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1. Introduction: The Interrelation of Trade and Knowledge

World history has known areas of relative isolation and areas of high intensity of cultural interaction. The Mediterranean Sea, the Silk Road or the Straits of Malacca can be cited as such crucial contact zones. Within these areas, centres sprung up that served as interfaces between cultures and societies. These “hubs” as we would like to call them, emerged at various points throughout the contact zones, rose to prominence and submerged into oblivion due to a variety of natural calamities or political fortunes.

Until the end of the 19th century, when sailing vessels were replaced by steamships, maritime trade in the Indian Ocean completely depended on the monsoons with the impossibility to cross the entire Indian Ocean in a single monsoon (Meilink-Roelofs, 1962: 60). Consequently with increasing international trade conducted, the trade routes were divided into sections or stages and port cities and trading centres acted as intermediaries and therewith rose to their glory. Entrepot trade meant that goods were assembled at strategically located ports and then reloaded and transported to other minor ports. Supply and trading routes were closely guarded secrets. Therefore “commercial” as well as “maritime intelligence”, i.e. local knowledge on products, wind, currents, sea routes and access to harbours turned out to be valuable cultural capital. Trade was enabled and accelerated by commercial and maritime knowledge.

Trade functioned as carrier of religious beliefs and knowledge. Hence, trading hubs emerged and acted as knowledge hubs as well. Like rods radiating from the centre, networks of trade and knowledge extended from the centres as from the “hub” of a wheel. Indian philosophy has used the image of the wheel (Sanskrit *cakra*) to back the claim of the *cakravartin* as the one who turns the wheel of dharma and therefore is the ruler of the universe. This symbol is still used as the logo of Buddhism laying claim to universal truth as a world religion. Islam as well as Christianity has spread along trade routes from “hubs of knowledge”, from centres of religious learning. “Hubs” are geographical locations with a high density of interactions and of transfer of information and knowledge. They are by no means static but rise and decline, change their intensity of interaction, rearrange their “spikes” of networking and move from one location to another. Along networks of knowledge dissemination they form hierarchies of interconnected premier, secondary and tertiary hubs each surrounded by a somewhat larger hinterland of declining knowledge density.

In this paper we will explore an area of past and present strategic importance for world history, the Straits of Malacca (Evers and Gerke 2006). We shall briefly establish the historical context of shifting knowledge hubs along the Straits, refer to the interrelations between trade, religion and knowledge and finally analyse the rise of Singapore as the current premier knowledge hub along the Straits of Malacca. Finally we shall attempt to develop a model or at least a hypothesis about the rise and movement of knowledge hubs in general.

2. Centers of Trade as Hubs of Learning

The history of the Straits of Malacca is until today strongly determined by international trade. At different points in time different ports in the Straits formed the main centres of commercial activities and as such arose as crucial contact zones for the exchange of not only products but furthermore commercial and nautical knowledge as well as religious beliefs and

other types of knowledge.² The connection between religious faith and commercial knowledge lies in travelling as the traditional form of intercontinental communication in earlier times. Religious beliefs were spread by believing traders themselves, furthermore by Buddhist and Hindu monks, Christian priests and Muslim scholars who all travelled to the Straits of Malacca region via the trade routes and with trading ships from and to Europe, the Middle East, South and East Asia.

Trade centres therefore (often) became centres of learning. The trading capital of Srivijaya that dominated trade through the Straits of Malacca, was also known as a center of Buddhist learning. I-tsing, a Chinese monk, who had spent one decade in the seventh century in Nalanda and the holy Buddhist places in North India, stopped for several years on his way back to China in the port-city of Srivijaya, today known as Palembang. Here he translated Buddhist texts from Sanskrit to Chinese. Back in China he recommended such a stop over in Palembang on the way from China to India to his fellow Buddhist monks. In the port-city of Srivijaya, these travelling Chinese monks could prepare themselves together with several hundred Buddhist scholars for their studies in India (Kulke, 1998a: 6) enjoying the relative comfort which the prosperous port-city offered. These accounts underline how port-cities did not merely emerge as trading hubs but rather as places of exchange: exchange of goods, ideas, and therewith knowledge.

Reid outlines how Arab scholars travelled to Aceh, "made it their temporary home, preaching, writing (primarily in Arabic), and disputing with one another there" (Reid, 1993: 144). Due to this, Aceh was later referred to as the "Veranda of Mecca". The trading of goods and the spread of religious ideas went hand in hand and fostered each other. The trade enabled the spread of religion and the spread of Islamic faith created networks and alliances supportive of international trade. Until today, groups of Acehnese Islamic scholars cross the Straits of Malacca to visit mosques and Islamic schools in Malaysia to preach and trade.

Concerning the exchange of commercial knowledge, Tarling outlines the English learning process regarding the trade of European and Southeast Asian products (Tarling, 1992: 358). After returning from their second voyage to the Straits of Malacca (1604-06), the English merchants realised that English goods could not be sold profitably in the Malay-Indonesian Archipelago. Instead, they learned from Portuguese traders that Indian piece-goods turned out to be essential for Southeast Asian trade. Consequently, the English established trade with Surat in India and several ports in the Red Sea before continuing to the Straits of Malacca region on their third voyage in 1607. Later on manuals were also published to inform trading houses or planters about climate, soil conditions, local plants and products; "with the view of smoothing the path and lessening the risk to the adventurous planter" (Low 1836, reprinted 1972: 1).

