal working company. Finally, the technology companies have in some cases enjoyed grants from the AVS Fund or other research funds.

At development Phase II, the product is put on the market. By this time the co-operation between the technology companies and the fisheries sector has developed to the extent that the fisheries companies are ready to purchase the technology equipment. At this point the technology company has become more established and is able to seek funding from financers who have specialised in the fisheries sector. In addition, the company begins co-operating with a range of service entities familiar with the ocean cluster.



By development Phase III, the company has established itself on the domestic market and is now ready to try to gain a foothold in the export market. Provided that the Icelandic fisheries sector continues to maintain a leading position, conditions for successful export are good. To achieve success however, co-operation with various other parties, such as entities in the packaging sector, transport sector, etc. must be established. Moreover, it may be necessary to seek the assistance of expert promotional and marketing bodies such as, e.g. Promote Iceland (Islandsstofa).

to the information obtained, it is estimated that their turnover was approximately ISK 600m in 2010.

5.1.4 Aquaculture

In light of how many fishing industry companies play a key role or are leaders in aquaculture in Iceland, it was considered reasonable to include them in this analysis. Total production in aquaculture in Iceland has fluctuated somewhat between years. During the period between 1985 and 1990 production went from a few hundred tonnes to over 3,000 tonnes. From 1991 to 2002 production remained at approximately 3,000-4,000 tonnes, and then increased substantially with increased salmon farming in 2003-2006, when the sector shrank again and the total production went down to 4,000-5,000 tonnes. In 2009, the production was approximately 5,000 tonnes and the total value approximately ISK 3bn. In 2010, production increased again and was just under 6,000 tonnes with a value of ISK 5bn. It is believed that around 230-250 people were employed in aquaculture in just under 30 companies.

5.1.5 Sales, marketing and distribution

Efforts have been made to assess the scope of the sales and marketing activities of Icelandic companies as regards foreign seafood products. In addition to the large sales companies, there are numerous small companies involved in seafood sales and marketing. There appears to have been a considerable increase in third-country transactions with fish and seafood products handled by Icelandic companies. Third-country transactions means when an Icelandic company sells marine products between two foreign countries. Both large and small sales companies have been contacted in an attempt to estimate income from such activities in Iceland. Income from handling, sales fees and commissions are estimated to amount to approximately ISK 500m and it is assumed that the sector creates up to 100 jobs in Iceland.

5.1.6 Research, consultancy services and financial services

Numerous companies involved in research and consultancy services for the fisheries sector have grown quickly in recent years. Financial experts provide consultancy services overseas, technical engineers and naval engineers sell their services abroad and a variety of research projects here in Iceland have been funded by foreign entities. It is worth mentioned that the Icelandic Coast Guard is currently involved in exports through the lease of cruisers and more for guarding foreign marine regions, although these figures have not been included in these calculations. According to information from the companies, it is estimated that the turnover is ISK 1.5bn per year and that the sector creates up to 150 jobs.

5.1.7 Further processing of seafood

Several independent companies have been established that further process marine goods, produced in the fish processing part of the traditional fisheries sector. Among these are companies engaged in enzyme processing, companies processing fish skin and companies that seek to create health improving goods from fish products. The operation of these companies is generally not classified under fish processing in the industry classification of Statistics Iceland but under other industry categories.

At the top of the list of such companies, at least based on size, is Lysi hf. Lysi's production is not included in the data on the export of marine goods. In addition to Lysi, there are several other independent companies processing health goods or industrial goods from marine products for export, although these are much smaller. The aggregate turnover of these companies, according to information provided by them, is approximately ISK 6bn and number of jobs around 300.

Table 3. Scope of the export activities of companies connected with the fisheries sector

Companies	Number of direct jobs	Turnover (ISK million 2010 prices)
Technology companies	550	16.000
Transportation	450	8.500
The ocean's biologically active compounds	50	600
Aquaculture	250	5.000
Sales and marketing companies	100	500
Research and consultancy	150	1.500
End product processing classified as industry	300	6.000
Other companies	400	4.000
Total	2.250	42.100

Source: Information from the companies and own calculations.

