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THE FEHMARNBELT TUNNEL: REGIONAL DEVELOPMENT PERSPECTIVES

ABSTRACT

The Fehmarnbelt Link between Denmark and Germany, for which in September 2008 a bilateral government treaty was signed, is the last of the three links uniting transportation networks in Northern Europe. The three links (the Great Belt and the Øresund Link being the other two) are impressive mega structures (bridges/ tunnels) spanning international waterways. They concentrate traffic flows and create strong transport corridors and are the basis of new regional development regimes.

In early 2011, following almost two years of extensive work on different conceptual designs for the fixed link it was decided that an immersed tunnel should form the basis for the continuous planning of the project, including the environmental impact studies. Completion of the link is scheduled for 2020.

INTRODUCTION

In the 1980s The European Round Table of Industrialists identified 14 missing links in the transportation network of the continent. Three of them were found around the Danish island of Zealand (see Figures 1a and 1b).

One link was within Denmark; the other two were between nations. One link connects heavy economic centres, one joins more thinly populated regions and the last one links peripheral areas. Two of them (the Great Belt Link – linking the Danish islands of Zealand and Funen and the Øresund Link between Denmark and Sweden) have been constructed and are fully operational. The third – the Fehmarnbelt Link between Denmark and Germany – was decided in 2008 on a bilateral government level. The three links are impressive mega structures (bridges/ tunnels) spanning international waterways. Their lengths are around 20 km (12 miles) each. They concentrate traffic flows and create strong transport corridors. They are the basis of new regional development regimes. “Ferries connect systems, fixed links unite systems”. The concept of missing links has been adapted by the European Union in different large-scale strategies.

Above: The present situation showing the ferry with vehicles coming from Puttgarden (Germany) disembarking at Rødby (Denmark). The fixed Fehmarnbelt link will not only take over the transport services now carried out by the ferries between Rødby and Puttgarden. It will forge new relations between the communities on both sides of the link.

Following these new strategies, the Trans-European Transport Network was adopted and implemented nationally in different ways. Some countries have been focussing on high-speed railway infrastructures, others have improved airports and seaways, and in Denmark the three fixed links totalling a €13 billion investment have been given high priority in the national transport action plans. The revision of the guidelines and the new EU initiatives regarding “Green Corridors” intends to substantially affect funding programmes of the TEN-T towards fostering sustainable cross-border transport infrastructure linking up to policies of regional development, innovation and growth. The third fixed link, the Fehmarnbelt Link forms a giant step in the creation of a new North-European corridor.

The first stage of the Northern European integration project was completed with the opening in 1997/1998 of the fixed link across Denmark’s Storebælt (Great Belt) (Figure 2). This represented a giant leap into the future in terms of logistics and physical interaction between East and West Denmark. Although the networks across Storebælt already existed, the new link largely increased the potential for co-operation between the various parts of Denmark.

The second stage, the Øresund Fixed Link was ready in 2000 (Figure 3). Despite the fact that the Øresund Region's major cities appeared to provide good pre-bridge opportunities for integration, only some fairly weak networks had been established between Scania in Sweden and Zealand in Denmark. The opening of the Øresund Bridge/tunnel, therefore, substantially improved potential networking across the strait and, following a somewhat sluggish start, due to lack of updated administrative rules, such links ever since have been steadily growing in a learning process.

With the decision by Germany and Denmark to enter the third stage and build a fixed Fehmarnbelt link, the two nations not only embarked on a large-scale project to improve the infrastructure of Northern Europe and reduce travel times, but also to stimulate economic, cultural and social development in the areas, regions and countries around the link. With the fixed Fehmarnbelt link, one of the world's mega projects in terms of logistics will be completed. "The missing Scandinavian link" will no longer be "missing".

The fixed Fehmarnbelt link will result in considerably changes. Although differences between the German and Scandinavian languages and the fact that the near areas are sparsely populated will constitute barriers to the area's development. Nevertheless, the potential gains are significant. And one thing is certain: As new infrastructure projects of this size have always resulted in major changes, the link will create growth and development.

The fixed Fehmarnbelt link will not only take over the transport services previously carried out by the ferries between Rødby and Puttgarden. No less important is the fact that new relations between the communities on both sides of the link will be forged – between southern Zealand, Lolland and Falster in Denmark and eastern Holstein in Germany as well as, further afield, between Copenhagen/the Øresund city and Hamburg. As a result, new trading opportunities, new forms of tourism, new jobs and new housing opportunities will arise. In turn, this will open up new regional development perspectives for the entire Fehmarnbelt region. Already a range of contacts and partnerships are being

formed between Denmark, Germany and Sweden for the purpose of exploiting the opportunities created by the fixed Fehmarnbelt link.

The treaty on the construction of a fixed Fehmarnbelt link was signed by the Danish and German governments on 3 September 2008. The decision engendered strong focus on the development perspectives following the fixed link's completion in 2020.