Besides religious and commercial knowledge, these centers of maritime trade were of course also hubs of nautical knowledge (Tarling, 1992: 372). Due to sparse records of shipbuilding techniques before 1800 however (archaeological research on shipwrecks has hardly been conducted until today), little historical evidence can be offered in order to determine the extent to which (South, Southeast and East) Asian and European knowledge on different shipbuilding technologies was exchanged. Nevertheless, Arab as well as Indian nautical texts show, that the Indian and Arab knowledge of certain territories as well as of specific ships and methods of manoeuvring highly differed. Arab texts (i.e. the *Mohit*) confirm that Arab knowledge of the territories East of Cape Comorin was rather faulty, while the knowledge regarding the Arab seas was given greatest importance and a high level of nautical knowledge was achieved (Meilink-Roelofs, 1962: 60ff).

² Regarding the interrelation of trade and the spread of religious ideas, see Kulke, 1998a; Reid, 1993; Schrieke, 1966.

With regard to different methods of shipbuilding Tarling points out that “the Southeast Asians were aware of the advantages of European ships and there was a steady transfer of construction detail from European to Southeast Asian shipwrights” (Tarling, 1992: 378). Similarly, all other merchant groups, i.e. Indians, Portuguese, British, Chinese and Dutch, relied on nautical, territorial and of course commercial knowledge which nevertheless at least partly highly differed from the knowledge of other merchant groups. Consequently, the ports-of-call in the Straits of Malacca acted for these traders as places for the exchange of goods, products, for awaiting the monsoon that would take them back to their places of origin as well as for the exchange of knowledge. And this knowledge ranged from commercial to nautical, territorial knowledge, knowledge on ship technologies, on food preservation for the long sea trips, for the curing of unknown diseases, the exchange of religious belief systems. Basically every type of knowledge that was of concern to the passengers of the trading ships, whether they were merchants, sailors, missionaries, scholars, monks or simply adventurers. Reason for coming to those knowledge hubs was trade and for some the spread of a certain faith. But once the travellers arrived in these ports, knowledge that made the long-term aim (trade or conversions) possible became of ultimate importance.

Consequently, knowledge flowed or was transferred from the foreigners to the local communities, from one group of foreign traders to another (i.e. from Indians to Chinese, Arabs to Indians, Europeans to Arabs, etc.) as well as from the local communities to the foreign traders. The transferred knowledge included religious, commercial and nautical knowledge and the transfer took place in institutionalised modes of knowledge transfer (i.e. schools of religious learning, art) as well as in un-institutionalised ways (i.e. spontaneous exchange of knowledge through interaction with a trader from a different ethnic group). Yet a lack of serious research on the modes and extends of knowledge transfer through trade unfortunately prevails.

Furthermore, these knowledge hubs often housed centres of learning, as indicated with regard to religious learning above. Yet, besides religious studies, in some port-cities indigenous schools of fine arts and literature were created, especially in the capital cities of the Southeast Asian kingdoms. Kulke refers to indigenous schools of fine arts in Majapahit/Java, as well as the mainland Southeast Asian empires such as Angkor, in today’s Cambodia and Sukothai/Ayuthaya, in today’s Thailand. These schools developed locally influenced high arts, such as the reliefs in east Javanese temples in the style of Wayang-puppets (Kulke, 1999: 111). But lines of communication also radiated back to India from the knowledge hubs of Southeast Asia. Javanese or possibly Sumatran architectural knowledge and temple management influenced Sri Lankan temple architecture during the 14th century (Evers, 1972: 32)..

3. The Rise and Fall of Knowledge Hubs

Just as the degree of importance to maritime trade of the various port-cities in the Straits of Malacca and beyond changed from time to time, their roles as knowledge hubs increased and decreased over time align with the port-city’s position in international trade. Hence, maritime trade determined the glory or fall of each port-city, not merely as trading center but as religious and therewith knowledge hub. In reverse, the loss of local knowledge could also lead to the decline of a port-city.

From 670 until 1025 (some authors even state 1286³), the maritime empire Srivijaya with its center in Palembang, East Sumatra controlled the main trade routes in the Southeast Asian Archipelago (Kulke, 1998b). Yet, from the late thirteenth century onwards, Muslim traders established a trading center in Pase (Pasai), Aceh, Northern Sumatra at the Western entrance point to the Straits of Malacca (Reid, 1988: 7). As described by Odorigo (circa 1323) and Ibn Battuta (1345-1346) (quoted by Schrieke, 1966: 16), “the increase in the power of the state was accompanied by an intensification of its Mohammedan convictions”, which points to the above mentioned parallel development of commercial hubs as centers of religion and knowledge. Palembang was increasingly losing its former monopoly status, further accelerated by Jambi, also Eastern Sumatra gaining more and more importance as a pepper port. Consequently, Hindu Javanese traders left Palembang in order to create a new commercial centre in the Straits of Malacca. After being only partially successful in Singapore which was still too close to the emerging empire of Majapahit, they moved northwards after 1377 to the then village of Malacca. Amongst these traders from Palembang was the prince Parameshvara who is said to have founded the port-city of Malacca in 1400 with support from China (Kulke, 1998a: 7).

Schrieke describes “although Pase and above all the nearby pepper port Pidië remained places of importance for a long time afterwards, the focal point of international trade soon (around 1450) shifted from Pase to Malacca” (Schrieke, 1966: 17). Palembang had lost its former superior position and Malacca rose to become the intercontinental trading centre in the region through which the trade from the East and the West passed. Close to Palembang, Jambi further established itself as commercial hub in the east of Sumatra.