5.1.8 Other companies

On examination, it is revealed that the diversity of exports linked to the ocean cluster is growing. Icelandic dockyards handle foreign vessels, various tradesmen, such as electricians and plumbers, who have specialised in services to Icelandic fisheries companies, undertake projects overseas, and contractors undertake a range of construction work connected with overseas fisheries sectors. Moreover, there are companies here in Iceland that are responsible for monitoring marine areas for overseas entities. It is estimated that these activities account for ISK 4bn per year and provide around 400 jobs.

5.2 Summary

We are now in a position to summarise the main conclusions of the investigation, mentioned in earlier chapters, into the scope of the export activities that have resulted from the ocean cluster and have established an independent existence in exports. It should be noted that as this summary is based on information from the companies and the operations of those contacted, it is likely that some aspects have not been included. In this report it is safe to say that this is an underestimation of the scope of these activities. On the other hand, it should be kept in mind that our estimate of the turnover and number of employees is only a rough estimate. It is first and foremost based on information from the parties within the sectors and for which we have not systematically sought confirmation.

Table 3 summarises our estimate of the scope of the export activities of the sectors that have been created on the basis of specialised services to the Icelandic fisheries industry and which have subsequently initiated their own exports. These export companies have not been taken into account as part of exporting Icelandic seafood.

The conclusions in Table 3 indicate that the turnover of this independent export that has occurred as a result of the ocean cluster amounts to over ISK 42bn in 2010. This amount is equivalent to approximately 4% of the total exports from Iceland that year. It is unclear what this export means in direct and indirect contributions to the GDP, i.e. added value. Conservatively estimated, however, this contribution could be between 1.5-2% of the GDP. Many software, high-tech and biotechnical companies have up to 80% of their costs in wages, while other companies pay wages that are closer to what is generally the norm in the economy, or 40%.

5.3 Overseas operation

This report does not contain any separate discussion on the fisheries operations that Icelandic companies operate overseas. The operating form of these companies is varied. Some are operated as the subsidiaries or affiliated companies of

Icelandic companies, while others are wholly foreign but owned by Icelanders.

Many of the Icelandic companies and investors who are involved in such overseas operations have been contacted. These investigations indicate that the scope of such operations is considerable. The most common involve the operation of factories, fisheries companies, freezer storages, transport companies and marketing and sales companies. Icelanders have also invested in aquaculture, technology firms, etc. It is estimated that more than ten thousand people overseas work directly for Icelandic entities involved in operations connected with the fisheries sector and related sectors, i.e. many more than here in Iceland. The major parties in the operation of companies in the ocean cluster outside Iceland are the sales companies in the fisheries sector, large fisheries companies and the largest manufacturers of high-tech equipment for fish processing and fishing gear. Smaller companies in the ocean cluster have subsequently increased the scope of their overseas operations in sectors such as aquaculture, marketing, financial consultancy services, etc. Not included here are the food manufacturing plants owned by Icelanders that use an insignificant amount of seafood products in their goods or the activities of Marel in sectors other than those linked to the fisheries industry.

No attempt is made to assess the economic impact of these operations on the Icelandic economy although it would be useful if such an investigation were carried out. Such investigation could try to assess both the profitability of such operations and estimate how much of this profitability flows back to Iceland. Moreover, it should be kept in mind that many Icelanders, though only a small proportion of the whole, work for these companies overseas. It may be assumed that a proportion of the wages of these people flows back to Iceland. More important, however, is the fact that these individuals have gained experience and knowledge which in many cases will be useful in the further outward expansion of the Icelandic ocean cluster.

