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PROFILE

The Kra Isthmus Canal: A New Strategic Solution for China's Energy Consumption Scenario?

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Abstract This paper is a conceptual study that examines the viability of the construction of the Kra Isthmus within the context of the five dimensions of megaproject success of Sovacool and Cooper (The governance of energy megaprojects: politics, hubris, and energy security, 2013)—social (governance), technological (systems), democratic (politics), externalities (economics, ecology), and risks assessments (accountability), and its possible impact on China's strategic energy supply chain. One of the objectives of this study is also to discuss the current impacts, perceived benefits, and risks of China's dependence on its multinational and transnational pipelines. China could see the construction of Kra Canal as an alternative option for its strategic sourcing activities especially crude oil and gas at much lower costs. The megaproject would become a passageway that connects the Indian Ocean, Andaman Sea, and the Gulf of Siam at the choke point of Isthmus region in Thailand. However, this megaproject could also trigger the internal conflicts of Thailand, and affect the ASEAN countries' political and economic relationships.

Keywords Thailand · China · Energy economics · Kra Isthmus Canal · ASEAN · Malacca Strait · Pipelines

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Introduction

China's economy has been growing significantly since the 1980s and this phenomenon causes the China's energy consumption to also increase tremendously. The ratio point was ranked >1.0 in the calculation of Elasticity Ratio of Energy Consumption in China from year 2000 to 2007. The figure, which was bigger than one, provides the justification of the country's energy consumption that increased even faster than its economy. Also, China, in the year of 2007, consumed 258,641.4104 tons of coal and 36,570.1104 tons of oil, making China as one of the largest oil importers in the world and the second largest energy consumer, only falling behind the USA (Yuan et al. 2012). In 2013, China has imported approximately at 6.2 million barrels of oil per day and USA at the level of 6.6 million per day (EIA 2014). Also, the domestic oil consumption has been increased to 10.7 million barrels/day in 2013 or almost 4 %, from 2012 (EIA 2014). But however, China has now become world's largest oil importer in 2014 surpassing USA with 6.6 million barrels/per day compared with the States which is at 5.5 million barrels/per day. According to Erickson and Collins (2010), most of the China's crude oil transportation and transferring largely depends on pipelines especially the Kazakhstan–China, Russia–China, Burma–China, and Pakistan–China pipelines. Due to the high dependence on pipeline, and it could possibly cause the misunderstanding of global oil price mechanisms, and incomplete assessment of local security issue such as the proposed lines through Burma and Pakistan which are making less economic and security sense to China.

The long abandoned project—The Kra Canal—has now once again resurfaced on the negotiation table; the question lingers as to whether this proposed project can be executed on time to reduce China's over reliance on pipeline at

inefficient costs, where most of petroleum exporter countries (East Siberia) are situated in politically unstable environments including the latest military invasion of Russia into Ukraine that could cause economic turmoil and uncertainties. There are predictions that the Kra Canal project can help Thailand in term of boosting the economy especially in Southern Thailand. Thus, there are even more speculation, anticipation, and debate regarding the objectives and purposes of the canal's development. In this paper, the authors hope to stimulate the discussions about the canal's construction that can basically provide new alternative trading routes which in future could provide potential economic and strategic benefits for China, and concomitantly to reduce the reliance of overland pipeline and the Malacca Strait. It also ignites the argument that Thailand's commitment toward the project might cause internal conflicts and strain relationships with other countries in the Southeast Asia (SEA) region.

The Overview of Pipeline Project in China

According to Herberg (2010), the International Energy Agency (IEA) forecasts that in the coming two decades leading up to 2030, China and India are likely to consume more than 50 % of total world energy demand growth, 60 % of world oil demand growth, 20 % of natural gas demand growth, and 85 % of world coal demand growth. The statement from Erickson and Collins (2010) also indicated that between now and 2025 the world's major economies will still depend, to a large scale, on conventional energy sources, particularly on oil and liquefied natural gas (LNG), as they must be transported by sea to the extent that domestic supplies or overland pipelines are insufficient to meet the demand. Hence, China would not reduce the seaborne imports which accounted for 40 % of oil products. The commitment of seaborne transportation is unlikely to be reduced as well as for inland/overland pipeline oil transportation, as the study widely cited that currently China already has 50,000 km of oil and gas pipelines and they intend to double the amount, up to 90,000 km, during the 12th 5-year plan (2011–2015) (Xin et al. 2010). Even though the ultimate proposed goal is to have ninety thousand kilometers pipeline, the pipeline construction in China is not likely to enhance oil import security in quantitative terms; this is because every additional volumes they bring in will be overwhelmed by its internal strong demand growth; China's net reliance on seaborne oil imports will grow over time, pipelines notwithstanding. For instance, the projection of Burma–China and Pakistan–China pipes are making the transportation route shorter and it is not considered as real overland supply options; and the petroleum will still have to be carried by sea tankers to the pipelines' starting points (Erickson and Collins 2010).