PLANNING THE FEHMARNBELT TUNNEL: STATE OF THE ART

In early 2011, following almost two year's extensive work on different conceptual designs for the fixed link it was decided that an immersed tunnel should form the basis for the continuous planning of the project including the environmental impact studies. However, alternative technical solutions – for example a cable-stayed bridge – are still being considered and benchmarked. The decision on

Figure 1a. Pre-fixed links: Southern Scandinavia plus parts of Northern Europe. Distance between the Zealand archipelago and the rest of the region as time: 1 hour equals 80 km. The three ovals indicate the location of the ferry lines and the "Missing Scandinavian Links" as stated in the late 1980s. Western oval (left): The Great Belt. Eastern oval (right): Øresund. Southern oval: Fehmarnbelt. Larger oval at Øresund indicates several ferry cross



Figure 1b. Post-fixed links: Southern Scandinavia plus parts of Northern Europe. Solid line: Existing connections and roads. Broken line: Fehmarnbelt link to be constructed. Distance in kilometres.





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which solution is finally to be built will be made pursuant to a specially enacted construction act in Denmark and subject to approval by the German authorities. The final approval is expected in 2013.

The recommendation of the immersed tunnel is based on a preliminary, comprehensive assessment of, not least, environmental and safety issues including navigational safety but also technical, traffic, time and financial issues.

The state-of-the-art tunnel under the Fehmarnbelt is set to be one of the safest in the world (Figure 4). With a length of about 18 km it will also be the world's longest combined road-rail tunnel to date. The tunnel will be five times the length of the Øresund tunnel (approx. 4 km) between Copenhagen and Malmö and three times the length of the Trans-Bay Tube Bart Tunnel in San Francisco, which is currently the world's longest immersed tunnel. The total length of the Fehmarnbelt tunnel will be about 18 km from tunnel mouth to tunnel mouth. At a speed of 110 km per hour, this will offer motorists a journey time of approximately 10 minutes through the tunnel. For train passengers, the journey will take seven minutes from coast to coast.

Technical challenges

An immersed tunnel will present considerable technical challenges during the construction phase, as a result of the intensive shipping traffic in the Fehmarnbelt. However, unlike a bridge, an immersed tunnel will not entail as many technical operations which push the limits of what has been done before. Essentially, the procedure will be the same as it was for construction of the Øresund Fixed Link's immersed tunnel under the Drogden Channel, only many more times over and at greater depth, i.e., up to 30-40 metres in the Fehmarnbelt compared to approximately 25 metres in the Øresund.

A cable-stayed bridge across the Fehmarnbelt, with two free spans of 724 m each, would be the largest spans ever constructed for combined road and rail traffic. Compounded by the high shipping traffic in the area, this would pose significant risks in the construction phase in terms of cost overruns, delays and industrial accidents. One of the key parameters for the choice of technical solution is the

environmental impact of the projects. Both a cable-stayed bridge and an immersed tunnel would impact the marine environment in the Fehmarnbelt. The preliminary conclusion is that a bridge would have slightly more significant permanent environmental impacts than an immersed tunnel. A number of the environmental impacts of a fixed link would be on Natura 2000 sites. In such instances, EU legislation prescribes that the least intrusive alternative must be selected.

In the interests of navigation safety, a tunnel clearly poses fewer risks than a bridge. The Fehmarnbelt is a heavily trafficked stretch of water with 47,000 vessel transits per annum (2006), including many tank vessels. In the coming years, shipping traffic in the Fehmarnbelt is expected to increase substantially to approximately 90,000 vessel transits in 2030. However, risk analyses for a bridge show that, from a vessel perspective, navigation safety would be improved in relation to a situation with no bridge and continued ferry crossings. This would require a cable-stayed bridge with two navigational spans of at least 724 m each, and the implementation of permanent, radar-based vessel monitoring in the form of a Vessel Traffic Service (VTS) system covering a range from the south end of the Great Belt to the Cadet Channel.

Financial factors

In financial terms, there is at the outset very little difference between the two projects. The construction estimate (2008 price level) for an immersed tunnel is € 5.1 billion and for a cable-stayed bridge, € 5.2 billion.

Assessment of the overall cost of each of the two projects must also take into account the construction time and the cost of operation and maintenance. The construction time for the tunnel is estimated at 6.5 years, and for the bridge, 6 years. The cost of operation and maintenance is slightly higher for a tunnel than for a bridge.

All told, the payback time for the two projects would be essentially the same: approximately 30 years for the coast-to-coast project. This means that, from an overall financial perspective, there is no difference between bridge and tunnel.



Figure 2. The Great Belt Bridge connecting the Danish islands of Funen and Zealand represented a giant leap into the future in terms of logistics and physical interaction between eastern and western Denmark.



Figure 3. The Øresund Bridge between Denmark and Sweden. The opening of this bridge/tunnel link has substantially improved networking across the strait.

Construction

The immersed tunnel solution comprises 89 tunnel elements in total, made of waterproof concrete (Figures 5 and 6). The elements each weighing around 75,000 tonnes will be manufactured on land in covered factories and then transported by tugs to the alignment and sunk into the dredged trench and connected to the preceding element.