6 Conclusions

The fisheries sector, i.e. fishing and fish processing, is a base industry in the Icelandic economy. A wide range of companies connected with the sector has gradually developed in Iceland and these companies are responsible for supplying the sector with some of its resources and take its products for further processing and distribution. The scope of these operations is substantial. On the scale of contribution to the GDP it is almost as great as the direct contribution of the fisheries sector itself (Figure 5). It is important to keep in mind that the prerequisite for the formation of such indirect contributions is the existence of the base industry, the fishing industry.

The fisheries sector and the above related operations can overall be viewed as an industry cluster as defined by Porter (Porter, 1990). The companies in this cluster are linked to one another in various ways and draw support from one another. The cluster, viewed as a whole, is therefore economically more dynamic, more efficient and more flexible than the simple sum of the companies that form it. One reason for this is the development of human resources and technology within the cluster which all the companies have access to through market trading, collaboration and co-operation. Thus it is possible, within the cluster, to achieve a significant economy of size and range. The cluster, therefore, operates to some extent as a very large and diverse company without the administrative disadvantages that generally characterise such companies. In the Icelandic ocean cluster, therefore, we see typical cluster effects as defined by Porter.

The added value, wages and profits, that form in the ocean cluster leads to demand for goods and services for both consumption and investment. To the extent that it is possible to meet such demand locally, there will be production increases. These effects, referred to in this report as the demand effect, can also be quite significant. As with the indirect effects within the ocean cluster, such impact depends on the existence of the base industry, i.e. the fisheries industry.

Industry clusters tend to have some of the characteristics of a living organism. They can strengthen, grow in scope and may even grow off-shoots that may establish themselves in a new industry. Thus companies in the ocean cluster can grow and develop to the extent that they can begin manufacture for other industries, or even begin their own independent export. There are several examples of this in the Icelandic ocean cluster; Marel hf. is probably the best known. However, there is absolutely no guarantee that industry clusters will grow and prosper. Clusters can also wither and die away. This can happen if the base industry, on which the cluster rests, suffers setbacks such as those due to altered operational conditions or less favourable competitive conditions.

To date, the Icelandic ocean cluster has clearly been undergoing a growth and development phase. This can be seen from the fact that a large and growing aspect in the ocean cluster is the independent export of goods by companies in the cluster. Examinations indicate that Icelandic companies that have grown out of the Icelandic ocean cluster and are engaged in their own exports have returned ISK 42bn in export value in 2010. For comparison,

Table 4. Estimated contribution of the ocean cluster to the GDP 2010
Percentages of the GDP

Fisheries industry:	**% of GDP**
Direct contribution	10.20%
Indirect contribution	7.30%
Demand effect	7.00%
Other export operations of the Cluster:	1.50%
Total	26.00%

it may be mentioned that the export value of seafood products during that year was approximately ISK 220bn. Although many of our interviewees were not able to estimate their growth over the next few years, both due to uncertainties regarding fisheries management in Iceland and instabilities in domestic and foreign economies, it is clear that many of the companies have considerable expectations to further expand overseas and hope for a 10-15% annual growth in their export operations over the next few years.

Our assessment of the direct and indirect contribution of the ocean cluster to the GDP, its demand effect and the independent export operations that have grown in the cluster, is summarised in Table 4.

In other words, the total contribution to the GDP is approximately 26%. It should be noted that this assessment is subject to considerable uncertainty. The greatest uncertainty involves the demand effect and the added value that the other export operations of the cluster create. We believe, however,

The conclusions in Table 4 indicate that the ocean cluster's direct and indirect contribution to the national economy may be approximately 26% of the GDP. Based on this percentage it would be appropriate to consider that approximately 26% of jobs in Iceland, or about 45,000 jobs, can be traced to the ocean cluster. However, we believe this to be an overestimation. The reason is that in the base sectors of the ocean cluster, in particular the traditional fisheries industry, profits are typically much greater than in other industries in the economy and the ratio between wages and added value lower. In addition, wage terms in the ocean cluster are typically better than the national average and therefore fewer jobs support the wage aspect of the added value. For this reason we consider it more likely that the ocean cluster directly or indirectly supports 15–20% of jobs in Iceland, or 25,000 to 35,000 jobs.

