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REVIEW ESSAY

Lighthouses, pilotage and technology: the impact on small island societies

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ABSTRACT: This paper discusses how lighthouses and pilot services have been bearers of technology intended to improve the safety and reliability of maritime shipping. The introduction of technology has had a considerable impact on many small island societies through state involvement meant to reduce hazards in navigation and shipping. The impact has, however, been manifold and varied, and including positive and less positive impacts. Indeed, small islands and islanders have generally never been the beneficiaries of large scale, state-driven technology programs seeking to modernize society. As an exception, however, certain small islands have traditionally been of interest to the state due to their locations, either for defence purposes or to assist seafarers' navigation in hazardous waters. This paper reviews the thrust and effects of investment in lighthouses and pilotage services on small islands. It concludes with a brief case story from a small populated island in Sweden that has undergone several periods of development and stagnation as a result of technology and state involvement.

Keywords: islands, lighthouses, pilotage, small island societies, state involvement, technological development, Sweden, Landsort.

Introduction

Travelling by sea has been quite always an adventure for humankind. In the beginning, boats and small sailing ships hugged the coastline as the closeness to land was safer than venturing into the open sea. As ships were small in size and with limited draught, it was easy to find shelter in natural harbours overnight or during stormy weather. The sailing instructions known as King Valdemar's Sea Lane – after the Danish king Valdemar II from the year 1219 – are appreciated for the detail with which the course for travelling from the North Sea along the Swedish coast northward to the Gulf of Finland is described. Weather was always uncertain and unknown waters presented a risk; thus, the experience collected in the diary was of great value for seafarers and could mean the difference between life and death.

As ships became bigger and safer, it was no longer necessary to stick to coastal waters: vessels could navigate open seas, away from land and shallow waters. Approaching land from the sea and cruising between islands and rocks in archipelagos required, however, not only skills and experience but also landmarks from which positions could be determined. Stone cairns were erected by islanders who would also light fires from time to time to assist seafarers. The first lighthouses were built around waters of special importance for commercial shipping and for warships.

Lighthouses and other fixed landmarks have contributed to safe shipping in the same way as pilots, local islanders being familiar with navigational conditions and living on islands close to traditional shipping lanes. They were fishers who were acquainted with any shallow waters or reefs around the islands, how winds blew and where to seek protection from storms if and when needed for anchoring. They were early on referred to as steersmen or pilots and

were found practically all over the world where safe navigation was a precondition for commercial shipping. The dependability of locally recruited pilots and skippers remained important until fairly recent times. Primitive charts or existing travelogues and notes had to be regarded with serious reservations for several centuries and it was always safer to have someone on board who had already been in the region (Dresen, 1958).

As an example, the first steersman on the Swedish island of Landsort was appointed by the King in 1522. According to narrative tradition, the appointment was written on a piece of birch bark and delivered by a courier; the newly appointed and very proud pilot nailed the message on the wall of his house for all on the island to see. The message was, however, immediately eaten up by a goat (Öberg and Landin, 1998).

In spite of modern maritime and navigational technology (including satellite), lighthouses and pilotage remain important also today for safe navigation. Lighthouses used to be located at strategically placed coastal areas and islands; jobs were thus created that contributed to generate critical and steady revenue for small island populations. These same lighthouses have, however, in general now become fully automated, with loss of jobs as a consequence.

With increases in ship size, value of cargo, cost of insurance and fierce competition and the focus on safety has probably never been more accentuated than today. The service of pilots for navigation assistance is therefore significant. In Sweden alone there are about 210 pilots providing 33,000 pilotages each year (Swedish Maritime Administration, 2016).

Lighthouses and pilotage

Lighthouses

The history of the world's lighthouses is closely linked to the history of navigation, especially after the latter moved beyond the early stages of development to become what can be considered regular maritime traffic. The Mediterranean was the meeting place of great maritime communities of the era – the Phoenicians, Romans, Greeks and Persians – a crucible where a significant part of the history of Europe, the Middle East and North Africa was shaped. The oldest lighthouse still in use today is the Tower of Hercules, located at La Coruña, Spain, and built in the second century AD (Stevenson, 1959).

Lighthouse technology developed rapidly in the wake of the Industrial Revolution with advances in civil, mechanical and optical engineering. A major step was the introduction of acetylene gas in the 1940s: this enabled automatic flashing lights for lighthouses in unapproachable coastal areas and islands. More recently, generators powered by lead-acid batteries and transistors, together with wind-powered chargers and solar panels, have replaced the earlier technologies.