The arrival of the Portuguese in the Straits of Malacca in 1509 and their conquering of Malacca in 1511 resulted in religion-based and -structured competitions between Christian and Muslim traders. Although the Asian merchants were able to build on the advantage of being more established and experienced in the region than the Portuguese and all later groups of European traders, these European merchants possessed the advantage of being heavily supported, some of the initial endeavours in the region even fully financed, by their governments (Tarling, 1992: 353ff). The religion-based struggle between Christian and Muslim merchants resulted in Muslim traders avoiding the usual trade route along the eastern coast of Sumatra and a preference towards a route along the western coast of the island. Together with the choice of this diverted trade route, the Muslim traders from Malacca and other commercial centers in the Straits decided to establish Aceh at the most northern tip of Sumatra as their trading post. Furthermore, some of the Muslim traders settled in Banten, Western Java where they succeeded in establishing the power of Islam before the Portuguese arrived there. Hence, the flowering of Aceh and Banten as trade centers originates from the competition between Christian and Muslim traders. The Portuguese attempt to destroy Muslim trade in the region by conquering Malacca had proven to be impossible. Instead, the Muslim centers of trade, Aceh and Banten increasingly gained importance (Reid, 1993: 64ff), while Malacca – abandoned by the Muslim traders and so lacking the wide range of formerly available commercial and nautical knowledge – gradually fell into oblivion.

By the middle of the sixteenth century, Aceh had become the main commercial center connecting Muslims from western Asia and India with the Indonesian Archipelago. Furthermore, Johore on the peninsula of Malacca rose to an important center for maritime trade, backed by its tin and pepper resources as well as its close ties with Borneo and the Spice Islands. By the end of the sixteenth century, the king's monopoly was abolished and Malacca once more evolved as the main stapling point for the products from the Indies and the main “port-of-call” for ships between India and China. With increasing engagement of the Dutch and British in the

³ i.e. Tarling, Nicholas, 1992: 196.

region, this position was nevertheless regularly stressed by the struggle for access to products and trade ports mainly between the Portuguese, the Dutch Vereenigde Ostindische Compagnie (organised in 1602) and the English East India Company (organised in 1600). In the early seventeenth century, the Dutch Company for example established a year-long blockade of Malacca in order to cut off supplies and therefore weaken its position. This in turn strengthened the position of Aceh again, which besides its trading activities was in control of the tin regions. It could therefore offer, additionally to the usual products such as petroleum and baros camphor, menyan, gold and pepper and tin in rich quantities (Schrieke, 1966: 59).

In 1641 the Dutch Company captured Malacca and therewith broke the competitive power of the Portuguese and directly improved its own power position in its rivalry with the British who had arrived in the Archipelago. The Dutch company from then onwards used its strengthened position in Malacca⁴ to slowly subordinate the main nodal points of maritime trade in the Straits region, starting with Palembang and Jambi (both Eastern Sumatra), followed by Aceh (Northern Sumatra), Kedah (1642), Ujung Salang (1643), Bangeri (1645) and Perak (1650), which are located on the Malay Peninsula, upper entrance of the Straits of Malacca (Schrieke, 1966: 62-63). Malacca as their capital for maritime trade in the Straits of Malacca rose to a dominant position in the Straits regarding trade of goods and the exchange of knowledge.

It therewith is not exaggerated to call Malacca the dominant trade and knowledge hub in the Straits in the fifteenth century right up to the rise of British influence. Yet, the situation changed dramatically in the late eighteenth/early nineteenth century. In 1786, Georgetown, the capital city of Penang-Island off the north-western coast of Malaysia, was founded by Captain Francis Light, a trader of the British East India Company as a port-of-call for the Company in the Straits of Malacca. Georgetown soon overtook Malacca in its importance to maritime trade and therewith as knowledge hub in the Straits. Malacca which had been governed by the Dutch since 1641 became British from 1795 to 1818⁵ and again in 1824 with the signing of the Anglo-Dutch Treaty by Great Britain and the Netherlands.

In this treaty – also known as the Treaty of London – Great Britain and the Netherlands carved out their territories in Southeast Asia and divided it into a British zone in the North and a Dutch zone in the south. The settlements Penang, Malacca and Singapore were governed independently from these two zones as one unit: the Straits Settlements. In the first years, Georgetown formed the capital of these settlements. Yet in 1832, the capital moved to Singapore and in 1867 the Settlements became a British Crown Colony. The Anglo-Dutch Treaty of 1824 and the founding of the Straits Settlements therewith established Penang, Malacca and Singapore as the three major port-cities in the Straits of Malacca. Here, trade could be conducted (relatively) free of conflict motivated by religious differences, power struggles and the urge for territorial control. With the move of the Settlement's capital to Singapore in 1832, the opportunity arose for Singapore to actively develop itself into the main commercial centre as well as knowledge hub in the Straits of Malacca region.

⁴ The Dutch administrative center in the Malay-Indonesian Archipelago nevertheless formed Batavia (today's Jakarta). Malacca was merely used as main port-of-call for maritime trade in the Straits of Malacca.

⁵ In 1795 (until 1818), the Dutch gave Malacca to the British in order to prevent it falling to the French, who had captured the Netherlands during the French Revolution.

