Looking East, looking West: Penang as a knowledge hub

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Abstract

Penang has always been a focal point, absorbing knowledge (and popular culture) from civilizations to the East and West. In modern Penang the pattern of cultural contacts has changed over time. Research institutes and universities in Penang cooperate with foreign partners to produce research papers and reports. Based on an analysis of joint research output, the changing international position of Penang as an emerging research hub will be analysed. The paper will show that international cooperation has increased considerably between 1970 and 2010, but that there has also been a remarkable shift from European, Australian and American partners to East Asian and to South Asian partners. The latter will be analysed in greater detail to show the development of Penang as an increasingly important Asian knowledge hub. One of the highlighted results of our paper will be the increasing importance of research ties across the Indian Ocean.

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Introduction: Knowledge Hubs in a globalised World

World history has always 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-Roelofsz, 1962:60). Consequently with increasing international trade, the trade routes were divided into sections or stages and the 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. In addition to material goods ideas, values, information and knowledge was exchanged, in modern terms the "software" and the "intangibles" of maritime trade and shipping.

Like rods radiating from the centre, networks of trade and knowledge extended from the centres as from the "hub" of a wheel. Indian and buddhist philosophy has used the image of the wheel (Sanskrit *cakra*) to back the claim of the *cakravartin*[1] as the one who turns the wheel of dharma[2] 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

[1] *Vartin* is „the one who turns the wheel (*chakra).* Thus, a chakravartin may be understood as a ruler "whose chariot wheels roll everywhere," or "whose movements are unobstructed." (Encyklopedia Britannica, 2007)
[2] *Dharma* is the universal law.

religious learning. “Hubs” are thus defined as 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.

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. They brought their religious knowledge that was of high interest especially for the ruling classes, who could gain more power through their new knowledge.[3]

Trade centres therefore (often) became centres of learning. Knowledge 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). Basic facts are known but research on the modes and extend of knowledge transfer through trade and on the knowledge architecture of the trading centres still awaits further analysis. This type of organised and informal exchange of knowledge continues as of today, but the emphasis of this paper will be on the organised and highly structured part of knowledge exchange, namely cooperation in scientific research. In this paper we will present results of a first step in our joint CenPRIS-ZEF research project on Penang as a knowledge hub (Evers 2011; Evers, Gerke, Menkhoff 2010; Azhari 2011).

[3] The adoption of Islam, that reached the region from 1400 onwards, offered new ways of legitimation for rulers. But also local traders converted to Islam that integrated them into the Islamic Umma and the close network of Muslim traders.

The Epistemic Landscape of the Straits of Malacca

Knowledge hubs take time to develop. They often emerge on the basis of earlier social and economic conditions; in other words they are strongly path-dependent. The institutions that were created in earlier times show their own dynamics and strongly influence outcomes at a later date. This statement goes beyond the simple assertion that history matters and argues that the knowledge architecture, as defined above, has its roots in local conditions and local knowledge. as well as local concepts of knowledge, i.e. the creation of what types and forms of knowledge are especially fostered (Hornidge 2007b). Development strategies aiming at the creation of knowledge hubs and ultimately knowledge societies will produce different outcomes dependent on which location is chosen. We have substantiated this argument on the basis of our case study of knowledge hubs in the Straits of Malacca region (Evers and Hornidge 2007).