The immersed tunnel will thus lie in a channel dredged in the seabed and will be protected by a layer of stones 1.2 m thick as protection against sinking ships or ships' anchors.

A new concept for special elements has been introduced when developing the conceptual design for the tunnel. As all mechanical and electrical equipment requiring space and

maintenance will be gathered in these special elements. This means that the standard elements can be made technically simpler and homogenous and, therefore, better suited for batch production.

Femern A/S is working on the assumption that a large proportion of the tunnel components would be produced locally owing to their great weight. On account of the risks entailed by sea transportation of such large components, Femern A/S has previously concluded that production of concrete components should ideally be sited within 120 km from the alignment in order to always have a sufficient handle on the weather outlook. A more distant siting may also be considered but will increase the risks picture.

It is expected that the contracts with the contracting firms who will be undertaking the construction project will be signed in 2014.

Safety in the tunnel

Thorough safety analyses have been conducted and the proposed tunnel more than meets all relevant safety standards – including the EU's tunnel safety directive – because of the end-to-end emergency lane, amongst other features. The requirements for road tunnels have increased a great deal over the last decade. The design of the forthcoming Fehmarnbelt tunnel takes all the new requirements into account.

For motorists, the immersed tunnel will be at least as safe as a standard motorway. All traffic will run in separate one-direction tunnel tubes so there is no oncoming traffic. To minimise the risk of accidents, a computerised traffic control system will be installed and there will be a 24-hour manned control centre. Moreover, traffic information will be available on FM radio and signage for motorists and varied architectural lighting will be installed in the tunnel so drivers can maintain concentration for the full 10 minute journey.

As is the case with flying, studies show that some few users may feel discomfort when entering and driving in tunnels. For a very few users, the discomfort is so intense that it will make them choose an alternative route. Correspondingly, a similar number of users

experience anxiety driving across long or high bridges. When driving in tunnels the anxiety can be relieved with creative and strong lighting, decoration, clear information with frequent signage and a welcoming and reassuringly safe design for the tunnel portals (Figure 7).

With the dramatic decrease in hazardous emissions from cars and trucks in the last ten years, the “piston effect” – longitudinal ventilation – of the vehicle traffic will be sufficient to comply with the requirements for air quality in the tunnel during normal operation. In the event of irregular operation, a fire or discharge of toxic fumes, the ventilation system will ensure that motorists can get safely out of the tunnel and that rescue and emergency teams can work safely. In addition, a sprinkler system will be installed in the tunnel, which will limit the extent of any fire and smoke.

There will be a central gallery between the road tunnel tubes to which the motorists can go in the event of an accident. Approximately every 100 metres there will be cross-connections between the tunnels, which means that there will be no more than around 50 metres to the nearest emergency exit. The over-pressure ventilation in the central gallery will ensure that there is fresh air and no smoke in the gallery in the event of a fire.

Landscaping

The tunnel will be almost invisible in the landscape, with the exception of the portal buildings and landfills. The tunnel will not impact the marine environment once it has been built. The preliminary environmental investigations show that an immersed tunnel has the least permanent environmental effects and thus also requires fewer measures to minimise environmental impacts.

The proposal is for the tunnel to be constructed almost in a straight line from coast-to-coast. On the German side, motorists will drive over a small hill and then downwards into a green valley before arriving at the mouth of the tunnel (Figure 8). After a gradual transition to artificial lighting, they will continue into a tunnel with light-coloured walls and architectural decoration.

The approach on the Danish side of Lolland will be characterised by a designed landscape and will be marked by a portal containing the control and monitoring centre. In this way, the portal building on the Danish side is envisaged as a landmark for travellers en route to Germany (Figure 9).

THE GEOGRAPHY OF THE FEHMARNBELT REGION

The Fehmarnbelt region comprises the Zealand archipelago, Bornholm, Schleswig-Holstein, Hamburg and Scania. Parts of Mecklenburg-

Vorpommern and, when discussing major cities, Rostock are at relevant occasions included in the Fehmarnbelt region. The region comprises 9.3 million people with 1.2 million in the Swedish part, 2.5 million in the Danish part and 5.6 million in the German part.

In 1997-1998 the Zealand archipelago was joined to mainland Europe by the opening of the Great Belt tunnel and bridge whilst the fixed link between Zealand and the Scandinavian peninsula, the Øresund Bridge, was commissioned in 2000. The two mega bridges/tunnels have significantly changed the geographical reality for Southern Scandinavia. Looking at the diagram in Figure 10, what is striking are the traffic jumps following the opening of the fixed links. The traffic jump was significant after the opening of Great Belt Bridge and developments subsequently entailed a new, lasting, growth regime. The reason was that a series of networks were already in place and were waiting to be employed in new and more value creating ways. Family ties were national, companies had Denmark as their market and the public sector, institutions and organisations were organised on a nationwide basis. What was needed was simply to change the logistics and localisation patterns.