The Existing Pipeline Project

There are few current pipeline projects that are already in the operational stages. Below are the examples to describe the characteristics and the supply model of each overland pipeline in China.

Kazakhstan–China Pipeline

This pipeline is in the operational stage in China, from the business agreement that China authorities had with Kazakhstan officials that China previously imported the crude by using rail that go through the entry port of Alashankou, Xinjiang. Soon, both parties realized that pipeline construction is a strong need. The development took place in September 1997; both parties signed the General Agreement on the Project of Oil Deposits Development and Pipeline Construction (Erickson and Collins 2010). This project cost approximately $806 million to form up to thousand-kilometer from Atasu to Alashankou, together with the 252 km extension from Alashankou to the refinery station at Dushanzi, Xinjiang. The pipeline currently supplies 200,000 barrels per day (bpd) and China is approximately getting the supplies at only 115,000 bpd averagely by the pipe and rail transportation. The capacity is not maximized, and this is mainly due to pricing dispute and problem with supply availability. Furthermore, the above action does not fulfill the strong demand of China for oil . The China National Petroleum Corporation (CNPC) had opened a 400,000-bpd-capacity crude pipeline from Shanshan in Xinjiang to Gansu Province as China had located a refinery station in Lanzhou. As for the project integration, the strategic petroleum reserve near Urumqi can possibly max out its capacity of 400,000 bpd in year of 2011 (Lee 2007). The potential threat and concern regarding supplies of 200,000 bpd may seem low and oil field reserves in Kazakhstan are limited in the major supply compound (e.g., eastern Siberia), and China also has difficulty to offset its seaborne petrol imports. Besides that, not only the limited reserves, but political instability will also soon become an unclear picture for both parties (Erickson and Collins 2010). Figure 1 indicates the current pipeline supplies and locations of Kazakhstan.

Russia–China Pipeline

The discussion between the two Asian giants, China and Russia, of the pipeline construction in 1994 formed from the inspiration for China that viewed Russia as a rich and secure oil source capable of delivering crude overland. According

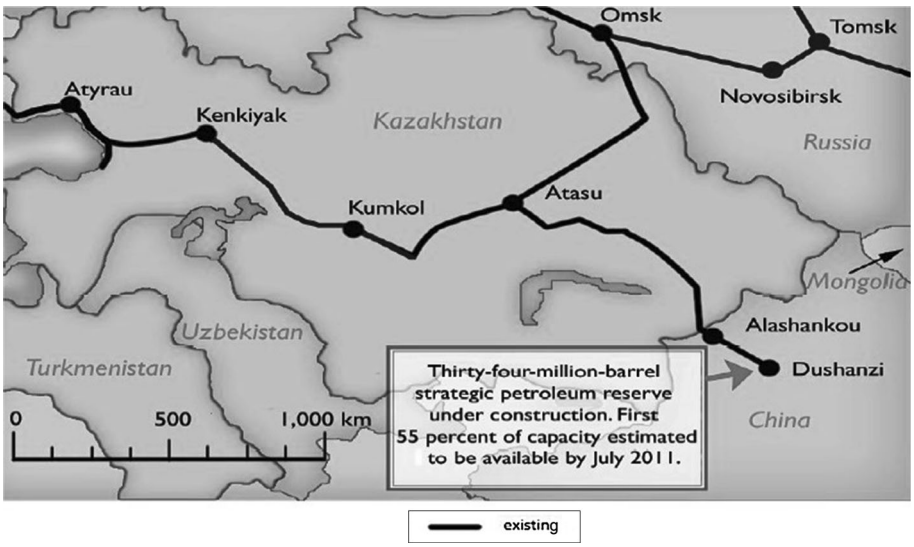

Fig. 1 Kazakhstan–China oil pipeline. *Source* Erickson and Collins (2010)

to Erickson and Collins (2010), Yukos compiled plans in 2001 to develop a pipeline from Angarsk to Daqing but unfortunately the plan was halted during Kremlin's 2004–2007 assault on Yukos. The massive project by Transneft's East Siberia-Pacific Ocean (ESPO), from the first section from Taishet to Skovorodino now can pump crude and the second portion runs about 2,100 km from Skovorodino to Nakhodka, toward the Sea of Japan, and this whole line may not be fully functional until 2025 (Erickson and Collins 2010). In the meantime, China imported oil from Russia mainly using the rail, and in between 2007 and 2008 China had already bought crude from Russia on more than 300,000 bpd on average (Energy Intelligence Group 2007).