4. The Straits of Malacca as Knowledge Corridor

The Straits Settlements, Georgetown, Malacca and later Singapore, rose as the main trading centers in the Straits of Malacca region and therewith as the ports-of-call for all trading ships passing through the Straits on their way from Europe or India to China. The trade brought wealth that further accelerated the growth of producing industries as well as the service sector. This diversification of the economy as well as the growing administrative bodies of the colonial powers in the region required skilled and formally educated labourers. Consequently, the first schools and universities were founded. In 1816, the first Malaysian school, the Penang Free School, was founded in the then flowering trading center of Georgetown. In 1823, Sir Stamford Raffles is quoted to have proposed the establishment of a College that would provide educational and research facilities in Singapore. This proposition was answered in 1905 with the founding of The Straits Settlements and Federated Malay States Government Medical School, which is renamed into King Edward VII Medical School in 1913 (renamed in 1921 into King Edward VII College of Medicine). It was the first institution of higher learning in Singapore. Additionally, the Raffles College was set up in 1928 and with the merger with King Edward VII College of Medicine in 1949, these two colleges lead to the founding of the University of Malaya. On the website of today's National University of Singapore the newly founded University of Malaya is described as "a beacon of knowledge that beamed across both sides of the Causeway". As the first university with full-degree granting powers in the Straits of Malacca region, the University of Malaya expanded rapidly and opened up another branch in Kuala Lumpur in 1959. While the Singapore branch was renamed into University of Singapore in 1962 (and in 1980 after merging with the Nanyang University into National University of Singapore), the Malaysian branch carries the name University Malaya until today.

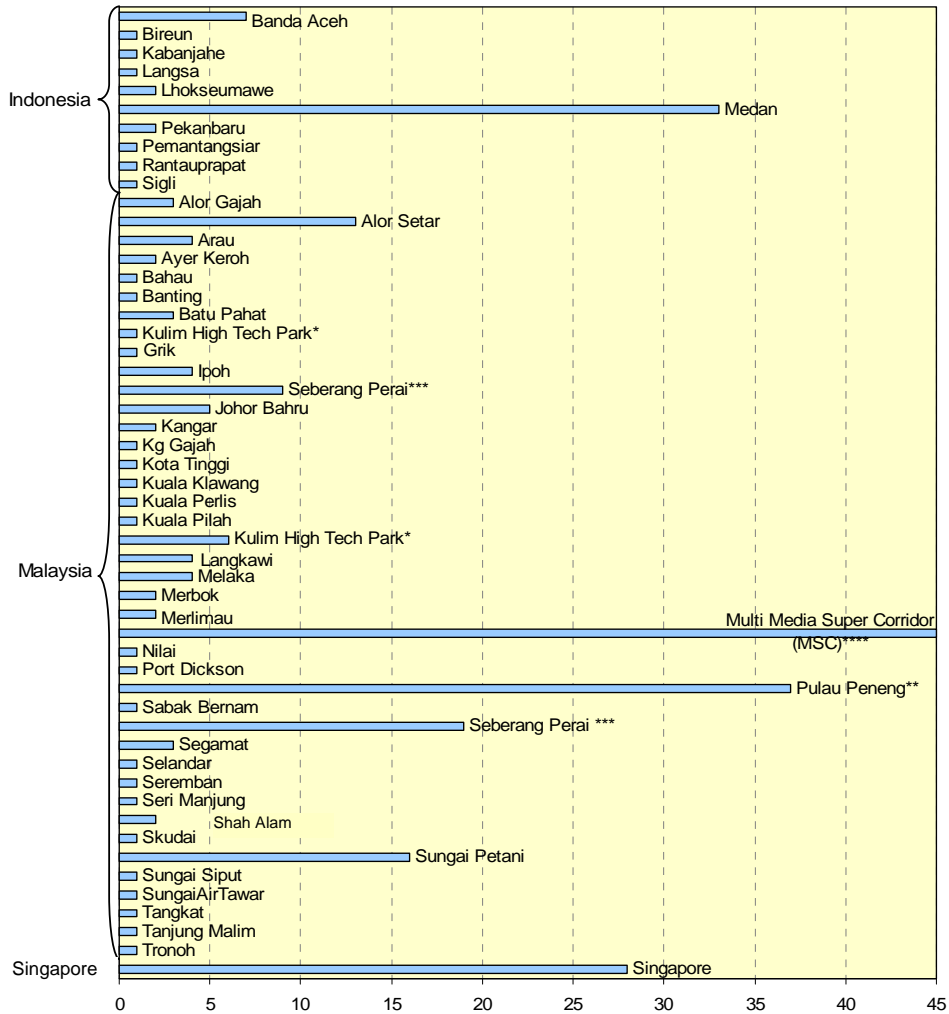
In Medan, not a Straits Settlement but one of today's knowledge hubs along the Straits, located along the north-eastern coast of Sumatra, the first universities, Universitas Sumatera Utara (USU) and Universitas Islam Sumatera Utara, were founded in 1952, closely followed by Universitas HKBP Nommensen in 1954, Universitas Cut Nyak Dhien and Universitas Muslim Nusantara Al-Wasliyah in 1956, Universitas Muhammadiyah Sumatera Utara in 1957, Universitas Alwashliyah in 1958, and Universitas Darma Agung in 1959.⁶ Several more universities were founded in Medan in the 1960s and then again in the 1980s catering for the increased demand for education by a growing population and a developing economy.