There was also a traffic jump following the opening of the Øresund Bridge, but this took longer because there were no existing, well-



Figure 4. The approach ramp and portal structure on the Danish side of a Fehmarnbelt tunnel with the control and monitoring facilities seen from the north towards the south.



Figure 5. The Fehmarnbelt tunnel will be constructed from 79 standard elements each 217 m long and 10 shorter special elements to be located every 1.8 km.



Figure 6. The special elements will ensure that ongoing operations and maintenance can be carried out without disrupting traffic. Beneath the road lanes and the rail track, there will be access to all technical rooms. Personnel, therefore, do not have to cross the traffic.

developed networks to build upon. Rather, developments following the Øresund Bridge can be described as something entirely new with a learning process in which all localisation decisions were taken in light of the fixed link as a reality, where logistics acquired new development opportunities and where new economies of scale were added to the agenda with their starting point in an overall Danish/Swedish metropolitan region.

The question now is how the transport picture at Fehmarnbelt will change post fixed link. There is no doubt that changes will occur and that the fixed Fehmarnbelt link will result in a traffic jump and new growth potential. In the

short term, this will probably be less dramatic than it was following the two other mega projects (the Great Belt and Øresund links) because there are no well established networks across the Fehmarnbelt or heavy centres near the future fixed link. By contrast, predictions suggest that the project will create a new lasting growth regime based on its considerable value creating potential, particularly brought about by the establishment of new networks and because a new border regional framework calls for action.

REGIONAL ANALYSIS PERSPECTIVES

In the Fehmarnbelt region, the national sea borders act both as system separators and as

localisation factors for infrastructure, transport and logistics. Compared to the domestic regional traffic, traffic across Fehmarnbelt is weak and cross-border infrastructure consists of ferry services. Although there are also ferries across Øresund, the Øresund Bridge constitutes the significant link between Zealand and Scania.

Basically, there are three different perspectives for regional development. The first comprises the interaction between the major heavy centres, i.e. between Copenhagen–Malmö–Lund (the Øresund City) on the one side and especially Hamburg, but also Kiel, Lübeck and Rostock on the other. Within this perspective,

there are almost exclusively potential gains. The second perspective comprises those parts of the region that are close to the Fehmarnbelt. Here it is not only about potential winners, but also realising that once the fixed link is completed, jobs linked to the ferries and crossings will disappear and that at the same time construction work will cease. The third perspective encompasses the other ferry towns, which will experience new tough competition (compare Figures 11 and 12).

The major cities will experience new growth potential. First and foremost, this will apply to the Øresund City and Hamburg and secondly to Kiel, Lübeck and Rostock which, however, will see some negative development potential in that ferry services in these towns will be exposed to strong competition. The major cities will also see a strengthening of their crossing point function, which will make them more attractive as localisation targets for a wide range of activities. They themselves will be occupied by strengthening the interaction within areas that create new value by exploiting both the complementary opportunities and supplementing each other's activities. They will be better positioned within the international metropolitan competition. Moreover, the construction of the fixed Fehmarnbelt link will provide great opportunities for linking the Øresund City and the heavy Scandinavian centres to the network of high-speed trains that are

increasingly set to become the backbone of Europe's mass transport system. These opportunities are too good to miss.

Those areas (Lolland-Falster, the Northeastern part of Schleswig-Holstein), which border the future fixed link, can expect job losses when the link opens and the ferry services cease operating. This is unavoidable, but it could mean that these areas mobilise and demand new localisation of government assets.

This was, for instance, the case with West Zealand's success in connection with the construction of the Great Belt Bridge where the Danish government came under pressure to move the Copenhagen naval station to Korsør and did so. However, there are also gains to be had. The property market will respond to more efficient transport connections and to the fact that access to major cities in the neighbouring country will be much faster and more convenient. The areas that border the fixed link will become "real" border regions with neighbours in another country within daily reach and commuting areas to the centres expanded.

Property price increase

As part of the project of reference (Matthiessen, ed. 2011), the impact of accessibility on house prices is estimated. These estimates confirm that a fixed link will

have a substantial and statistically significant positive impact on house prices. These estimates do not take other future dynamic changes into account, such as new property developments or new commuting trends. An 8 per cent increase in the price of the average house on the German side corresponds to an absolute increase in 2009 prices of €16,000. The estimates for the Danish side are somewhat more uncertain, but can be expected to fall within the same range. Using data from housing markets in other areas with high-speed train links shows an overall increase in residential property values of €1.6 billion on the German side of the Fehmarnbelt.