As far as China is concerned about the shipping cost using rail, this method could cost twice as much as shipping by pipeline. Also, this is not the only reason to force China authorities to implement pipeline project alliances with Russia; the reality and fact about the regional rail system and infrastructure are unlikely to solve China's desirability toward the crude volumes. The hefty refinery project worth around $436 million is located at Daqing and it runs from Skovorodino and it accounted for 1035-km long (70 km on the Russia side and 965 km on the Chinese side). As for the main Chinese buyers, CNPC and Sinopec pushed the construction on this spur line (BBC 2007). The similar issue such as pricing dispute between the CNPC and Rosneft does exist as we did mention it from the previous case of Kazakhstan. The other concern shown by China would be the Pacific port of Nakhodka that can potentially become Russia's new alternative option to divert petroleum which has the possibility to put pressure on China's authorities. Also, another pressure point would be initially that Russia could supply an adequate amount of crude by using rail to Pacific Ocean, and this allows Rosneft to disconnect a substantial portion of pipeline export to China in the event of dispute (Erickson and Collins 2010). Figure 2 indicates the current and future pipeline supplies and location of Russia.

Burma–China Pipeline

The idea initiated by Professor Xiaohui (2004) at Yunnan University outlined the objective of this pipeline that would be targeting the issue of over reliance on Malacca Strait. Also, Yang stated that Burma would act as 'backdoor' supplier for mainland China, and this proposed line would definitely reduce the reliance on Malacca Strait and at the same time help to secure China's oil import (Xiaohui 2004). Apart from the reliance issue toward Malacca, China also has to promote inland economic growth such as southwest area of Yunnan, Tibet, Guizhou, and Guangxi, as well as Chongqing since frequently these areas have severe shortage of petroleum supply (Zhang 2006).

From the first stage, it is clear that if the pipeline project is executed in the long run, it would generate crude oil up to a capacity of approximately 200,000 bpd and it is entitled for expansion plan if necessary, therefore, the maximum capacity after it is fully built would be at least 300,000–400,000 bpd. From the economic point of view, this pipeline agreement may make sense, it is simply because the costing is approximately equivalent to those shipping crude by tanker to southeast China refinery. Furthermore, this additional pipeline would be seen as a strategic point where it provides and enhances the oil's supply chain management (Erickson and Collins 2010). The operation of gas pipeline started last July which carried as much as 12 billion cubic meter of natural gas, as well as the crude oil pipes are now 75 % complete and should go into operational stage by coming June of 2014 and it will be able to deliver up to 440,000 bpd from the Middle East and Africa by tanker (Larson 2014). The statement claimed

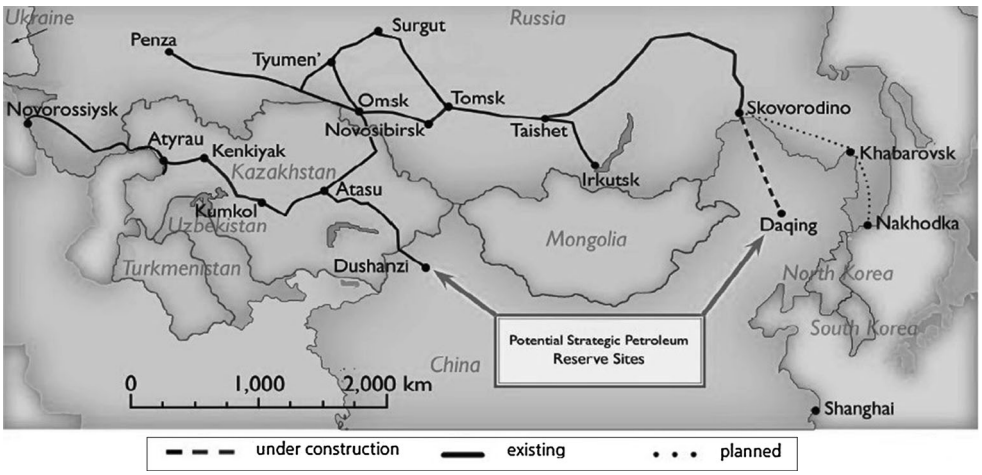

Fig. 2 Russia–China oil pipeline. *Source* Erickson and Collins (2010)

by Professor Lin Boqiang from Xiamen University's Energy Economics Research Center of China "China's piped gas is mainly imported from areas around the Malacca Strait, and now we have one more pipeline from the land instead of the seabed, which will decrease China's energy vulnerability." Figure 3 indicates the current supplies lines of natural gas and crude oil of Burma.