Earlier investigations indicated that the fisheries industry is responsible for 25,000 jobs (Agnarsson and Arnason, 2007). This assessment accords with the lower limits above. We believe that the number of jobs created by the fisheries industry may be somewhat higher, for a number of reasons. Firstly, we have reasoned that the direct and indirect contribution of the ocean cluster is much greater than the fishing industry's, as such. The impact of the ocean cluster on job creation is likewise greater. Secondly, in the statistics previously compiled on the fisheries industry, no examination has been carried out on the independent export operations that have developed in various industries connected with the fisheries industry and which have gradually gained an independent base. Our research indicates that the number of jobs in these sectors is over 2,200. In our opinion, the number of jobs in independent export operations connected to the fisheries industry is as follows:

Sectors	**Jobs**
Technology companies	550
Transportation	450
End product processing classified as industry	300
Bioactive compounds	50
Aquaculture	250
Sales and marketing companies	100
Research and consultancy	150
Other companies	400
Total	2.250 jobs

No statistics on the development of these jobs over the past few years are available. However, it is clear that there have been considerable increases, with the exception of aquaculture, in all these sectors.

that we have been conservative in our assessment of these figures and there is therefore a greater likelihood of underestimation than overestimation in this report. What strengthens this conclusion is that it is similar to the overall assessment of the fisheries industry's contribution to the GDP that can be found in an article by Ragnar Arnason and Sveinn Agnarsson (2006) and Agnarsson and Arnason (2007) which is based on a completely different methodology. For further comparison, it is worth mention the fact that investigations into the economic impact of ocean clusters in countries such as Ireland, the UK, Canada and New Zealand, indicate that the economic impact of ocean clusters in these countries is between 1.5-5% (Morrissey et al, 2011). Based on the direct contribution of the fisheries industry to the GDP in these countries, this estimate involves a significantly greater demand effect than we have assumed in Table 4.

One of the main goals of this report is to explain how a dynamic base industry, in this case the fishing industry, can form the foundation for a diverse range of other industries that may subsequently become considerably larger than the initial base industry. There are numerous examples of this overseas. For instance, not long ago the Netherlands were a leading force in flower growing in the world. Flower cultivation has now moved to other countries while the Netherlands have become a world leader in flower marketing and sales. Another example is of Finnish companies who serviced Nokia with a diversity of related operations connected with mobile phones, and have now established themselves as the largest companies in the world in the field of various kinds of applications for mobile phones. The development of the Icelandic fisheries industry and the development of diverse related operations in the ocean cluster is merely one more example of the same phenomenon, i.e. how a dynamic base industry leads to a cluster of industries that multiply the contribution of the base industry to the GDP and can, moreover, create a new independent base industry.

If properly managed we may expect industries within the ocean cluster, such as support or related industries of the fishing industry or new technology start-ups connected to the fisheries industry, to be responsible for a considerable part of the export value within the ocean cluster in the future. Norway, for example, estimates that various knowledge sectors connected to the ocean cluster in Norway can grow from NOK 4bn in 2006 to around NOK 25bn by 2025 (The Royal Norwegian Society of Sciences and Letters, 2006). Thus these knowledge sectors, which in Norway created approximately 10% of exports linked to the ocean cluster in 2006, may generate approximately 25% of exports linked to the ocean cluster in 2025. Norway emphasises that in order for this to become a reality, the economic sector and the authorities will need to formulate comprehensive policies in this field.

There are no objective reasons preventing Iceland from achieving the same success as Norway in this field. In order to achieve such success, however, the authorities must avoid undermining the ocean cluster and must avoid weakening it by introducing irresponsible measures. Instead, the authorities should steer a different course and direct efforts toward nurturing the ocean cluster and making it easier for the cluster to grow and prosper, as other fisheries nations in the Atlantic are doing. A step in that direction should be to formulate a comprehensive public policy on strengthening and developing the cluster. Such policy formulation has not taken place. Interviews with the representatives of technology companies and other new industries in the ocean cluster have clearly shown that they feel that there is a lack of comprehensive public policy formulation for the cluster.