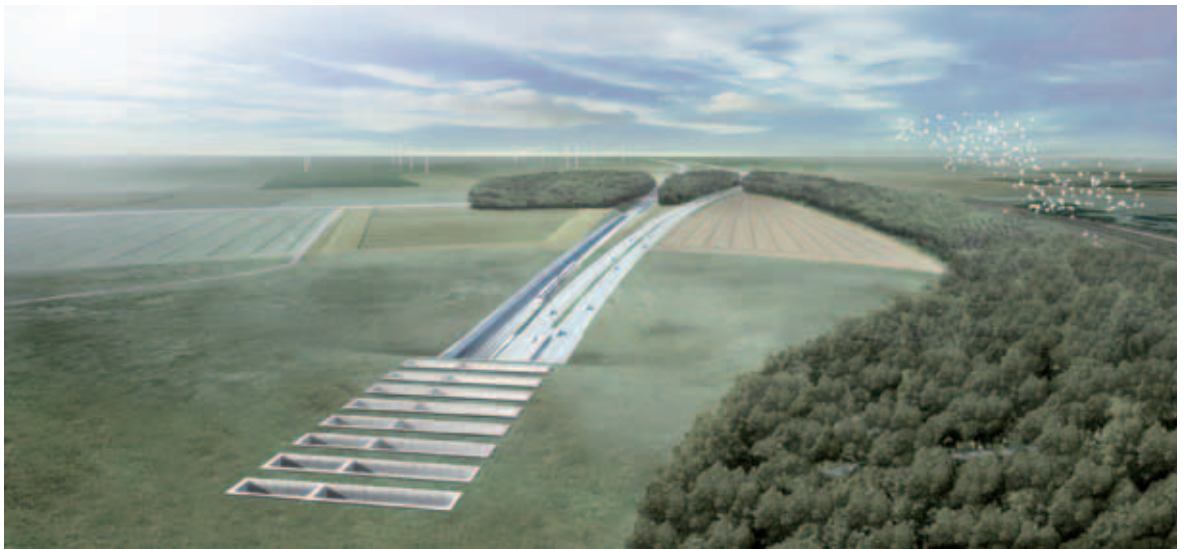
The total increase for the local housing markets on the Danish side would amount to at least €1.4 billion. The total minimum increase – assuming high-speed rail service links – thus amounts to €3 billion in 2009 prices (providing the economic structure in Denmark and Germany remains unchanged). One can assume, therefore, that the improved infrastructure in the areas near the fixed Fehmarnbelt link will result in relocations from Greater Copenhagen to the Danish areas near the link and similarly, relocations from Hamburg to the North German areas near the link.

Differences in property prices will not, to the same extent as has been seen around Øresund, promote border commuting although the new



Figure 7. Three colored zones and illustrations on the walls of the road tunnel will help to give motorists a varied journey during their 10 minute drive through the Fehmarnbelt tunnel.

Figure 8. On the German side the proposal is to make the approach area as green as possible and thus integrate it into the existing landscape as much as possible.



role as a hinterland for Copenhagen and Hamburg, Lübeck and Kiel will create new opportunities for what is today regarded as peripheral areas in Lolland-Falster and in the NorthEast Schleswig-Holstein. Similarly, the tourist market and the market for border localisation will react to the newfound accessibility. This also means significantly more realistic efforts within the European Union's range of border regional policies.

Logistic change

Copenhagen Airport is the leading air traffic centre for Denmark and large parts of Northern Europe – and since the opening of the Øresund Bridge, Southern Sweden is part of the local hinterland. Traffic across the Øresund Bridge reflects the increasing integration of Greater Copenhagen–Malmö–Lund. Due to the short and frequent ferry services between Helsingborg and Elsinore, this border area is also displaying some signs of integration. The Fehmarnbelt currently shows no evidence of developing cross-border systems except within some retail areas driven by price differences.

The network position of the two major conurbations within the Fehmarnbelt region – Copenhagen and Hamburg is of high quality. Hamburg is the second harbour of the European continent with a global network of lines, whilst the harbours of the Øresund region plays more modest roles with feeder traffic as their mission. When it comes to land traffic Hamburg is the North German hub for

motorways and railroads (inclusive high speed train lines), whilst the Øresund city plays the same role for Scandinavia (excluding high speed train lines).

International air transport indicates the potential accessibility for the flow of people and the handling of high value cargo. Copenhagen is an important centre with flight connections to cities on four continents and a strong European network whilst Hamburg is served by relatively few international flights and has a modest European network. On non-material accessibility the Internet backbone network Copenhagen performs well and Hamburg is also a central hub, but not as important as Copenhagen.

The Fehmarnbelt link and the Øresund Bridge will bring Schleswig-Holstein and Hamburg closer to the Øresund regional market. Perhaps even more important, they will create a direct portal for the entire Scandinavian market of almost 20 million inhabitants (Sweden, Denmark and Norway). The same scenario is presented by Scania and Zealand, which will have a great improvement in accessibility to the German market of 80 million inhabitants.

Urban system

The Fehmarnbelt Region's urban system is structured with a number of large heavy centres within and outside the region as important nodes (co-ordinating network centres). The Øresund City and Hamburg are crucial for the region's function, activity level,

and prosperity and future prospects. Without these cities, the region would not have an international format.