Pakistan–China Pipeline

Also, to mention are the two controversial sourcing lines which involve Burma and Pakistan; the reason why we stated they still remain controversial are mainly due to the internal civil warfare, unstable political and economic growth, as well as geographical issue. From the below analysis and perspective, we can understand further the real time circumstances of Pakistan and their commitment of the pipeline construction.

The pipe which shared the similar objective with Burma is that it bypasses Malacca Strait—China authorities and some Pakistani analysts have also planned the possibility of the development of an 'energy corridor' that is inclusive of oil and gas pipelines, rightly directed from Pakistan into western China, and to diversify the oil import routes (Xuegang 2007). The pipelines are expected to deliver 250,000 bpd. The proposed route would pass by one of the controversial areas, Kashmir, which is a location controlled by Pakistan and at the same time it is claimed by Indian authorities (Erickson and Collins 2010). Figure 4 indicates the proposed route of the pipeline from Pakistan to China.

Fig. 3 Current supplies lines of natural gas and crude oil of Burma. *Source* Energy-Pedia (2009)

Perceived Benefits of Pipeline

After all the consideration regarding the pipeline construction, some analysts see that the potential growing demand for oil and gas in China would stimulate the pipeline development across the region especially western China. The growth of domestic market is particularly strong after the disastrous Sichuan's earthquake, and Chongqing, a place claimed as 'China's Chicago' enjoying approximately 14.5 % gross domestic product growth in the year 2009 (Chongqing Real Estate Net 2009). The true

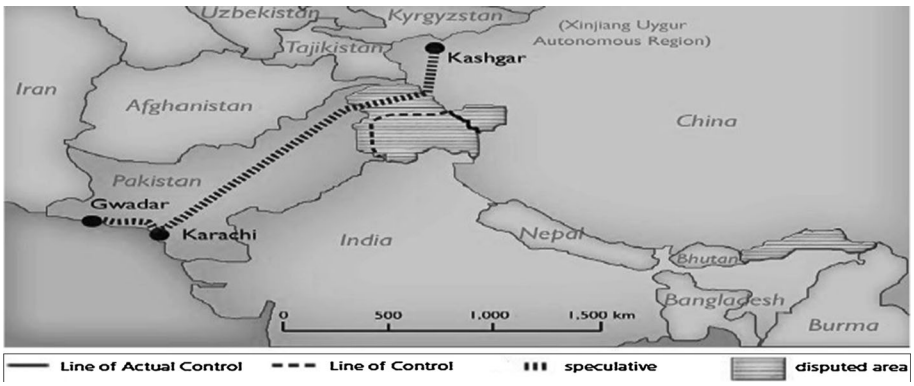

Fig. 4 Pakistan–China proposed pipeline. Source Erickson and Collins (2010)

facts and benefits of the pipeline construction definitely are to create more jobs by building more domestic refining facilities as well as local pipelines expansion that would also be beneficial to the local authorities to ensure a lower cost of oil's product supplies (Erickson and Collins 2010). For instance, argument from ICIS Chemical Business (2007) stated that the refinery near Kunming, could actually generate up to 10,000 or more construction and engineering jobs and at least provide more than several hundreds of long-term positions to run the facility, and pipeline building including the storage and pumping facility that would definitely offer extra short-term and long-term job opportunity. Furthermore, China's action of securing pipeline across the region might be seen as a strategic move to setup multi-cities choke point, and primarily, to enhance its energy security at lower financial and diplomatic cost. Supported by the local and provincial officials, they are keen on cooperation due to projects security that creates sustainable local job opportunity and investment.

Perceived Risks of Pipeline

Some of the potential threats that have been discussed in the previous part cover the unstable political environment in Kazakhstan and Russia, and as for the political barrier in Yukos' assault incidents back in 2004–2007, the pipeline project was suspended. Moreover cases of pricing dispute are common not only in Russia but also in Kazakhstan, particularly Rosneft from Russia which has stopped exporting oil to China for more than a decade due to lack of profitability (Erickson and Collins 2010). Next, from the report of CNPC, between 2002 and 2006, theft case such as illegal drilling into the pipeline at approximately 18,382 times accounted for company losses of more than 500 million RMB ($72 million) (Erickson and Collins 2010).