In spite of advanced on-board navigation technology like satellite navigation and GPS, lighthouses and beacons still play a major role in guaranteeing safe navigation around the world. Examples from some countries show that Chile maintains 34 lighthouses around its coast and on its islands (Puppinck, 2009) while South Africa has 54 lighthouses (Hobernan, 2009). The responsibility of lighthouses has varied through history from private ownership to predominantly state ownership today. Although many lighthouses around the world are still in operation, the managing of a lighthouse by a lighthouse keeper and his (and, rarely, her) staff has in most cases been replaced by automation.

The following example from Sweden illustrates the change: in 1946, there were 64 manned lighthouses in operation along the Swedish coast of which 37 were located on islands, even on very small islands! Lighthouse keepers and their staff on island-based lighthouses amounted to 85 persons (Kungliga Lotsstyrelsen, 1946). The island of Garpen at the entrance of the Kalmar strait on the Swedish East coast with a land area of 300 metres by 70 meters,

that is around 0.02km^2, may serve as an example of a small but not exceptional lighthouse island. The lighthouse was manned between 1893 and 1967 when the last lighthouse keeper left with his staff. In the year 1935, the Garpen lighthouse staff consisted of three families with fourteen members (Alvemo, 2000). The last traditional lighthouse keeper in Sweden left in 2003 according to the Swedish Maritime Board (2016). Today, there are no manned lighthouses in Sweden.

Lightships

A special kind of lighthouses is the lightships, a lighthouse arranged on a ship that was permanently anchored near extremely hazardous waters to warn passing ships. In certain situations the construction of a lighthouse was not possible since there was no suitable island for the construction or weather conditions were too rough to allow construction work. The alternative was to put a lighthouse on a ship! The first lightship in the world was anchored in Britain in 1731, just outside the mouth of the River Thames. The lightship period in Sweden lasted between the years 1844 and 1972 (Werner, 1999).

Pilotage

Ships entering or leaving ports often have to pass through congested or hazardous waters like shoals, reefs, river banks and currents or archipelagic waters where there are increased risks for grounding or collision with other ships. For most ships above a certain size in depth and tonnage, or carrying dangerous cargo such as petrol or fertilizer, a pilot must be contracted in such waters. A pilot is a person with a maritime background (mostly with a captain's degree) having acquired sufficient knowledge and experience for navigating in local waterways.

Pilots operate within dedicated pilot districts from where the pilot embarks on an arriving ship from a pilot boat and, if the ship is leaving port, the pilot disembarks to the pilot boat in open sea. Occasionally pilots may also be boarding by helicopter. Pilots are organized either as civil servants employed by the state or by the private sector in many countries.

Since pilot stations must be placed where ships can be met outside of risky areas, they are mostly located along the coast or just off the coast on suitably located islands. Before the advent of modern communication technology, approaching ships were obliged to call for a pilot using signal flags or lamps. Pilots therefore had to reside close to the pilot station in order to be prepared for duty at short notice. In Sweden pilot stations were either located on the mainland close to major ports or on small islands near the shipping lanes. Table 1 shows the number of Swedish pilot stations on the mainland and on islands respectively over time.

Table 1: Pilot stations in Sweden on the mainland and on islands, 1886-2016.

Pilot stations on:	1886	1906	1910	1946	1954	2016
mainland	93	80	84	61	56	21
islands	42	37	34	22	22	2
Total	135	117	118	83	78	23
Island stations as share of mainland (by %)	45	46	41	36	32	10

Sources: Pilot, lighthouse and sea rescue establishments along the Swedish coast 1873-1910, Swedish Statistical Office SCB; Staff register of the Pilot Board, Kungliga Lotsstyrelsen 1946, 1954. Oral information, Swedish Maritime Administration, 2016.

During the 19th century, the number of pilot stations on small islands was still relatively high and so was the number of pilots. Table 2 shows the number of pilot families stationed on islands – adults and the number of dependents (children and servants) in brackets – from the county of Östergötland on the Swedish East coast at three different time periods: 1850, 1860 and 1900.

The pilot stations are located on eight small islands, denoted A, B, C … in Table 2 and named below. The eight islands are located along the coast of Östergötland within a distance from north to south of 65 km as the crow flies. The pilot station density was thus rather high in this section of the coastline.

Table 2: Pilots and their dependents stationed on islands in Östergötland, 1850-1900.