The Icelandic ocean cluster is the one factor of the Icelandic economic sector where our comparative advantage is greatest in comparison to other nations. It is, therefore, obviously sensible to make every effort to base the continued development of the Icelandic economic sector on this foundation. The ocean cluster is, and has been, the key support of the Icelandic economic sector. It has every capability of growing and strengthening and becoming one of the mainstays of Icelandic prosperity and providing new and diverse opportunities for future generations.

7 Bibliography

Agnarsson, S. og R. Arnason. (2003). The Role of the Fishing Industry in the Icelandic Economy: A Historical Examination. Hagfræðistofnun W03:07.

Agnarsson, S. og R. Arnason. (2007). The Role of the Fishing Industry in the Icelandic Economy. Í T. Bjorndal, D.V. Gordon, R Arnason og U.R. Sumaila (eds.) Advances in Fisheries Economics. Blackwell Oxford, UK.

Andrews, R. B. 1953. Mechanics of the urban economic base: historical developement of the base concept. Land Economics, 161-167.

Bergman, E. M., & Feser, E. J. (1999). Industrial and regional Clusters: concepts and comparative applications. West Virginia: Regional Research institute.

Branson, W.H. 1972. Macroeconomic Theory and Policy. Harper & Row Publishers. NY.

European Commission (2004). Final Report on the Expert Group on Enterprise Clusters and Networks.

Foster, N. (2006). Exports, Growth and the threshold effects in Africa. Journal of Development Studies, 42(6), 1056-1074.

GSGislason & Associates Ltd. (2007) Economic Contribution of the Ocean´s Sector in British Columbia. Canada/British Columbia.

Hagfræðistofnun. 2007. Hlutur sjávarútvegs í þjóðarbúskapnum. C07:05. Hagfræðistofnun Háskóla Íslands. Reykjavík

Hagstofa Íslands. (2011). Þjóðhagsspá 2011-2016. Hagtíðindi. Hagstofa Íslands. (án dags.). hagstofan.is.

Iðnaðar- og viðskiptaráðuneyti. (1995). Tengsl iðnaðar og sjávarútvegs. Reykjavík.

Iversen, A., Klev, J.M., Bergersen, R.E., Storhaug, K., & Rotnes, R. (2011). Markeds- og verdikjedeanalyse. Fase 1 av prosjektet Value Propositions i nordisk marin sektor. Nofima.

Jón Þ. Þór. (2002). Sjósókn og sjávarfang; Saga sjávarútvegs á Íslandi (B. I Bindi). Akureyri: Bókaútgáfan Hólar.

Karl Friðriksson og Sævar Kristinsson (2006). Klasar. Samstarf í samkeppni. Impra, Reykjavík.

Kindleberger, C.P. 1989. Economic Laws and Economic History. Rafaele Mattioli Lectures. The Press Syndicate of the University of Cambridge. NY, NY.

Kindleberger, C.P. 1965. Economic Development. McGraw-Hill, NY.

KPMG endurskoðun (2010). Skýrsla KPMG endurskoðunar um áhrif gagnavers Verne Holding á atvinnulíf á Suðurnesjum sem kynnt var fyrir iðnaðarnefnd Alþingis.

Krumme, G. (1968). Werner Sombart and the economic base concept. Land Economics 44:112-16.

Linda B. Bryndísadóttir (2011). Ekki er allt sem sýnist. Mat á þjóðhagslegri arðsemi íslensks sjávarútvegs. BS ritgerð. Hagfræðideild HÍ.

Marine Institute (2007). Sea Change – A Marine Knowledge, Research and Innovation Strategy for Ireland 2007–2013.

North, D.C. (1955). Location theory and regional economic growth. Journal of Political Economy: 63(3): 243-267.