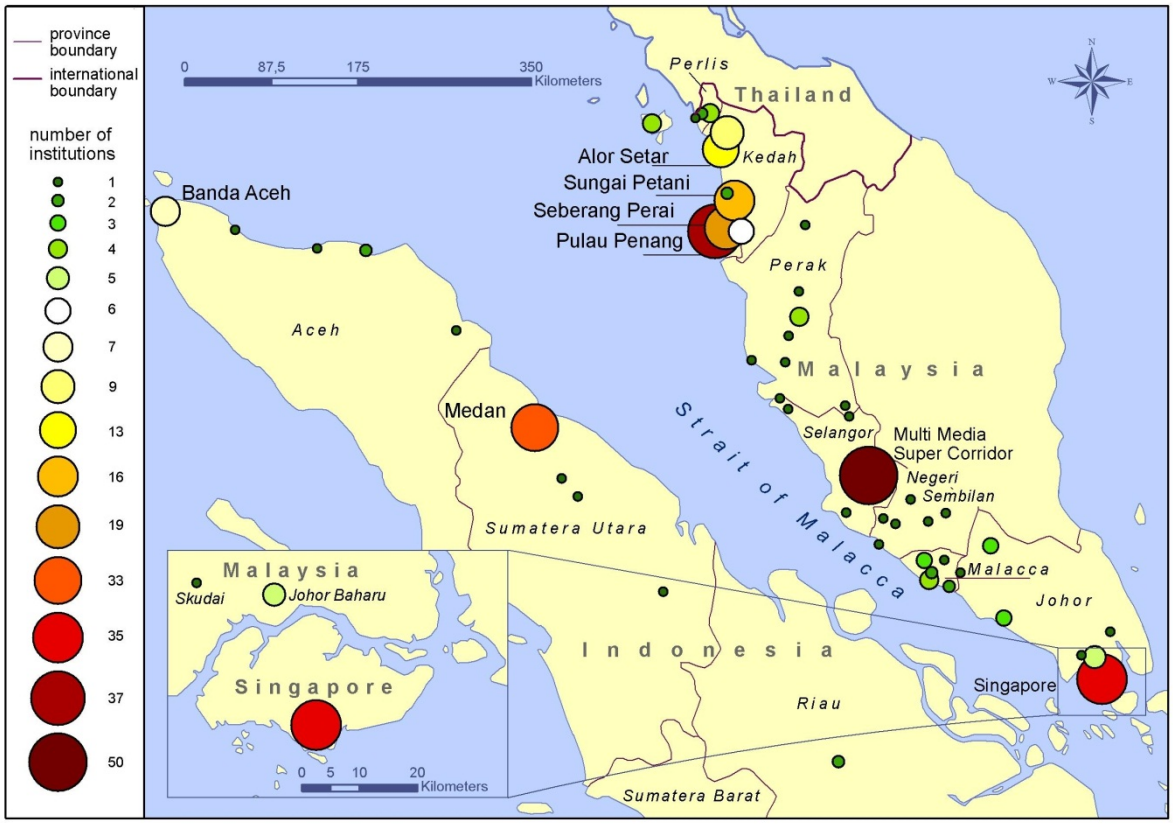
The history of the Straits of Malacca is until today strongly determined by international trade (Evers, Gerke, Hornidge 2008). At different points in time different ports in the Straits formed the main centres of commercial activities and as such arose as crucial contact zones for the exchange of not only products but also commercial and nautical knowledge as well as religious beliefs including state-craft. But once the travellers arrived in these ports, access to knowledge became of ultimate importance, as it became the precondition for reaching the long-term goal, namely success in trade or conversions.

Up to now Penang'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 trans-boundary business networks (Gerke and Meinert 2008; Evers and Hornidge 2007:432). The transfer of knowledge took place in institutionalised modes of knowledge transfer (i.e. schools of religious learning, traders associations, the feudal courts) as well as in informal ways (i.e. spontaneous exchange of mostly tacit knowledge through interaction with traders from a different ethnic group).

To delineate knowledge clusters in the Straits of Malacca region we compiled a directory of research centres and institutions of higher learning. Combining these data with geospatial coordinates we were able to identify areas of agglomeration of knowledge transferring and

producing organisations. These were defined as knowledge clusters[4]. Combining these data with output variables, i.e. numbers of internationally recognised academic publications, patents, number of persons graduated and similar data we could identify knowledge hubs. The following map shows the knowledge clusters, using the number of knowledge-producing organisations as an indicator. Four major clusters emerge: a Northwest Malaysian cluster (around Georgetown and Alor Star), a West Malaysian cluster (Kuala Lumpur with the Klang Valley, the MSC and Malacca), the North Sumatra cluster (centred on Medan) and the Singapore-Johore cluster as the major knowledge cluster of Southeast Asia.

Knowledge Clusters along the Straits of Malacca



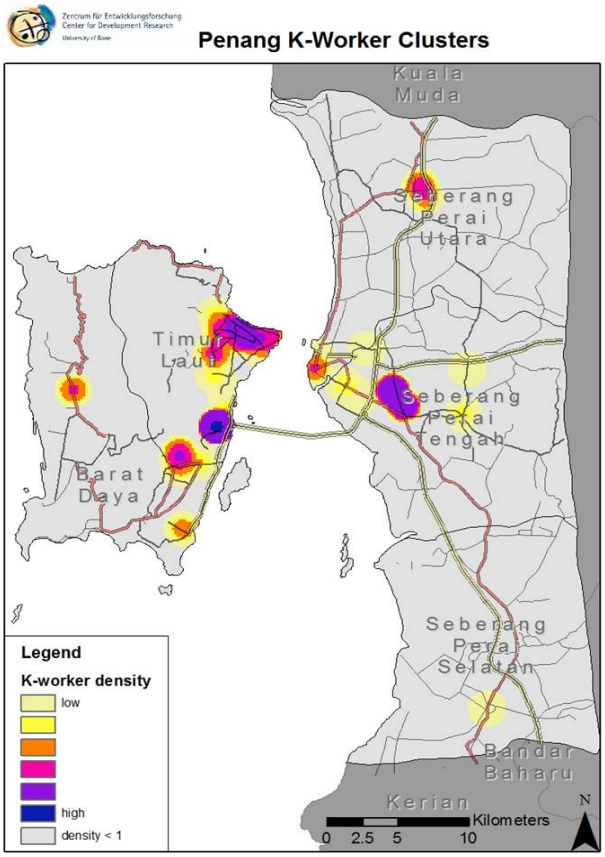
Source: (Evers, Gerke and Hornidge 2008; Evers and Hornidge 2007:426)