Year	A	B	C	D	E	F	G	H	Sum
1850	19 (39)	23 (37)	13 (14)	10 (14)	13 (29)	8 (15)	25 (37)	12 (19)	123 (204)
1860	21 (42)	27 (41)	14 (19)	7 (13)	19 (29)	8 (9)	18 (47)	11 (18)	125 (218)
1900	43 (62)	-	-	-	-	-	-	21 (15)	64 (77)

A: Arkö; B: Gränsö; C: Lindö; D Lindöj; E: Bokö; F: Håskö; G: Kättilö; H: Häradsskär.

Source: Bergman (1995).

The table shows a relatively stable pilot population on the eight islands; but, by 1900, all pilot stations except for two had been withdrawn by the state. There were primarily two reasons for this. The first reason was due to elevation of the land that has been going on in the country since the ice age and gradually reduced the depth of the shipping lanes in the inner parts of the archipelagos: with increasing ship size, there was finally not enough water under the keel. The second reason was the improved salary conditions for pilots that justified longer working hours and longer distances and less need for frequent pilot changes. The number of pilot stations could hence be reduced (Bergman, 1995).

Nowadays, pilot services must be booked in advance; this allows pilots to choose their place of residence outside the pilot station proper, for example on the mainland. The pilot will then be called in good time before the service is required and turns up in time to deliver the service. Advances in communication technology have thus resulted in a drastic reduction in pilot stations, as the example from Sweden shows: in the year 1946, there were 22 islands along the Swedish coast where pilot stations had been located. A total of 122 pilots were based on these islands where they lived with their families, compared to 371 pilots living on the mainland (Kungliga Lotsstyrelsen, 1946). The situation today is that there are no still active pilots living on these islands in Sweden, although pilot stations still exist on a number of them with the only function of manning the pilot boats used to transport the pilots from the mainland to a waiting ship, and vice versa.

As modern technology has more or less eliminated the need for pilots to live on islands, it is relevant to argue that technology has had a dual and contradictory effect on island societies: first, as a contributor to increased population on certain islands through lighthouse staff and pilots; second as a contributor to reducing population through automation of lighthouses and making it possible for pilots to live on mainland due to communication technology.

Living conditions on small islands

Taking a broad time perspective on development shows the significant impact of technology and technological development on social and economic life. The adoption of technology has, however, varied between types of societies: having been predestined to live by what the surrounding sea and limited resources could provide, small islands have generally not been at the forefront in the use of new technology. Fishing, petty farming, craftsmanship, eventually tourism and trade – not to mention piracy – constituted the main living conditions for small island societies. Owing to their strategic position, however, a few islands have been able to develop due to state interest, either as military outposts for defence purposes or to serve commercial shipping by providing navigation assistance through pilotage and lighthouses. Regular income as civil servants employed by the state for the provision of such vital services made those islanders less dependent on traditional income from fishing and farming.

In the wake of the transformation of fishing from small scale and coastal to large scale and industrial, with ocean-going trawlers operating in international waters, fish stocks have gradually decreased where fish used to be the traditional food and merchandise for many small islands.

Technology impact on small island societies

In considering the impact of technology on small island societies, one may distinguish between the indirect impact of the technological development taking place on a global level and the more direct impact of adopted techniques on the local level. From this viewpoint, one may ask how technology and the various techniques that may have been adopted are affecting the island society, and what theoretical aspects would be appropriate.

Theoretical aspects

For small islands, the impact from globalization is often masked by local factors such as new brands of equipment and that are more significant than globalization itself: this has also been noted for other peripheral regions like certain less developed countries (Lind, 2012). Measures of economic development and technology in use in low income countries and regions come into conflict with general economic growth models and would therefore need to be measured by partly different yardsticks (Kingsbury et al., 2004; Sen, 2009; Moyo, 2009). A similar view about the need for measures that can be applicable also to the study of island societies has been noted, for example by Ronström (2015). Various attempts have been made to construct theories and models for describing, analysing and promoting growth and prosperity for less advanced regions (Lind, 2012). Some of the models below might be applicable also in island studies, for example those related to dependency and sustainability,

The 'development as growth' approach – economic growth would lead to prosperity;

Human aspect approach – a reaction to the one-sided focus on economic growth and capital formation as the determining factors for development, marking the growing emphasis on human capital in addition to physical capital;

The trade approach – a growing focus on trade as a growth engine in the world economy although it was obvious that developing countries would find it increasingly difficult to compete with manufactured goods from the more advanced nations;

The dependency approach – commerce between countries with different economic and technological strength will lead to increasing imbalance between the two. Countries in the periphery will always be dependent on the countries at the centre;