The history of schools of higher learning in the Straits of Malacca region correlates with the rise and fall of centers of trade along the maritime passage way. The first school of Malaysia opened up in the then center of maritime trade Georgetown. The first university in the region was founded in the then British Crown Colony Singapore. While Malacca had been the most important trading port from the fifteenth right up to the early nineteenth century (long before the first universities in the Straits region), it was overtaken by Georgetown/Penang and Singapore in the later nineteenth and twentieth century. Today, Malacca mainly houses branch offices of Malaysian schools of higher learning, no main campi, while the knowledge structures of Singapore and Penang (in 1962, the Universiti Sains Malaysia is founded in Penang) rest on a far more diverse environment of universities, polytechnics, private and public research institutes. These educational institutions did not only cater for the land population but increasingly attracted students from across the Straits of Malacca, turning them into internationally connected knowledge hubs, very much like the trading center and port-cities along the Straits .

⁶ These data were collected on the websites of the universities themselves.

If one assesses the sheer quantity of schools of higher learning in towns and districts along the Straits of Malacca, the picture illustrated in Diagram 1 can be found.

Diagram 1: Allocation of Institutions of Higher Learning and Research in the Straits of Malacca Region



* Kulim/Kulim High Tech Park includes Kulim, Sintok, Mahang

** Pulau Penang includes Georgetown, Bukit Minyak, Tanjong Bunga, Balik Pulau, Air Hitam, Bukit Coombe, Gelugor, Bayan Baru, Jelutong

*** Seberang Perai (Penang Mainland) includes Butterworth, Perai, Permatang Pauh, Seberang Jaya, Bukit Mertajam

**** Multi-Media Super Corridor includes Kuala Lumpur, Serdang, Bangi, Btg Berjuntai, Cyberjaya, Petaling Jaya, Subang Jaya, Kajang, Bandar, Puchong, Klang

Diagram 1 clearly states that (a) a decentralised distribution of educational institutions exists along the western coast of Malaysia and the North-eastern coast of Sumatra/Indonesia, as well as (b) nevertheless four main centres of higher learning and research along the Straits of

Malacca can be identified, namely the Multi-Media Super Corridor (MSC), Pulau Penang, Medan and Singapore.

In terms of quantity of institutions, the Multi-Media Super Corridor in the east of Kuala Lumpur in Malaysia forms the main knowledge hub. The MSC is part of the government long-term plan “Wawasan 2020” from 1991, in which the government of Malaysia formulated the explicit aim to develop Malaysia into an industrialised nation by the year 2020. In order to do so, the government identified the 15km wide and 50km long region between the Petronas Twin Towers and Kuala Lumpur International Airport (including the cities Cyberjaya and Putrajaya) as a special economic area for industries in the field of information and communication technologies (ICTs). Yet, since the ICT-industry and related companies (i.e. knowledge-intensive and creative industries) require highly-educated staff as well as research outcomes, the government of Malaysia and private education providers actively and with enormous financial input developed the education and research environment in the MSC in the past fifteen years.

The traditionally grown center of higher education and research along the Straits of Malacca and within Malaysia is the island of Penang, located in front of the harbour of Butterworth at the Penang Mainland. On the other side of the maritime passage way, along the coast of Northern Sumatra, Medan with its close by port Belawan forms the Indonesian knowledge hub along the Straits. In terms of pure numbers of higher learning and research institutions these three knowledge hubs exceed Singapore by far. Yet, when looking at the knowledge produced and taught in these knowledge hubs, Singapore clearly acts as the main knowledge hub in the region, forming a center in which qualitatively high local knowledge is produced and globalised by passing peer-reviews of internationally renowned scientific journals, participating in conferences worldwide, getting patents passed and therefore successfully using this knowledge for economic growth (Gerke/Evers, 2006). While the remaining knowledge hubs in the region, Penang, the MSC and Medan are mainly centers of knowledge transmission (via universities and educational facilities), Singapore houses a high number of internationally-linked research institutes and therefore focuses – besides on knowledge transmission – increasingly on knowledge production.⁷

5. Singapore as Central Knowledge Hub

After becoming independent in 1965, Singapore economically developed itself from a less developed into an industrialised country within three centuries. Traditionally and until the late 1960s, Singapore's economy was – as in all trading centers in the Straits of Malacca – based on the port as the center for international and regional trade. Around this port, numerous small manufacturing sites were established, producing wigs, kitchenware and other low skill manufacturing items. Yet, with increasingly low-skilled manufacturing sites moving out of Singapore to neighbouring countries in the late 1970s, the Singaporean government had to identify new economic sectors to tap into. After two expert groups formed by the government returned to Singapore from visits to the USA and Japan in 1980, the decision was made to develop Singapore into a regional centre for computer and disk drive production (Ang, 1992). Yet, the neighbouring countries developed as well and Singapore realised in the late 1980s that

⁷ The relation between polytechnics on the one side and universities and research institutes on the other side with polytechnics forming a much bigger group in the MSC, Penang and Medan obviously caters for a higher demand for job-oriented qualifications in highly populated regions. In contrast to this, in Singapore relatively less polytechnics and relatively more universities and research institutes exist. This is furthermore supported by the ratio of number of citizens per higher learning and research institute, which clearly counts far less citizens per higher learning institute in Singapore than in the MSC, Penang and Medan.

it had to increase local content production (i.e. local knowledge) and the local development of advanced technologies in order to move up the value chain (Anwar/Zheng, 2004). Consequently, the total public and private R&D spending as a percentage of the GDP was increased from 0.85% in 1990 to 2.15% in 2003 (A*STAR, 2005: 26; Hornidge, 2006).⁸ Furthermore, the government of Singapore founded the National Science and Technology Board (NSTB) in 1991, which was renamed into the Agency for Science, Technology and Research (A*STAR) in 2001. A*STAR is a statutory board of the government under the Ministry of Trade and Industry, which oversees altogether 12 research institutes and massively fosters local technology research (Hornidge, 2007; Menkhoff/Evers, 2005).