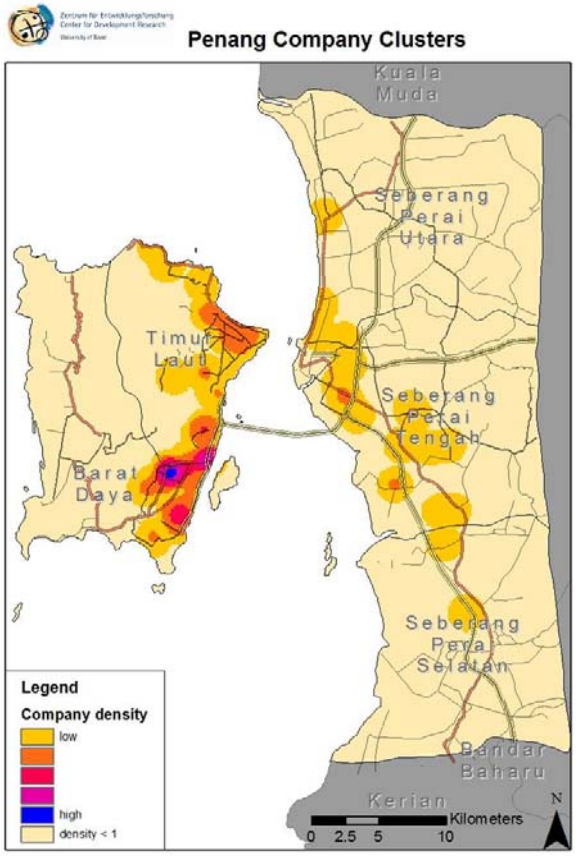
Nested within these knowledge clusters we find several knowledge hubs that coordinate a large number of highly qualified scientists, are connected to other hubs world-wide, are creative in producing new knowledge in specialized epistemic domains and are transferring innovations to firms and government agencies. Malaysia has two strong knowledge clusters:

[4] We are now using a more refined definition of clusters and hubs and therefore deviate somewhat from the terminology of our earlier study.

the Klang valley with KL and the MSC, Penang State and a number of smaller clusters. A calculation of the density of knowledge institutions and knowledge personnel show the epistemic landscape of Malaysia (see map). Penang has the potential to change from an industrial cluster to a knowledge cluster. For this purpose ***Penang has to reinvent itself as a „knowledge hub“.***

In the case of Penang as a knowledge hub, it can be shown that in Penang, as well as in other places along the Straits of Malacca, the modern knowledge clusters emerged mostly at localities that had a long tradition of trade and learning in the past (Evers, Gerke and Hornidge, 2008). The growth and the knowledge architecture of knowledge clusters and hubs appear to be highly “path dependent”, i.e. determined by history. This fact is often neglected in development programmes advocating the establishment of knowledge hubs “out of the blue” without regards for the existing knowledge landscape.





The history of schools of higher learning in the Straits of Malacca region correlates with the rise and fall of centres of trade along the pathway. The first modern school of Malaysia opened in Georgetown, the then centre of maritime trade. The first university in the region was founded in the then British Crown Colony Singapore, now NUS. 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 campus, while the knowledge structures of Singapore and Penang (in 1969, the Universiti Sains Malaysia is founded in Penang) rest on a far more diverse environment of universities, polytechnics, private and public research institutes.

Science Policy: Planning Industrial and Knowledge Clusters in Malaysia

In the1960s, Malaysia's policy makers realised the importance of export-oriented industrial clusters which should focus on light and heavy industries. Industrial clusters in the form of free trade zones were developed to encourage export oriented industrialization. The clusters were located in the relatively developed west-coast states of Penang, Selangor, Malacca and Johor.