The basic needs approach – social objectives dominated the 1960s and1970s as it became obvious that the so-called *trickle-down* effect, the wide dissemination of increasing prosperity throughout society as a result of the economic growth, did not happen;

The New International Economic Order – dissatisfaction by developing countries with the liberal international economic order had surfaced in the 1950s with demands for reform of the international trading order, and called for increased economic justice and aid;

The privatisation approach – to overcome the legacy of underdevelopment many third world countries had embarked on large development projects in agriculture, industry and infrastructure on achieving independence, with varying success; and

Sustainable Development – the UN Rio Conference in 1992 officially declared sustainable development as the new approach to development. Sustainable development is defined as development that meets the needs of the present generation without jeopardising the resources available to future generations.

With its geographical bias, the *dependency approach* (or centre/periphery model) may be seen to represent the enduring tension between islanders and mainlanders or even between islanders of more well-off islands and poorer islands. The tension may surface with tourism and signs of dependence and dominance in its wake. The tourist industry discovered islands as attractive places to visit after World War II which created a potential for small service industries. As tourism brought money to the islands the traditional lifestyles based on fishing and petty farming changed in favour of expanding tourist facilities but also for small shops like pottery. Shortage of other economic activities therefore makes small island societies dependent on visitors from mainland for jobs in the service sector. The growing tourist industry worldwide can be expected to generate further employment on attractive islands in the coming years. What is lost in genuineness through mass invasion is a task ready for studying.

Development economists Raul Prebisch and Hans Singer introduced the *dependency model* to describe the imbalance in resource exchange between poorer and richer regions, originally focusing on the poor underdeveloped and the rich advanced Western regions (Toye and Toye, 2003). When applied to describe the relations between small islands and islanders on the one side and people from the mainland on the other, there is an embedded centre-periphery tension that would justify further studies based on this approach.

Sustainable Development has become next to synonymous with a view encompassing how local places like small islands should address the prospects of meeting the qualities of a sustainable society. If this also means being able to preserve and protect an indigenous culture is another question that can be raised in the wake of technological development. Deculturation proliferates and local identity worsens thanks to the politics of development and modernization, according to French economist Serge Latouche (1996).

Francis Stewart (1978) concluded from her research on technology and underdevelopment that the huge gulf between the organisational form to which advanced country technology is designed and suited, and the forms of organisation indigenous to most less developed economies has meant that the use of advanced-country technology also generally requires the use of advanced-country organisations. Advanced-country technology

thus leads to advanced-country techniques of management. Modern society functions as a flow system where energy and information are distributed and disseminated by means of sophisticated technical networks. A small island would be too vulnerable if it should entirely rely on this advanced-technology network. Bad weather conditions can easily jeopardize access to the network, and back-up systems based on less advanced, sometimes even primitive, technology may be the way out of critical situations such as an electrical break down. Sometimes, even an inherent and genuine desire to emphasize distance to modernity may characterise islanders.

Stewart (1978) further noted that technology consists of a series of techniques and that the technology available to a particular country or region is all those techniques they know about and could acquire and the technology in use is that subset of technology they *have* acquired, and from this follows that there may be technology that is unknown or not available to the country or region. If the technology in use is inappropriate, it may be so because world technology is inappropriate, because an inappropriate subset is available to the country, because an inappropriate selection is made, or for some combination of these three reasons. The direct technological impact on island societies comes from adopted techniques that find different ways of reaching the island. The initiative for changing technique often comes from a change agent, individuals trying the new technique and later being followed by others (if the technology is seen to work).

An alternative to advanced-country technology has been discussed within the concept of *appropriate technology*, described as a technology designed with special consideration to resource limitations, environmental and local economic aspects. Appropriate technology is closely linked to E. F. Schumacher who studied village-based economies and suggested an appropriate technology that appreciates both human needs and resource limitations (Schumacher, 1973). Appropriate technology should normally be more labour-intensive than a less appropriate technology, less capital-intensive, less skill-intensive, makes more and better use of local materials and resources, operates effectively at a smaller scale and produces a more appropriate product designed for lower income consumers (Stewart, 1985):

Appropriate technology is not geared to large scale production and does therefore not benefit from economies of scale, which are typically absent in small island economies. But economies of scale are in themselves formed by the history of technological development in which particular organisational forms have favoured the development of large-scale survival. A small island with an economy that is predominantly based on appropriate technology may find different forms of competitive strategies where growth is not necessarily a survival factor. Small firms operating in this context can survive without access to advanced-country technology.