Park, S.-H. (1965). The economic base identification: An Appraisal. Land Economics, 382-386.

Porter, Michael E. (1990). The Competitive Advantage of Nation. Free Press, New York.

Ragnar Árnason og Sveinn Agnarsson, S. (2006). Sjávarútvegur sem grunnatvinnuvegur á Íslandi. Fjármálatíðindi 52.2: 17-32.

Ragnar Árnason og Þór Sigfússon. 2011. Umfang og horfur í tæknifyrirtækjum í sjávarklasanum Frumathugun á fjölda tæknifyrirtækja í sjávarklasanum, þróun og horfur. Íslenski sjávarklasinn. Reykjavík

Roy, N., Árnason, R., & Schrank, W. E. 2009. The identifiaction of economic base industries, with an application to the Newfoundland fishing. Land Economics 85 (4):675–691.

Stimson, R. J., Stough, R. R., & Roberts, B. H. (2006). Regional economic developement. Berlin: Springer Verlag.

Stynes, D.J. and Propst, D.B. (1992). A system for estimating local economic impacts of recreation and tourism. In. Measuring tourism impacts at the community level. S. Reiling (Ed). Maine Agr. Expmt. Sta. Misc.

The Royal Norwegian Society of Sciences and Letters (DKNVS) and Norwegian Academy of Technological Sciences (NTVA). 2006. Exploitation of

Marine Living Resources – Global Opportunities for Norwegian Expertise. Report #374. Oslo
Tiebout, C. M. 1965. Exports and regional economic growth. The journal of Political Economy. 160-164.

Appendix 1

Theoretical basis of measurements of the contributions of industries to the GDP

Statistics offices commonly collate data on added value in individual sectors and refer to these figures as a contribution to the GDP. Sometimes added value in related sectors, e.g. backward and forward connections, is added and referred to as the direct and indirect contribution of the sector to the GDP and even the multiplier effect of the sector. Methodology of this nature can be informative. It requires however, careful handling and can be extremely misleading. To see this it is sufficient to realise that if the contribution of all industries to the GDP were to be assessed in this manner, the results would be far, far greater than the actual GDP.

A necessary prerequisite for being able to examine the added value that forms in particular economic sectors or the sectors connected with it, with, e.g. added backward or forward linkages to the GDP, is that the industry is a base industry. All industries have economic bakward linkages and many also have economic forward connections. If, however, an industry is not a base industry, its contribution to the GDP is not independent in the sense that if the base industry in question stops operating, this industry will also stop operating. The added value in the sector is, in other words, completely dependent on the existence of the base industry (one or more). For this reason, it is not considered good methodology to examine the added value that forms within industries and which statistics offices measure, as their contribution to the GDP. This is justifiable only if the industry in question is a base industry. If it is not, the added value that the industry generates is in fact dependent on the operation of some base industry and would disappear if that base industry ceased operation. The clearest example of this is public services. Public services are typically measured with significant added value in national accounts. This added value, however, would of course not exist except for the fact that one or more base industries exist in the region and have attracted people and workers to the area. The same applies to various other industries operated by private entities.

Furthermore, it must be kept in mind that although it is a necessary prerequisite that the industry in question is a base industry in order for it to be possible to examine the added value generated by it, and connected industries, as an addition to GDP, this prerequisite is not sufficient. It is possible that there exist other possible base industries that could take up part or most of the slack if the base industry in question ceases operations. Thus one could, for example, imagine that the residents of a former mining town could turn to tourism and art sales following the closure of their mine. This industry would thereby become the base industry in the area, although the scope of activities would probably be somewhat less than previously and there would be some population decrease.

If new industries are established on the domestic market to supply the base industry with resources, such operations are referred to as the backward connection to the base industry. Bakward linkages involve the formation of added value, i.e. wages and profits, which is in addition to that created by the base industry. The same applies when new industries are created to further process products from the base industry, or transport such goods and distribute them to other markets. These are referred to as forward linkages and also involve the creation of added value in addition to that created by the base industry.