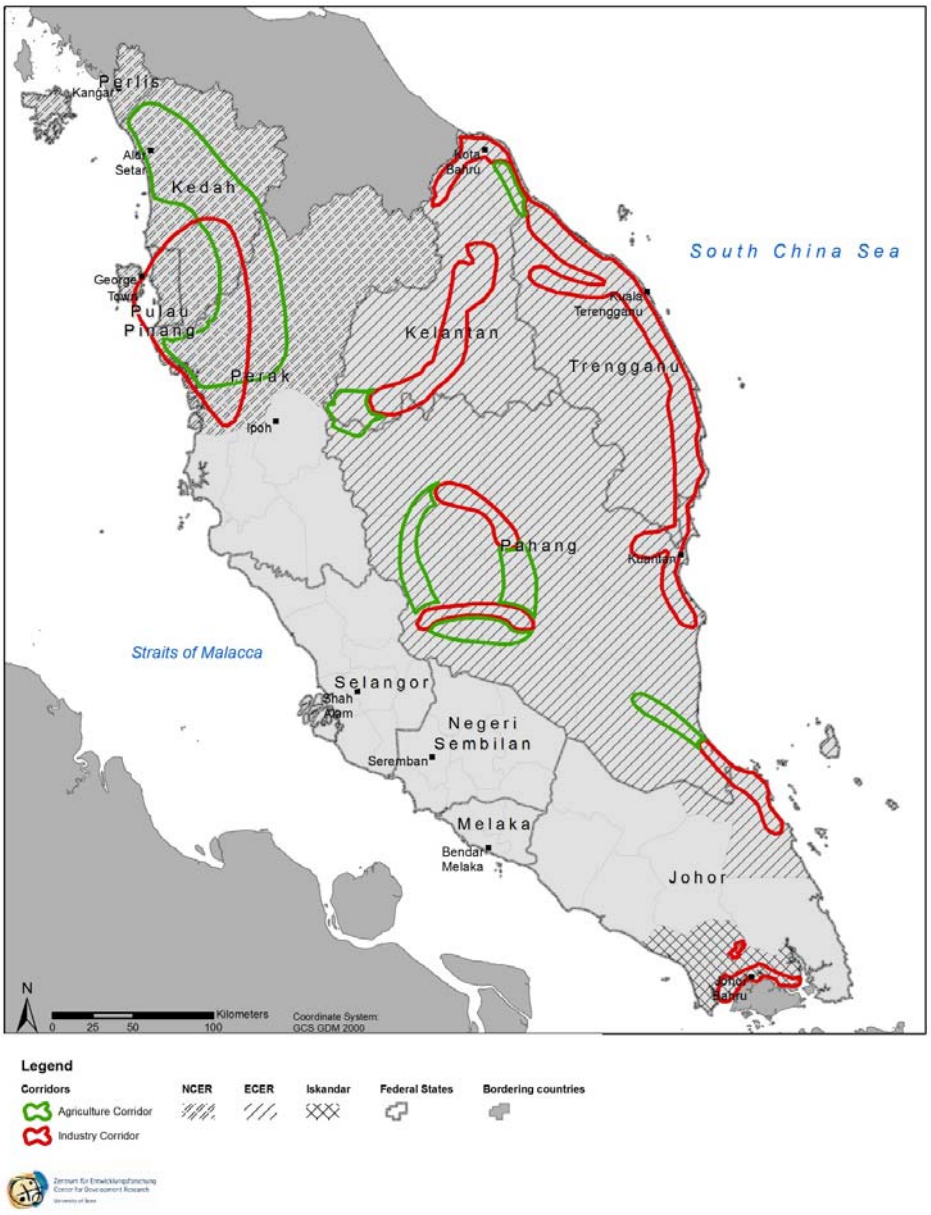
In 1991 Prime Minister Mahathir promulgated a new goal, the "Vision 2020". Malaysia was to be an industrialised and developed country by the year 2020 in its 'own mould' (Mahathir, 1991: 21). In the Seventh (7MP) and Eight Malaysia Plan (8MP), covering the period from 1996-2005, a knowledge-based development started with the use of information and communication technology (ICT) in all sectors of the economy to improve productivity. The Multimedia Super Corridor Malaysia (MSC) and the new city of Cyberjaya were built to spearhead Malaysia's development into a knowledge-based economy (KBE) by utilising information and communication technology (ICT). The government also encouraged the growth of companies related to biotechnology, advanced electronics and software development. Technology based incubator centres were set up by the Malaysian Technology

Development Corporation (MTDC) and Technology Park Malaysia (TPM) to facilitate industries related to a high technology base (Evers and Nordin 2010).

In the 9th Malaysia Plan, that covers the period of 2006-2010, "knowledge" for development and innovation were emphasized. The development of high-tech industries was to be concentrated in technology based knowledge clusters. The implementation of economic corridor or cluster development was spearheaded by the major GLCs (Government Linked Companies) and the government investment arm Khazanah Nasional. The economic regions and their corridors are shown in Fig.1. Penang is integrated into the Northern Corridor Economic Region (http://www.ncer.com.my).

A New Economic Model (NEM), unveiled in March 2010, is to ensure that Malaysia will achieve the target set by Mahathir. The NEM emphasizes the formation of clusters and corridors concentrated on specific economic activities. The focus is on innovation and productivity growth, in addition to technological advancement and entrepreneurial development. Development regions and corridors provide the spatial framework for government support and investment plans. Realization of these plans will depend on the on the financial strength of the government budget and ultimately on the economic development of ASEAN and the world economy (Evers and Nordin 2010).