These two cities, however, are not alone as high level centres. Berlin, Frankfurt and Stockholm also play significant roles in the region, Berlin as Germany's capital and a so far failed bid to establish itself in the elite of world cities. Frankfurt and Stockholm are in a class to which Berlin aspires. Frankfurt has a dominating role within Europe's financial world, which in other major nations is often located in the capital. In addition, the city is one of the world's large intercontinental airport centres. Stockholm occupies a significant role in terms of large international business groups as well as being Sweden's capital, but is nevertheless more isolated in respect of global integration than the other heavy centres.

Interaction is always an expression of added value. As a result, it makes sense to examine new opportunities and what these analyses can be used for. The view is that if stronger links, first between Copenhagen and Hamburg and second with Stockholm and Berlin could be created, a new North European axis could result, i.e., a network of mutually strongly linked cities with uniform partnership relations with the rest of the world. Such an axis could claim a position at a higher level within the continent's urban hierarchy and thus contribute to development, growth and wealth.



Figure 9. The tunnel entrance on the Danish side of Fehmarnbelt includes a control and monitoring centre in the portal building.

The urban system within and close to the Fehmarnbelt region includes a number of other centres. There are other large cities of which some with larger or smaller justification claim metropolitan status. Three large German cities are found on a somewhat lower level in the urban hierarchy than the Øresund City, Hamburg and Berlin. They consist of the specialised centres Braunschweig–Wolfsburg, Hannover and Bremen and are overshadowed by Hamburg but nevertheless play strong independent roles as industrial centres, meeting places and gateway cities.

The region’s urban system is also structured by a number of other major cities that play the role as regional centres with a strong concentration of hinterland-oriented public service activities. Most of these cities have a university, some have gateway function and all have considerable industrial niches. As part of the picture, there are a series of medium-sized cities in the Fehmarnbelt region whose roles are mainly local although a few like some of the major centres also function as a supplement to, and interact with, the larger gateway cities.

Commuting and labour market

Commuting statistics reveal that the region’s workforce is mobile. This is especially the case in the major cities which attract commuters from the surrounding areas. Approximately 105,600 individuals commute to Hamburg and its vicinity from areas in Northern Germany. By far the majority, 40 per cent,

come from the Lübeck area in Schleswig-Holstein. In the Danish and Swedish parts of the region, Copenhagen and adjoining areas attract most of the commuting from the surrounding areas, i.e., 66,500 commuters. 74 per cent of regional commuters into the metropolitan area of Copenhagen come from Region Zealand with 26 per cent from Scania. The many commuters from Scania to Copenhagen are largely a result of the increased integration between Denmark and Sweden that followed in the wake of the opening of the Øresund Bridge in 2000.

The German and Danish labour markets, particularly in the Fehmarnbelt Region, are largely distinct from each other – as is common with many other border regions in Europe. Cross-border commuting between the two countries is characterised by significant differences in the flows between north-south and south-north directions. This is owing to the current market situation where the Danish side offers a greater incentive for cross-border employment. In total, estimates are that some 11,600 individuals work in Denmark and live in Germany whilst 1,600 individuals work in

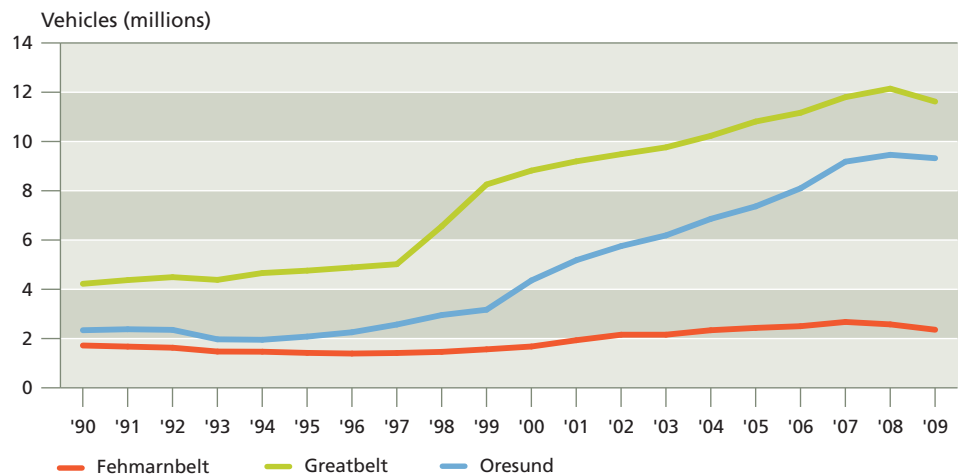


Figure 10. Traffic development across the three Straits that separate the Zealand archipelago from the rest of the world. The figures in the diagram show traffic across the whole section, millions of vehicles per year. With regard to the Great Belt (Storebælt) this includes smaller ferry crossings north and south of the Great Belt Bridge. The Øresund statistics comprise the northern ferry traffic Elsinore – Helsingborg as well as south of the Bridge. The statistics for Fehmarnbelt traffic include those from Rodbyhavn and Gedser to Northern Germany

Germany and live in Denmark (2008). Compared to the German-Danish land border, the Fehmarnbelt connection has roughly six times fewer commuters in both directions.