Appropriate or intermediate technology for less developed regions may be regarded as a means of adapting technology to the conditions prevailing in most of these contexts. We can find numerous examples of appropriate technology throughout history where the conditions of nature have forced humans to adopt suitable technology for security reasons. Crude oil motors dominates in fishing boats long after petrol engines came in use, simply because they were more reliable and lasted longer.

Technology affecting the development of small island societies

Life on small islands has been facilitated through the adoption and use of new techniques like transport by fast rescue boats and helicopters being vital for critical services (such as the rapid airlifting of the sick or injured) that have saved numerous lives. Generally, more reliable, affordable and decent transportation by boat have made it possible to live on an island and work on the mainland when the distance is not too large. Small engine driven vans replacing

manual carts has made work easier, kitchen equipment like deep freezers for the preservation of food has made household work more efficient, communication devices like television and the Internet have enabled an unparalleled integration with the information society.

Technology has also offered and introduced new dimensions to social life on islands. High speed communication technology makes it possible to perform administrative work as well as research and other forms of creative work on an island, in spite of being located far from any office on the mainland. This creates opportunities for new settlements on islands and also the potential for shared living between periods on the mainland to be intervened with periods on the island, creating a new category of semi-islanders. The ratio between ordinary and temporary islanders changes in favour of the latter, resulting in changes in the social structures. Temporary islanders from cities and the mainland are, however, often alien and extraneous to traditional island practice and customs, island history and living patterns.

Islanders living permanently on an island are exposed to changes in the environment like weather. Wind directions and wind force become significant elements for daily activities like fishing or calling at ports by boats and ferries carrying tourists. For those living on the mainland, weather is merely a pleasant or an unpleasant phenomenon with no particular impact on daily activities. Dependence on weather and closeness to nature has shaped island lives and values for generations and created traditional ways of living mirrored in local talk as well as socially. Special words are used to describe different weather phenomena or social roles have developed for interaction between inhabitants of an island. Temporary visitors with a mainland background cannot possibly share this specific sense of weather dependence which is so characteristic of islanders.

Small island societies are not smaller versions of large societies but a different kind of society altogether, perhaps comparable to similarly small societies on the mainland. The island sets boundaries for leaving and arriving due to weather conditions, something that may lead to feelings of isolation. Because of this, islanders may seem introvert and this attitude sometimes spills over to scepticism towards adopting new techniques where traditional habits have been in use for generations.

Being a permanent islander means developing a special mental frame regarding living on a small island. Words may not capture the essence of this special mentality; but the following autobiographical passage may elucidate some of the feeling (Lind, 2016),

> From where I am, I can see the mainland. When I leave the island for the mainland, I become immediately absorbed by another kind of life, other sounds and the smell of sea is gone, like its taste. After a brief period of hours, perhaps only minutes I find myself in a world defined by people. My time perspective is shifted to one that forces me to embrace the present and therefore does not allow me to think thoughts wishing to travel along other lines. The soul that has partly remained on the island tries to adapt itself slowly, or perhaps not at all.
>
> Islands need the mainland from where one can see the island and regard it as being outside of the mainland, more distant and isolated from the mainland. Islands also need the mainland to relate to, to like or dislike, look up to and look down upon, to long for and dissociate oneself from, or just to be indifferent to. Does the mainland need islands? Not only as metaphors for privacy and loneliness but also as projections for dreams, myths and fantasies. One can be obsessed by islands like the British author Lawrence Durrell who talked about ‘islandness’ (Gillis, 2004). Such obsession is, however, seldom a characteristic of those who live on islands but is rather an expression of distance to islands and the sea than presence on the islands themselves. It is not the physical island that captivates but the idea of the island as a metaphor that

is catching and attractive. Leaving the island for the mainland brings the metaphor back.

Now the journey goes in reverse gear, from the mainland back to the island. This is not just a reverse process but one that may be painful and take time. The island notes that I have returned, it can smell the mainland smell and it can note from my wandering eyes that constantly met other eyes while on the mainland, and saw objects that all the time forced themselves into my eyes. This look is different from the one resting on the horizon, far away and without movement but with unspoken promises. I end up in a period of quarantine before the island accepts my return. The island does not change but I am the one who must adapt and let the sea, the winds and the scents come to me. The inner restlessness being so palpable the first day or days slowly gives way and fades. Then I am back.