Figure 1: Development Regions and Corridors, Peninsular Malaysia



Source: Evers and Nordin 2010 and Northern Corridor Economic Region (www.ncer.com.my); Iskandar Malaysia (www.iskandarmalaysia.com.my); East Coast Economic Region (www.ecerdc.com).

Science Cooperation: Penang as a Knowledge Hub

Penang is one of the knowledge clusters of Malaysia with a large number of universities, research institutes, and Research and Development (R&D) divisions located closely together. Cluster theory is predicting an optimal output of knowledge in form of innovations, patents and research papers. In the context of our study, we add the idea that the knowledge hub

function, i.e. a close cooperation between the institutions as well as external connections, are an additional pre-condition for high knowledge productivity. We measured these external connections with an output indicator of joint journal articles to which Penang researchers in have contributed. Only scientific research results in internationally recognized journals have been taken into account. The indicator measures therefore not all projects of cooperation with international institutions, but only those that are documented by publications, recognized, visible and accessible.

In the following section we present preliminary results of our analysis with a focus on changing international cooperation worldwide.

It was already mentioned that Penang is one of the traditionally grown centres of higher education and research along the Straits of Malacca and within Malaysia . During the past 40 years, USM with currently around 1300 researchers, lecturers and professors clearly emerges as the main producer of published research results in cooperation with international partners, followed by the Penang General Hospital as a leading institution in medical research. Other universities and colleges show surprisingly low international cooperation. Their research output is relatively small or not existent, though there may be hidden treasures in the form of unpublished reports not covered by our data. Private sector companies increasingly take part in collaborative research, but are still dwarfed by USM and other research institutes. Of these, the World Fish Center and the Fisheries Research Institute stand out, whereas a well-known local think-tank like SERI, recently re-named Penang Institute, is well established and cooperates and publishes locally, but shows little international connections.

In general it is interesting to note that most of the research output is based on cooperation with foreign universities rather than local Malaysian universities and institutions. We therefore concentrate on the analysis of the evolving international network of scientific cooperation over the past 40 years.

Patterns of Scientific Cooperation

Social systems theory has taught us that in the course of history societal subsystems become increasingly differentiated to reflect and cope with the complexities of modern societies. Highly differentiated systems are more effective in dealing with external threats and have a higher capacity to cope with the external social and economic environments. Increasing systems differentiation also requires a more sophisticated system governance, but on the other hand, differentiated systems produce higher output.

All in all, we can observe changing pattern of scientific cooperation over the last 40 years – changes which may have been triggered by external events rather than by changes in the science system itself.

Table 1 Patterns of Scientific Cooperation

	Dominant Scientific Cooperation	**Centuries**
Colonial Legacy	Commonwealth Countries, mainly UK, Australia and Canada	1970s to mid 1980s
Globalization	EU(incl.UK), China, India, Japan, ASEAN (mainly Thailand)	mid 1980s to mid 1990s
Asian Century	China, India, Japan, ASEAN (Thailand, Singapore, Indonesia) Australia, EU	1990s
The Indian Ocean and beyond	INDIA and EU and Iran	2000-2011