Barriers to mobility in cross-border regions are created by geographical distance and other impediments to travel between two countries: Administrative barriers, different labour market conditions, qualification barriers and other barriers in the daily lives of the populations of these regions. Furthermore, information about the conditions on the other side is often fragmented. Strategies and initiatives aimed at reducing border barriers are based upon two principles: (a) problem solving, such as harmonisation of regulations through bilateral agreements, and (b) information and consultancy. Strategic success also depends on the learning process of the labour force and of the consultants.

The benefits of a cross-border region with significant labour mobility between the two sides stem from the fact that commuters themselves contribute to reducing border barriers and promote social cohesion across

the whole of the region. Moreover, such a new cross-border region profits from the economic benefits of a large and diverse labour market.

The expectation is that a strong development of information and consulting infrastructure and further progress in removing the border barriers will take place simultaneously with the construction of the fixed link. An increase of the number of commuters can be expected as a result of interaction of these impulses.

Figure 13 summarises the mostly, weekly commuter flow across the Fehmarnbelt as envisaged in the various scenarios.

Clusters in the economy

Scania, Zealand, Bornholm, Schleswig-Holstein, Hamburg and Mecklenburg-Vorpommern each have their own industrial profiles, focusing on specific clusters and their development. Whilst these regions differ, they also operate clusters of similar structure and focus. The object with the cluster analysis in this report is to identify clusters for potential co-operation. The immediate strategy is based

on the fact that life sciences and health are important business sectors in most parts of the Fehmarnbelt Region.

This research focus of many universities is reflected in the cluster policy of the respective organisations. Also, the business sectors of food and information technology (including the media) are widely represented in the Fehmarnbelt region where they have important roles in the regional economies and are the target of cluster development efforts. A fourth area with potential for regional partnerships is logistics focusing on shipping. A fifth is wind energy/green technology and a sixth is tourism (including business tourism).

There are other strong sectors although these only cover parts of the region. Maritime industries play an important role in all North German regions, nanotechnology in Schleswig-Holstein and Scania, the financial sector (with business-to-business services) is important in Copenhagen and Hamburg as, indeed, are the cultural sector and airport-related activities. Aviation is strong in Hamburg, but we have been unable to discover information from other parts of the Fehmarnbelt region although we would like to do so in view of the central role of the industry.

Although important for the regional economies, tourism is an area in which the regions see each other as competitors. Hamburg and Copenhagen compete for metropolitan tourism, including business tourism (meetings, incentives, conferences, events). The two metropolises also compete for cultural tourists and families looking for a city product. The many fine beaches around the Fehmarnbelt region are also attractive destinations, especially for families and for water sport enthusiasts.

Although competition is strong, opportunities for partnerships should be explored and joint cluster development should be placed on the agenda.

We also believe that the potential for co-operation between Copenhagen and Hamburg should be explored in terms of finance and related services as well as for the cultural sector. The cultural sector effort could

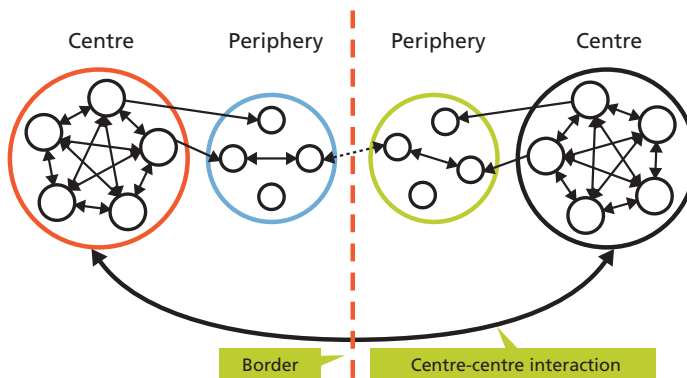


Figure 11. Simple model of activities and interaction – current situation in the Fehmarnbelt region.

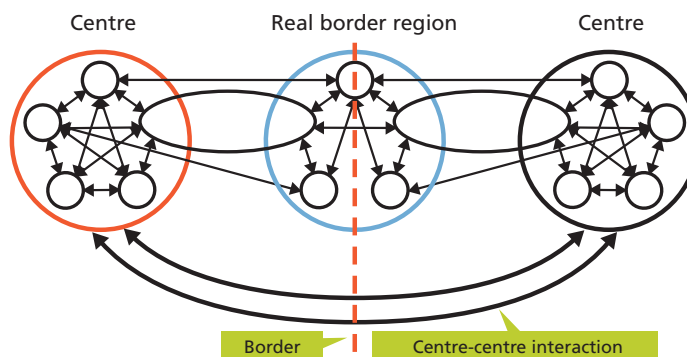


Figure 12. Simple model of activities and interaction – future scenario in the Fehmarnbelt region.