Together, the direct and indirect effects of the base industry on the GDP create a particular added value or contribution to the GDP. This contribution can be regarded as the additional contribution of the base industry to the GDP as it is created due to that industry´s existence and would disappear if the industry did not exist.

In addition to direct and indirect effects of the base industry on the GDP there is a third impact. This is the impact on the GDP that the demands of employees in the base industry, and its forward and backwards connections, create. To the extent that new companies and industries are established on the domestic market to meet these demands, the GDP grows by the equivalent of the added value formed thereby. These effects are of a different nature than the forward and bakward linkages and can be called an demand effect. How great the demand effect is on the GDP depends on conditions in the economy, not least the ability to meet increased consumption demands with domestic manufacture. However, it is clear that the impact can be substantial.

The base industry, together with its backward and forward connections, forms an industry cluster as defined by Michael Porter (1990). According to Porter, however, it is not possible to view the demand effect of the base industry as a part of the cluster. As a result, the cluster's contribution to the GDP consists only of the direct and indirect contribution of the base industry.

Disclaimer

This introduction was produced by Íslandsbanki hf.

The information in this summary is based on publicly available data and information from various sources deemed reliable. The information has not been independently verified by Íslandsbanki hf. which therefore does not guarantee that the information is comprehensive or accurate. All views expressed herein are those of the author(s) at the time of writing and may change without notice. Íslandsbanki hf. holds no obligation to update, modify or amend this summary or to otherwise notify readers or recipients of this summary in the event that any matter contained herein changes or subsequently becomes inaccurate.

This summary is informative in nature, and should not be interpreted as a recommendation to take, or not to take, any particular investment action. This summary does not represent an offer or an invitation to buy, sell or subscribe to any particular financial instruments.

Íslandsbanki hf. accepts no liability for any possible losses or other consequences arising from decisions based on information in this summary. Any loss arising from the use of the information in this summary shall be the sole and exclusive responsibility of the investor. Before making an investment decision, it is important to seek expert advice and become familiar with the investment market and different investment alternatives.

Various financial risks are at all times present during investment activities, such as the risk of no yield or the risk of losing the capital invested. It should further be noted that international investment includes risks related to political and economic uncertainties, as well as currency risk. Each investor's investment objectives and financial situation is different. Past performance does not indicate or guarantee the future performance of an investment.

Reports and other information received from Íslandsbanki hf. are meant for private use only.

This material may not be copied, quoted or distributed, in part or in whole, without written permission from Íslandsbanki hf.

This document is a brief summary and does not purport to contain all available information on the subject covered.

Regulator: The Financial Supervision Authority of Iceland (www.fme.is)

United States
Neither this report nor copies may be distributed in the United States or to recipients who are citizens of the United States due to restrictions stipulated in U.S. legislation. Distributing the report in the United States might be seen as a breach of the said legislation.

Canada
The information provided in this publication is not intended to be distributed or circulated in any manner in Canada and therefore should not be construed as any kind of financial recommendation or advice provided within the meaning of Canadian securities law.

Other countries
Laws and regulations of other countries may also restrict the distribution of this report.

This summary does not constitute any solicitation of services by Íslandsbanki hf. in the United States or Canada.

For further information relating to this introduction see:
https://www.islandsbanki.is

The Icelandic Ocean Cluster likes to thank following founding companies of the Icelandic Ocean Cluster for support provided:

Íslandsbanki
Brim
Eyrir Invest
Samhentir
Eimskip
Síldarvinnslan
Icelandair Cargo
Samskip
TM
Hraðfrystihúsið Gunnvör (H-G)

Íslandsbanki

The Importance of the Ocean Cluster for the Icelandic Economy

Íslandsbanki, Kirkjusandi, 155 Reykjavík, Iceland
Tel.: 440 4500

For more information:
seafood@islandsbanki.is
www.islandsbanki.is/seafood/