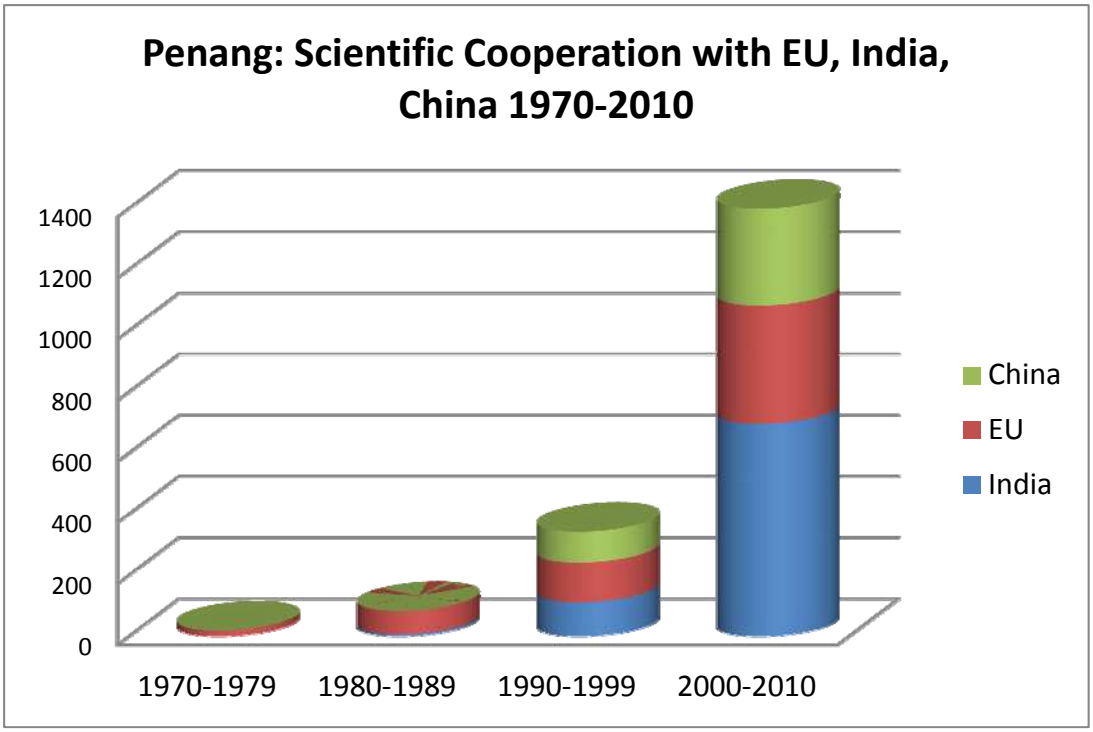


Fig. 2 Scientific Cooperation of Research Institutes, Universities and Companies in Penang State with EU, India, China 1970-2010 (joint articles in scientific journals, ISI Web of Science)

In the following we will take a closer look on how international scientific cooperation evolved during the last 40 years. Although we collected data on all countries worldwide, we will here look at measurable output that exceeds one or two publications a year. This is done by looking East at China and Japan, and further East at the US. If we look West, India is the dominating science hub, whereas researchers in Pakistan and Bangladesh only produced a few joint papers with Penangites. This is, with the exception of Iran, also true of Middle Eastern countries. Europe, including the dominating UK, is the main cooperation partner in the Far West. Scientific cooperation with other ASEAN countries is, as we will see later, slowly emerging. If we look East, China and Japan are the major cooperation partners, whereas, even further East, the USA plays a relatively minor role.

The time series of our data show the rapidly increasing international cooperation, especially after the foundation of the second Malaysian university in 1969, first as the University of Penang, then renamed in 1971 as Universiti Sains Malaysia (USM).

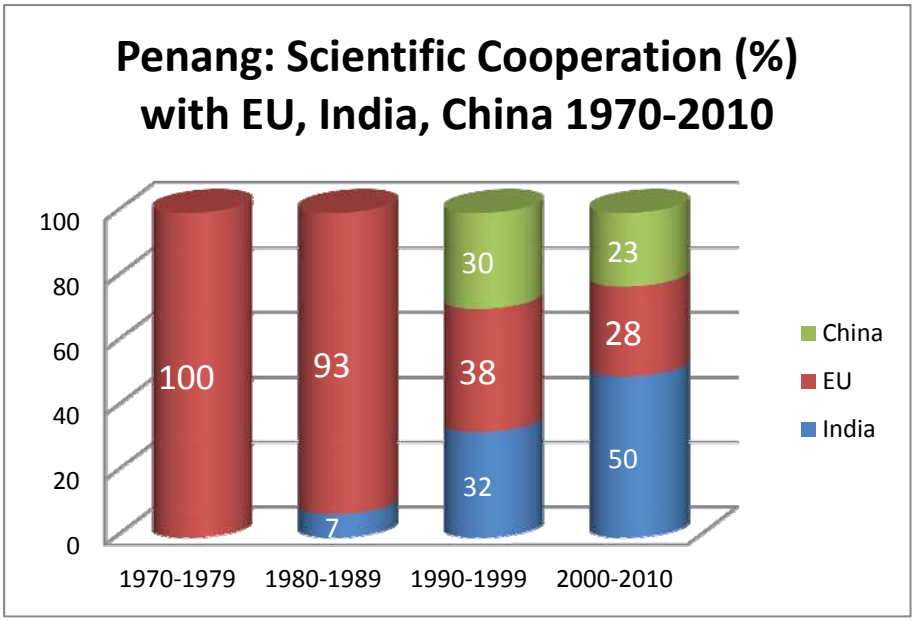


Fig. 3 Percentage Distribution, Scientific Cooperation of Research Institutes, Universities and Companies in Penang State with EU, India, China 1970-2010 (joint articles in scientific journals, ISI Web of Science)