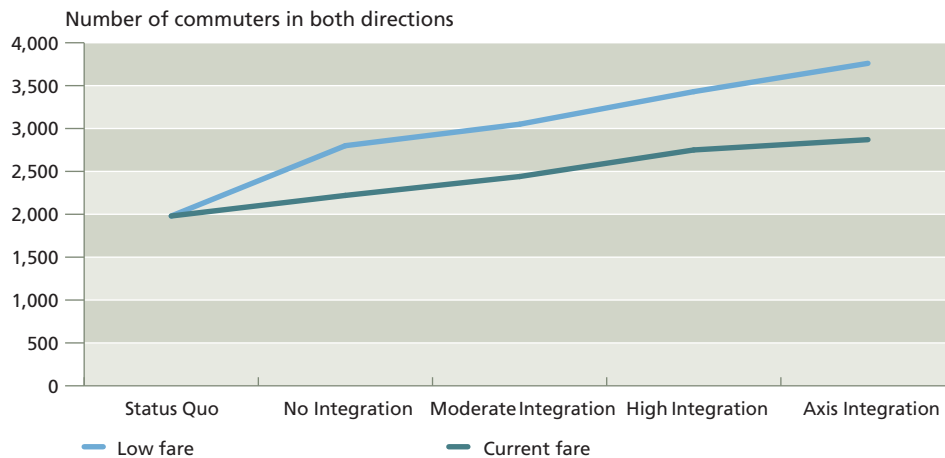


Figure 13. Commuting across the Fehmarnbelt 2020 – alternative scenarios.

be linked to the media industry. Airport related activities should also be explored with a view to co-operation.

The world of research

The Fehmarnbelt region comprises five scientific centres. The Øresund City belongs amongst the group of Europe's scientific metropolises; Hamburg and Kiel are research cities at a slightly lower level whilst Rostock and Lübeck belong to the group of regional research centres. The five research centres have different profiles, but also share some common features.

The Øresund City's position of strength is primarily based on health research, geosciences and the natural environment. In Hamburg, focus is on health together with traditional natural science. Kiel's strength is centred on geo-disciplines and on marine science. Rostock also focuses on marine science whilst Lübeck has a specialisation profile, which exclusively focuses on health.

An analysis has been made of the opportunities for partnerships by isolating those disciplines with potential for developing new links and which can partly supplement partly complement each other. Obvious opportunities for strengthening the interaction between the centres in order to achieve gains have also been pointed out.

On the basis of positions of strength, north as well as south of the Fehmarnbelt, a number of marine disciplines (oceanography,

marine biology, limnology) health-science fields (anaesthesiology, endocrinology and metabolism, immunology, research into infectious diseases, rheumatology, haematology) the geoscience areas (soil science, meteorology and atmospheric science, multidisciplinary geosciences) and two traditional natural science disciplines (physics: particles and fields; mathematical biology) would be able to supplement each other at a high level.

It is clear that a series of initiatives is currently under way to strengthen research within material science and nanotechnology. No fewer than four new scientific avant-garde facilities in the form of gigantic research laboratories are under establishment. Two of these are located in Hamburg, European XFEL (an experimental facility which generates extremely fast x-ray flashes) and PETRA (synchrotron x-ray facility) and two in the Øresund City, the European Spallation Source (European experimental facility based on the world's strongest neutron source) and MAX IV (synchrotron radiation facility).

Accounting for investments running billions of Euros, these projects will also establish new contacts and new partnership relations with the business community. The perspectives for research into material technology and life science research are significant and are monitored with great interest by those commercial sectors that have the potential to participate in, and exploit, the planned research activities.

CONCLUSIONS

Femern A/S is owned by Sund & Bælt Holding a 100 per cent state-owned Danish company and has been appointed by the Danish Minister of Transport to conduct preparation, investigations and plan for a coast-to-coast link across the Fehmarnbelt. A Fehmarnbelt Fixed Link realises the vision of a fixed, close and direct connection between Scandinavia and continental Europe. By uniting the populations in areas such as science, business and culture, it will promote the continuous integration of Europe.

The fixed link will considerably reduce the travel time between Scandinavia and continental Europe: Whilst the current ferry transit takes 45 minutes (plus waiting time), train passengers will require only 7 minutes, car drivers no more than 10. The duration of a train journey between Hamburg and Copenhagen will be cut short from about 4.5 to 3 hours.

The fixed link closes a gap between the Scandinavian and European rail networks and is supported by the European Union as part of one of the top priority rail corridors for Europe. In the future, freight trains will be able to avoid the 160 km longer detour via the Great Belt. This will create a strong transport corridor between the Øresund region in Denmark/Sweden and Hamburg in Germany, allowing a new greater and more competitive region – the Fehmarnbelt region – to emerge.

Together with a multi-national team of researchers Christian Wichmann Matthiessen in February 2011 finished a scientific study of the regional effects of the fixed link.

REFERENCES

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