The government's aim to develop Singapore into a globally-linked knowledge society resulted in enormous action focusing on (a) building a technological and legal infrastructure for the usage of information and communication technologies (ICTs), (b) fostering ICT-applications in all areas of public and private life, (c) increasing the level of local knowledge transmission, as well as (c) raising the level of creativity (via investments into the arts, social and human sciences) in society for increased innovations and creative ideas to happen (Hornidge, 2007). These government activities strengthened Singapore's disposition for a globally interlinked knowledge hub further and lead to a vast increase of knowledge creating and based activities within Singapore. In comparison to Penang, the MSC and Medan as the other three main k-hubs along the Straits of Malacca, one can clearly speak of a take-off in Singapore's landscape of high-technology research and especially with regard to the founding of research institutes as places of knowledge production. This is illustrated in Diagram 2.

*Diagram 2: A Historical Timeline on the Foundation of Research Institutes
in the main K-Hubs along the Straits of Malacca
- Research Institutes in Total Numbers*

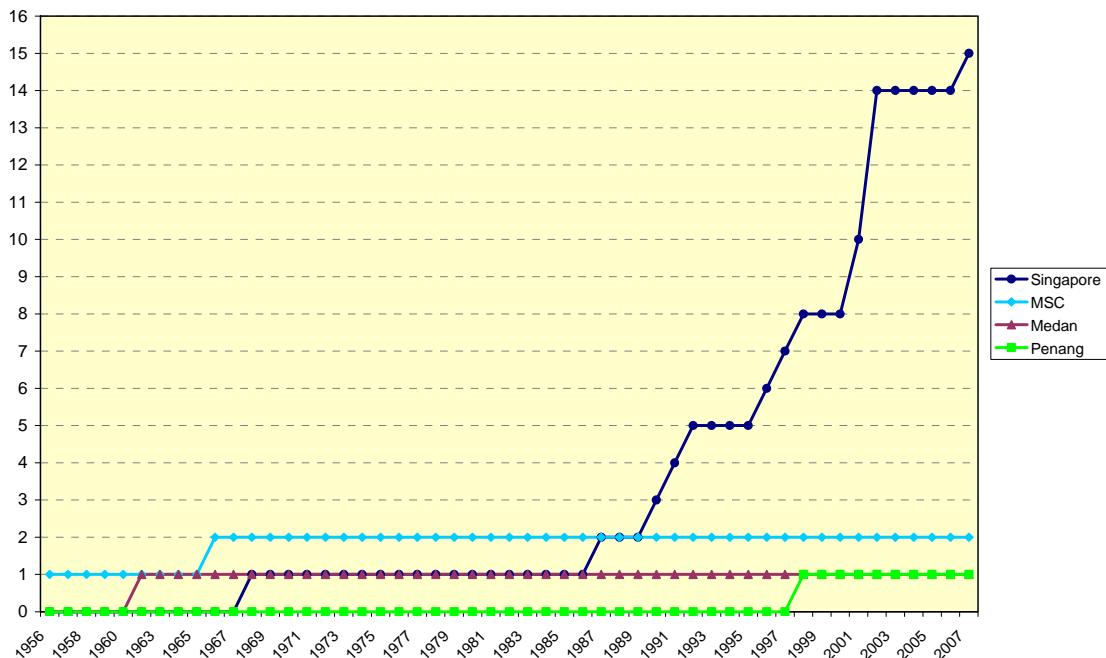


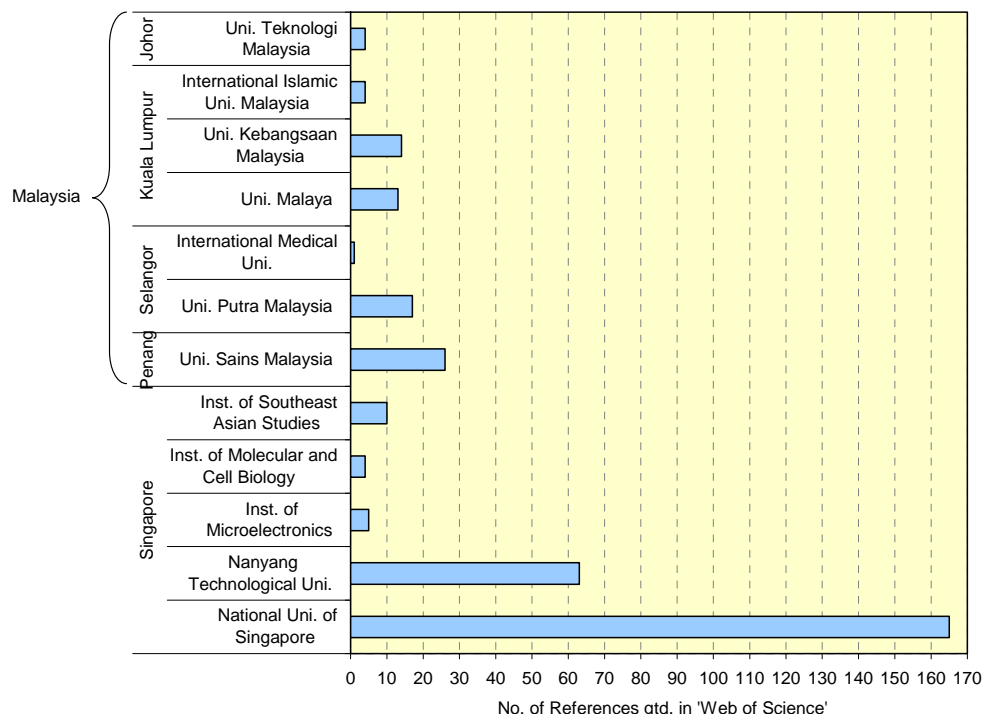
Diagram 2 shows several aspects that are of interest to us. Firstly, the oldest research institute of the today still existing once in the four k-hubs along the Straits of Malacca was