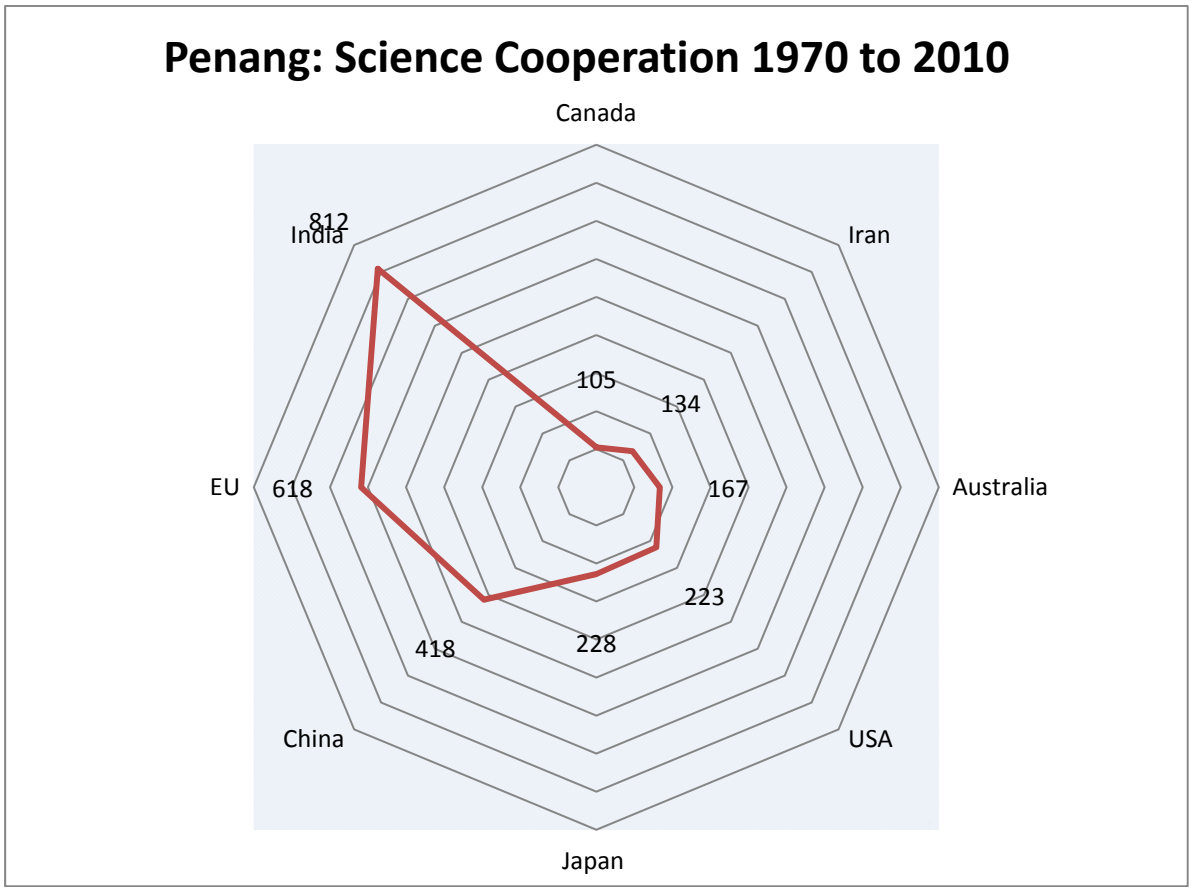
Data show evidence that the colonial legacy is mirrored in academic cooperation and joint paper writing in the 1970s and 80s. From 1970-79, 31 out of 52 joint articles have been published, with colleagues from the Commonwealth countries UK, Australia and Canada. From 1980-89 a similar picture evolves. Out of 172 joint articles 105 have been published with partners from the UK, Australia or Canada. This changes in the 1990s, when ASEAN countries (especially Thailand and Indonesia), as well as quite some European countries appear on the landscape. From the 1970s until the end of the 80s, there was virtually no scientific cooperation with India and China. That changes in the 90s, when joint publications with India and China are nearly at the same level and Japan becomes more important as a partner. The significant rise of cooperation with China is probably also due to more liberal politics in China.