The state and small islands: the example of Sweden

Industrial and economic development in Sweden began in the second half of the 19th century with the export of primary commodities like timber and iron ore, later to be followed by manufactured products. Safe and efficient shipping was a precondition for this successful trade and the state therefore took initiatives to establish pilot and lighthouse stations along the Swedish coast on a large scale. In the year 1900 there were thus 97 permanent lighthouses, 24 lightships, and 131 pilot stations (Kungliga Lotsstyrelsen, 1901), all under state control. Prior to the 1830s the lighthouse service had, however, been provided by a mix of private parties and the government, until most private lighthouses were taken over by the government. Private ownership lost its attraction primarily due to insufficient reimbursement by the state (Hedin, 2005).

In the wake of the development of technology, most lighthouses had become automatized towards the 1960s and there was finally no need for staff to run the daily operations of lighthouses (Hedin, 2005). For the same reason automatized caisson lighthouses gradually came to replace lightships. The last Swedish lightship left its station in 1972 (Werner, 1999). For pilot services the situation was somewhat different. The advances in communication technology had made it possible for pilots to move to the mainland while it was still necessary to keep a lookout for pilot seeking ships. Modern navigation technology like radar and GPS was used as arguments by the state for moving the lookouts to mainland offices. The arguments were, however, controversial and lacked support from major stakeholders as described below.

On July 5, 1997, the Swedish Maritime Administration, the government body for maritime related issues, decides to close down the three major pilot stations for the approach to Stockholm harbour. The three stations were located on three small islands in the Stockholm archipelago, and the decision implied relocating administration of pilot service like closing visual look out for ships in distress or requiring a pilot, dispatching and pilot reservation to a centralized unit on the mainland around one hundred kilometres from the coast (Lind, 1997). The main reason claimed for centralization was the expected cost savings and improved performance of pilot services. As the Board's decision had been accepted by the ministry of transport and was made public, it was immediately heavy criticised by numerous authorities and organisations with a variety of arguments ranging from no more humans to keep watch; another blow to the small and threatened island population; and increased risks with the pilot boats without reliable watch keeping from the island in case of accidents. The County of Stockholm, responsible for regional development including the archipelago area, was among the strongest critics of this policy and took the initiative to commission a study aimed at identifying convincing arguments for continued pilot service from the three pilot stations.

The report concluded that the service provided by the existing pilot stations might be extended to also include dispatching services, based on communication technology in combination with surveillance of maritime traffic (Lind, 1997). A side effect to increased maritime safety would be additional job opportunities on the islands. In spite of heavy support for the conclusions and recommendations of this report – by local municipalities, the Port of Stockholm, Swedish Navy, Swedish Environmental Protection Agency, the Pilot's Union, the Custom Authority, the National Police Force, the National Coast Guard and ship-owners – the government still decided to disregard the report and to proceed with its announced plan. The immediate effect was a loss of twenty one jobs on the three pilot stations.

A study had been commissioned by the County of Stockholm ten years earlier (1987) to evaluate the public economic effects of either relocating the pilot station at Landsort to a mainland centre or to relocate more pilotage activities to Landsort. The study was undertaken by Linkoping University, Sweden. The conclusion of the study was that the alternative of relocating the pilot station to the mainland could not be justified from a public economic point of view. Relocating additional pilot services to Landsort would, however, give an economic surplus (Linkoping University, 1987).

The attitude of the state to facilitate living on small islands in the archipelagos is not highly pitched on today's political agenda as technology has relieved the state of social responsibility of small island dwelling. As a contrast one may recall the situation when the pilots and lighthouse staff were required to be present on site to provide efficient navigation services. In order to cater for families living on small islands the Admiralty in its capacity as commander of the navy as well as for the pilot administration took the initiative in 1845 to set up schools for children of pilots and lighthouse staff on selected small islands (Severin, 1977). The minimum requirement for establishing a school on a small island was 3 to 4 children and the state organised housing and employed teachers. The schools were open also to other children living on the islands. This arrangement lasted from 1845 until 1925 when formal responsibility was transformed to the national education system. Some figures:

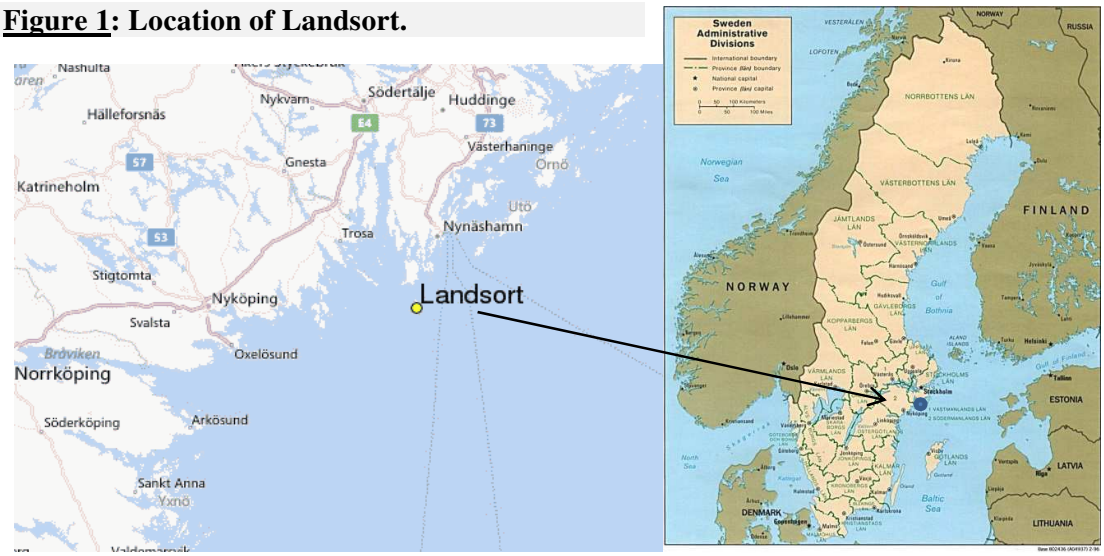
In 1891, there were 19 schools on small islands with a total of 284 children of which 141 were children of pilots and lighthouse staff. Nine years later, in 1900, the number of schools had increased to 24 with a total of 324 children, of whom 150 had pilots or lighthouse staff as parents. The schools were exclusively located on small islands (Severin, 1977).

It may be appropriate in this context to refer to a recent EU report that calls attention to the need for greater involvement of the Outermost Regions in the Europe 2020 strategy as they cannot compete with the know-how that exists on the mainland since the region's remoteness and fragmentation does not make it competitive (European Commission, 2014). The current philosophy of growth is considered far too focused and premised on the needs and requirements of densely populated urban regions. A hundred years ago there was perhaps a somewhat more pronounced state focus on Outermost Regions!

The case of Landsort: a small island in Sweden

Landsort is the southernmost island in the vast Stockholm archipelago of around 24,000 small and medium sized islands, islets and rocks. The map shows the location (see Figure 1).

Figure 1: Location of Landsort.



Sources: © *2016 Google Maps and Central Intelligence Agency, USA.*

Landsort may serve as an example of how technology has shaped and changed island society during the years. Landsort is a small island, five km long and 700 meters wide, and with a year-round population today of about 25 persons: I am one of these hardy 25. During the three summer months, however, the population may reach 250 persons. Similar examples can be found elsewhere in the world, albeit with different pretexts.

The first humans arriving on the island about eight hundred years ago were hunters and fishers hunting seal and fishing from the rich fishing waters. They came towards the end of the year from the neighbouring towns on the mainland from where sailing in wintertime was prohibited due to ice. As the ice broke up in spring they returned with the catch of salted fish that was now sold in town. Some of the fishers may have stayed after the fishing season and settled on the island. Gradually the population increased.

People used to live at the Northern part of the island partly because that was more protected from storms and bad weather than the opposite Southern part but also because the shipping lane passed close to the Northern point offering opportunities for contacts. With its strategic location at the Southern inlet to the Stockholm archipelago, the island was early on seen as a maritime outpost of strategic importance for the king's ships in the 15th and 16th centuries as Sweden was more or less permanently involved in European warfare. Troops and war material had to be shipped across the Baltic Sea and Landsort was the last outpost of the archipelago for ships to depart from and also the first sign of land as the ships returned to the Swedish kingdom. King Gustav Wasa therefore appointed one of the island's fishers to assist the king's ships in finding their way through the treacherous waters of the Southern archipelago. For the same reason, the first lighthouse was erected on the island in the 1670s, in order to guide approaching ships. As maritime activities increased in terms of ship size and numbers, as maritime technology draw up new shipping lanes to the South of the island there was an increasing need for pilots to move and reside on the Southern part of the island. The moving of settlements from North to South was indirectly the cause of development in maritime technology (bigger ships, lighthouses) and was the most far-reaching change in the history of the island.

This marked the beginning of a period where piloting and lighthouse keeping led to the steady economic and social development of the island. Pilots as well as lighthouse keepers, the latter being an important category in maritime service at the time, were employed

by the state and were therefore public officers. As such, they were at the top of the social hierarchy in the archipelago. The state as employer catered for schooling and other social services that were otherwise not common on the islands. Through this intermediation, the state helped create a skills platform that would later become a necessary precondition for the adoption of new technology.