⁸ According to OECD, 2006 the total public R&D-expenditures in % of GDP in 2005 amounted to 2.5%.

founded only in 1925 and is located in the area of today's Multimedia Super-Corridor (MSC) in Malaysia, namely the Rubber Research Institute of Malaysia.⁹ Its foundation was followed by the Forestry Research Institute's in 1929 and the Institut Bahasa Melayu in 1956 that also is located in the MSC area. In 1961 the Institut Sains dan Teknologi TD Pardede was founded in Medan, followed by the Malaysian Institute of Management in the MSC in 1966 and the first independent, multi-disciplinary research institute in Singapore, the Institute of Southeast Asian Studies in 1968. The first and only research institute in Penang was founded in 1998 and named the Institut Teknikal Jepun Malaysia. Hence, today's research institutes in the four main k-hubs along the Straits of Malacca look back on a rather short history and were only founded during and after the emancipating struggle for independence of the three nation-states Malaysia, Indonesia and Singapore. Secondly, the diagram clearly illustrates Singapore's take-off with regard to creating research institutes and therewith establishing Singapore as a knowledge hub where knowledge is not just transmitted (through education) and applied (e.g. in production processes) but furthermore and most importantly produced, from the early 1990s onwards.

This is also confirmed when assessing the knowledge output (quantitatively and qualitatively) of the higher learning and research institutes along the Straits of Malacca. For a rough overview we searched the global and interdisciplinary database 'Web of Science' for journal articles (in English, Malay and Indonesian) published by authors attached to Singaporean, Malaysian and Indonesian higher learning and research institutes, as illustrated beneath.

Diagram 3: Scientific Output of Higher Learning and Research Institutes along the Straits of Malacca



Source: The data were collected from the database 'Web of Science' on all universities and research institutes existing along the western coast of Malaysia and the North-eastern coast of Sumatra as well as Singapore (along the Straits of Malacca) on 24th of January 2007. Those universities or research institutes not mentioned in this

⁹ Today even a joint venture of the International Rubber Research and Development Board is located here, a network that brings together natural rubber research institutes from all over the world.

diagram were not referenced in the data base (e.g. not one institute along the Indonesian side of the Straits of Malacca was mentioned in the database).

While this search might not match Knorr-Cetina's sensitive methodology, it nevertheless illustrates the dominance of scientific output of Singaporean higher learning and research institutes in journals connected to the database 'Web of Science' over the scientific output produced by Malaysian and Indonesian higher learning and research institutes along the Straits of Malacca. The journals connected to the database 'Web of Science' are peer-reviewed journals covering a wide range of disciplines from natural sciences, engineering, bio and life sciences and medicine to social sciences and arts. Hence, the fact that knowledge produced by authors working for Singaporean higher learning and research institutions entered journals connected to the database by far more than knowledge produced at Indonesian (none) and Malaysian institutions is a clear quality indicator. Nevertheless, it also has to be pointed out that knowledge produced in English and in a language code and culture of thinking that is at least similar to the ones used in Western epistemic cultures is more likely to enter international journals and databases. In other words, there might be qualitatively high level knowledge produced by Malaysian and Indonesian institutions of higher learning and research that is documented in languages and codes which are less likely to be accepted by peer-reviewed journals and therefore do not show up in the diagram above (Gerke/Evers, 2005). But in an increasingly globalising world, knowledge has to be communicated in globally understood codes of communication in order to be heard. Hence, this barrier of communicating newly produced knowledge in a way (language and code) that it enters international journals has to be taken in order to compete in a globalised world.

The above indicators, while taking into account possible flaws of the collected data, point towards the Straits of Malacca as maritime passage way for – in history and today – vast, international trade. With trade and the development of particular trading centers in the Straits, knowledge hubs developed and transformed the maritime passage way into a knowledge corridor, specked with few but brightly shining centers of knowledge production and dissemination. Singapore, as the knowledge hub in the Straits which is especially well globally interlinked producing and transmitting global and local state-of-the-art knowledge seems to nevertheless shine the brightest of all.

6. Conclusion

To sum up this historical tour-de-force: Knowledge and trading hubs moved up and down the Straits of Malacca and adjoining areas from Palembang and other minor centres nearby to Pasai and Aceh in the north and from Malacca and Johore to Penang and Singapore. The question then arises, what accounts for these movements along a waterway that has connected Europe, the Middle East and South Asia in the West with Southeast and East Asia in the east for 20 centuries? With regard to today's knowledge societies, Hornidge (2007) argues that the construction of knowledge societies in each country is heavily determined by the respective structural realities, i.e. (a) difference in size of population and land; (b) type of political system; (c) central versus federal structure; (d) historical experiences; (e) maturity level of economy; (f) degree of economic exposure to world economy; (g) tradition of Research and Development (R&D); (h) tradition of the educational system; (i) level of civil organisation; as well as (j) model of functional differentiation with structures of decision-making between state and remaining subsystems of society.