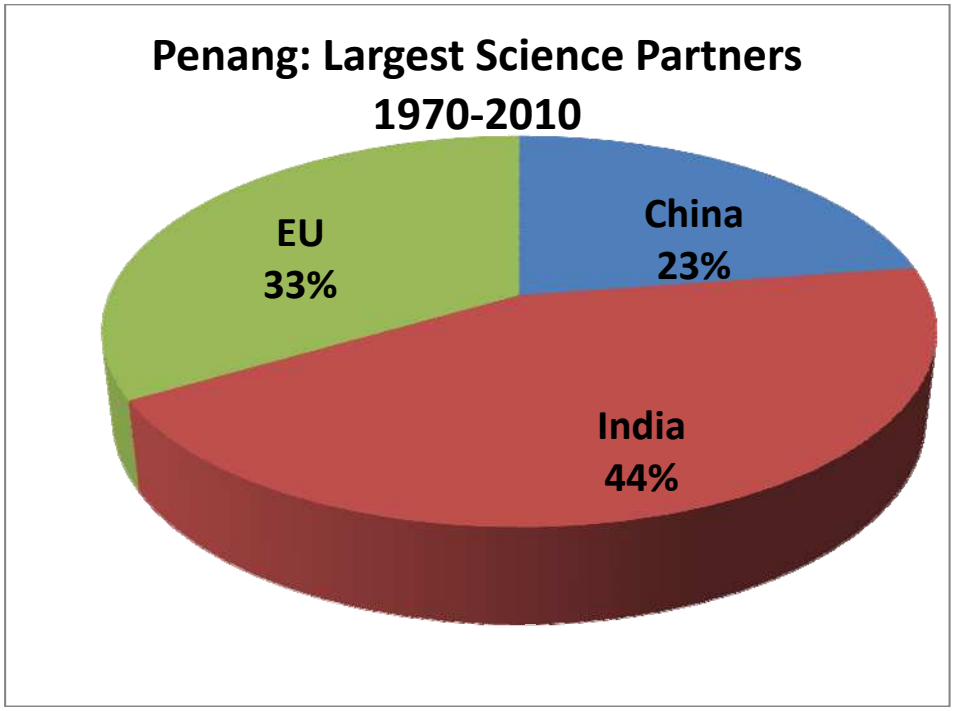
Since the year 2000 we can observe a dramatic change in science cooperation as most of the publications are written with colleagues from India which by far exceeds China and Europe. Cooperation in the form of joint paper writing is interestingly low with the US, compared to Europe. From 2000-2011, 445 articles have been published with partners from Europe (incl. UK), but only 173 with colleagues from the US. In recent years, scientific cooperation with India, especially in the sciences is much on the rise and overhauls China.

The dramatic increase of joint research and publication with India from 2000 to 2011 is surprising and in the next step of the project we will have a look at the individual partners as well as the topics to see, with whom and in which field most of the scientific cooperation takes place. We have, until now, no explanation, why China, contrary to all expectations, falls behind.

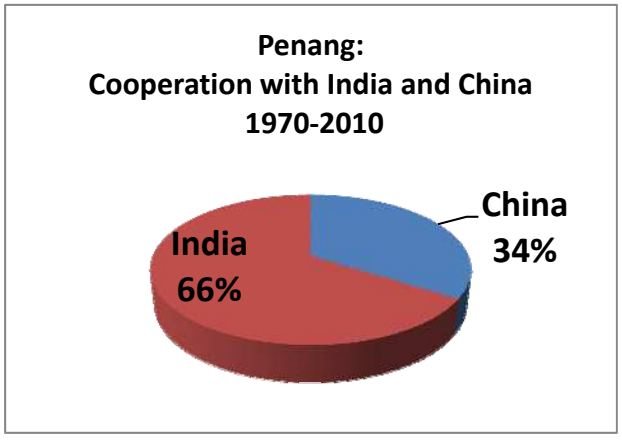
Looking West

After Chinas soft opening and more liberal policy, the country seemed to be the choice partner in many kinds of activities from trade to academic cooperation in Asia, not only in countries with a large ethnic Chinese population. Looking East was a slogan, also used by former PM Mahathir, whose advice was apparently not followed when it comes to science cooperation, as Penang scientists are obviously looking West (Mahathir 2005). Research cooperation with India and most recently with Pakistan, by far outnumbers cooperation with China, Japan and the US. The EU is, after India, Penang's second largest partner, with rising numbers in science cooperation.





During 1970 to 2010 India, the EU and China accounted for 55% of all joint article publication.



There are insufficient data on knowledge exchange within Penang, but it can be assumed that there is room for improvement. The so-called „triple helix" of research institutes, government and industry needs to be strengthened. Our maps show that clusters of knowledge workers and high-tech companies do not completely overlap. This can be taken as an indicator that industrial companies are short of knowledge workers.

USM as an APEX university has impressive research capabilities and has improved its international cooperation considerably (see map), but it is still not clear how far this potential is utilized to support industrial R&D, NGOs and government agencies.

Penang can develop and integrate its knowledge clusters further and advertise its position as one of the major knowledge hubs in Malaysia and the ASEAN region. The existence of knowledge hubs are incentives for investment and attract capital and high level manpower.

Annex: Definitions

Knowledge clusters are agglomerations of organizations that are production-oriented. Their production is primarily directed to knowledge as output or input. Knowledge clusters have the organizational capability to drive innovations and create new industries. They are central places within an epistemic landscape, i.e. in a wider structure of knowledge production and dissemination. Examples for organizations in knowledge clusters are universities and colleges, research institutions, think tanks, government research agencies and knowledge-intensive firms.

Knowledge hubs are local innovation systems that are nodes in networks of knowledge production and knowledge sharing. They are characterized by high connectedness and high internal and external networking and knowledge sharing capabilities. As meeting points of communities of knowledge and interest, knowledge hubs fulfil three major functions: to generate knowledge, to transfer knowledge to sites of application; and to transmit knowledge to other people through education and training.

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