In the late 19th century, maritime technology advanced (with steam ships and hulls of steel) and with the breakthrough of information technology in the 20th century, both ship architecture and navigation aids saw new developments which had a significant impact on shipping. As ship technology advanced from sail to steam, and navigation aids like small solar and gas driven beacons developed in the late 19th century, maritime traffic increased in number and ship size, leading to the need for more efficient navigation services like piloting and more efficient lighthouses on islands and coasts. Higher qualification needs of pilots led to higher salaries which improved quality of life both for pilots and their families and others living on the island. During the peak in the 1950s, there were 14 pilots living on Landsort with their families all the year round: a total of 60 people. Together with the lighthouse staff and other categories, the total population of the island in these years amounted to slightly less than 100 people. The population could justify a school, a shop, a post office, a church and a telephone station.

As communication technology developed further, ships calling for pilots could easily communicate their expected arrival long before actual arrival. Pilots had been compelled to live on the island in order to be available for service when needed; but, with the new information technology, it was no longer necessary to live on the island: one would have ample time to travel to the island in time for any requested service. Within a ten year period, practically all pilots had moved with their families to the mainland in neighbouring cities and towns from where they could travel to the island. As a consequence of this technological development, the island society changed drastically. Within a few years the school was closed because there were hardly any children left. The shop that had been open all-the-year-around was now open only for a few summer months when tourism increased the demand. The local post office shut down, only the one church remained open, but with a negligible number of churchgoers.

The technological impact on the society of this small island can be summarized in terms of positive and negative impacts, thus:

Positive impacts

Shipbuilding technology led to engine-driven ships instead of sail, with the result that ships grew bigger, faster and, in particular were not forced to wait for favourable winds. Higher investments together with higher costs of insurance and fuel (coal, oil) increased the demand for security and hence navigation aids and piloting became indispensable.

Solar and gas driven small lighthouses and beacons facilitated navigation in archipelagos with positive impact on ship traffic and trade. This increased the need for around the clock pilot service and the need for more pilots. The island saw a steady increase in population for a long period.

Crude oil engines started to replace sail as power in the early 20th century which significantly reduced risks of accidents at sea and significantly improved transport capacity.

The Internet opened up opportunities for communication-based professional work to be carried out on the island which has attracted newcomers to settle on the island.

A recently installed web camera at the top of the lighthouse serves as a marketing tool for tourists and visitors who can now observe weather conditions on and around the island.

Negative impacts

Constant supervision of the lighthouse and its performance, as well as regularly sending weather reports required a lighthouse staff of two persons. Information technology allowed that the lighthouse could be remotely controlled, which also included the regularly collection and dispatch of weather information by instruments and visual observations. On-site lighthouse staff is therefore no longer required.

A radical change also affected the pilot system since radar and information technology could spot arriving ships and arrange pilot service accordingly. The need to live on the island became no longer urgent since scheduling could be made with broader time margins and the pilot could be called for duty regardless of his/her place of residence.

Today's societies depend on a flow of technology that guarantees a continuous supply of energy (electricity, water, gas) and data (video, audio, other content). This has made life on the island more vulnerable due to unpredictable weather conditions like stormy weather especially in the winter months with increased risks of damage to boats and infrastructure.

Conclusion

Like the rest of society, small islands are exposed to technological development but, unlike the rest of society, they may be affected differently by such developments. While larger islands, much like mainland regions, may have the capacities and scale to absorb and implement new techniques in their existing infrastructure and competences, small island societies are more vulnerable, more fragile and more dependent on external initiatives. Such initiatives may come from private entrepreneurs of the mainland venturing into a ferry or a tourist project but also from the state or municipality for partitioning off land for recreational sites. The exceptions are those islands that continue to enjoy strategic significance to the state, either as military outposts for defence purposes or to serve commercial shipping by providing navigation assistance through pilots and lighthouses.

With the advent of technical innovations and techniques of relevance for islands and archipelagos like fibre optics, solar cell devices and basic communication technology, islanders and island based small-scale industries have been able to benefit. While communication technology was welcomed to break isolation and to improve safety at sea, automation and advanced information systems have been seen as a ground for the authorities to promote land based maritime activities rather than actively contributing to island based work opportunities. This development has had a negative impact on island societies today. It is particularly regrettable on small islands where the significant shortage of jobs forces people to leave for the mainland, probably never to return except for short nostalgic visits.

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