The data supporting Hornidge's thesis as well as the historical developments outlined above lead us to the argument that the historic rise and fall of knowledge hubs in the Straits of Malacca was, similarly to today's construction of knowledge societies, determined by the structural realities as well as the ability to effectively utilise, meaning to translate these structural realities prevalent in each trading center into a strengthened power position. Power in the centuries of maritime trade in the Straits of Malacca was strengthened and expressed by rising as center for maritime regional and international trade. Yet, these centers of maritime trade, as argued above, were at the same time always also centers of knowledge production and exchange, hence knowledge hubs. The rise of each knowledge hub in the Straits was catalysed by five factors, enriching each other: (a) an efficient, strong and stable government, securing trade, the main income-generating source; (b) a coalition of two powerful strategic groups (Evers/Schiel, 1988), the ruling aristocracy or bureaucracy and the long-distance traders (often strengthened by religious conversions and marriage); (c) established and enforced institutions to regulate markets and trade; (d) cultural diversity (diasporas) providing a trade-enriching knowledge depth (Hornidge, 2007) as well as access to international, ethnically diverse trading networks; and (e) the utilisation of knowledge (commercial knowledge) as well as economic prosperity due to trade as basis of legitimisation for the ruling government.

The rise of each of the above mentioned knowledge hubs in the Straits was determined by the ability to establish an efficient, strong and stable government which secured trade as the main income-generating source. This ability did not merely determine the rise and fall of the ancient empires in the Straits of Malacca region, i.e. Srivijaya and Majapahit, but furthermore the rise and fall of trading centers such as Malacca, Aceh, Johor, Georgetown/Penang and later Singapore which – through trade – also emerged as regional knowledge hubs. Strong coalitions between the ruling aristocracy or bureaucracy and the long-distance traders, two powerful (local or colonial) strategic groups, secured access to local products and markets as well as the arrival of trading ships in a certain, not any, port in the Straits. These coalitions were often further strengthened by religious conversions and marriage between traders and the local aristocracy, as outlined above. Once a trading center had established itself as main hub in the region and therewith laid the ground works for also developing itself into an important knowledge hub, established and enforced institutions regulated trade. These institutions were responsible for assuring that trade interactions were conducted in a smooth manner and consequently that the trading center was able to compete with the services offered in other centers along the Straits. A high level of cultural diversity provides the trading center with a, for trade very positive, knowledge depth. Via diaspora-settlements in the trading centers, contacts to a wide range of ethnic trading networks can be established. Furthermore, commercial, geographical and nautical knowledge, specific to certain cultures and ethnic groups gets mutually exchanged and creates a high level of knowledge width and depth as basis for successful trade and prosperity. This knowledge depth and the constructing of a knowledge hub as well as the economic prosperity based on trade acted in each trading center as legitimisation for the ruling government. Economic and cultural prosperity served as a means to justify the existing power structures. In the case of Singapore the connection between trade and knowledge has now moved to a new stage of development, namely to trade of knowledge as well as the explicit construction of Singapore as a knowledge society by its government. Actions taken do not merely focus on knowledge exchange but furthermore these actions are accelerated, legitimised and marketed by the matching semantics and terminology, subsumed in Singapore under the terms 'knowledge-based economy' as well as 'creative society'. Production of new scientific knowledge and the sale of knowledge based products and patents, especially in bio-medical technology, have moved Singapore onto the rank of a global knowledge hub.

The factors that fostered the establishing of each knowledge hub along the Straits in history – as identified above – also provide a fertile ground for the construction of Singapore as

a regional and global knowledge hub today. Singapore's political leadership can clearly be described as an efficiently working, strong and stable government which increasingly focuses on trade of knowledge as the main income-generating source. This is supported by strong linkages between the Singaporean government and administration with national and multi-national corporations. Furthermore, markets of goods, services and knowledge are highly regulated through enforced legal institutions. Singapore's cultural diversity provides access to a wide range of culturally specific knowledge pools as well as of course to multiple ethnically defined and historically grown transboundary business networks (Hornidge, 2004). This cultural diversity and its contribution to a high level of knowledge depth as well as global interconnectedness is today consciously intensified by the Singaporean government by recruiting 'foreign talents', i.e. high-level scientists and business experts, who are hoped to contribute to Singapore's long-term sustainable growth. Additionally, the global interconnectedness of Singapore – given due to its geographical location – is today further intensified by a high-level ICT-pervasiveness in all areas of public and private life. And finally, the utilisation of knowledge for economic and social development acts for the ruling government as a basis of legitimation for maintaining political power.

Consequently we argue within the concept of path dependencies that traditional trading centres along the Straits of Malacca have always been at the same time centres of knowledge exchange. Yet, in a globalised world in which knowledge increasingly acts as main income-generating source, traditional trading centers can build on this potential and establish themselves as hubs of not only trade and knowledge exchange, but furthermore as centers of producing, transmitting and trading knowledge, as knowledge hubs. Along the Straits of Malacca, the former main trading centers also established themselves as main knowledge hubs. Singapore as the most globally interlinked and economically successful trading center in the Straits today also establishes itself as the main knowledge hub in the region.

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