As for the economical perspective regarding the transportation and shipping costing, pipelines are not the cheapest way to secure the oil businesses, hence, China should consider more toward the seaborne transferring. The calculation as shown below is an example of how China could save more by using sea transportation. As stated below, China tanker that travel from Ras Tanura to Ningbo would cost China about USD 0.18 cent per barrel per 1000 km. This figure compared with pipeline from Angarsk to Daqing is put at USD 0.75 cent and by rail mode costs USD 7.19 dollars from Angarsk to Manzhouli. As we can see, from the economic perspective, seaborne transportation still will be the cheapest way of delivery and yet economical. Table 1 indicates the example of expenditure on shipping cost by China by using three different kinds of transportation mode for oil.

From the viewpoint of terrorism and national security aspect, there are some critical reviews and criticism regarding the safety level especially the situation in Pakistan—the country's perpetual violence and increasing political instability, along with the rise of Islamic fundamentalism and terrorists attacks against outsiders. There were kidnapping cases of the Chinese workers and their murders in at least three separate incidents in western and northwestern Pakistan. The incident would trigger intensity between the Chinese and Pakistani regarding the deal of the pipeline (Reuters 2007). As for Burma, when the China's oil pipelines run through the territories, it is extremely vulnerable to be struck by nationalist rebels. In the current stage, after the pipeline project was launched, and by 27th January, police had detained more than 20 Burmese pipeline workers after a feud with the Chinese labors at the construction site which escalated to arson, and resulted in the oil-storage facility engulfed in flames (Larson 2014). Next, the pipeline has the exposure potential to separatist's regime that is still wandering in Burma's hinterland.

Furthermore, from the geographical barrier, as far as China is concerned, the Burma's pipeline could be affected in the area of Sichuan where the place had suffered from May 2008 earthquake, and most of the large refinery, storage, and facilities were near an active seismic zone

Table 1 Oil transportation/shipping cost to China

Mode	Route	Distance (km)	Cost (US$/BBL)	Cost (US$/BBL/1000 km)
Tanker[a]	Ras Tanura–Ningbo	7000	1.25	0.18
Pipeline[b]	Angarsk–Daqing	3200	2.41	0.75
Train[c]	Angarsk–Manzhouli	1000	7.19	7.19

Source Erickson and Collins (2010) cited from Hongtu Zhao (2007)

[a] VLCC at $150 km/day charter, 2 million bpd cargo

[b] Transneft tariff of 15.41 rubles/ton/100 km

[c] Based on weighted average of Russian Railways' oil tariff to Zabaikalsk and Naushki

(Erickson and Collins 2010). In addition, the geographical barrier cost of Pakistan's pipeline construction would be seen as major problem in the sense of, trying to build in one of the world's most challenging terrain. It is surely a challenge to pump up oil from sea level at Gwadar to the 15,400-foot-high Khunjerab Pass, and it needs massive and tremendous pumping power and consistent electricity supplies in this remote area. Due to this challenge, the discussions are still taking place and the China authorities realized that using the port of Gwadar would be a good option to secure their next strategic move. From the viewpoint of geopolitics', operational control of Gwadar port would act as both commercial and defense purposes and will ultimately provide China an entry point into the Arabian Gulf (Fazl-e-Haider 2013). In fact, a contract agreement between Pakistan and Singapore for Gwadar port management came to an end in Jan 2013, and now Pakistan has handed over the management and operation to Chinese company, and another landmark decision was Pakistan has signed Iran-Pakistan gas pipeline project which is expected to be completed in Dec 2014. This Iran–Pakistan pipeline project is seeking opportunity for extension into mainland China as part of a planned economic corridor, but unfortunately this project remains stalled due to sanctions against Tehran over its nuclear program by the US government (Fazl-e-Haider 2013). Such political pressure could crush the hope of China to further secure the strategic location for energy sourcing.

Current Malacca Strait Situation

We all know that, the growth of regional transportation is crucial to the contribution of country's gross domestic product. The idea of adequate transportation infrastructure can allow for greater connectivity, access to trade routes, and also increase the attractiveness of the area to investors (Gauthier 1970). For the SEA waterway, the Malacca Strait is considered as one of the world's busiest trading routes and studies have shown that the strait possesses two-way traffic (Kusunagi et al. 2008). According to the US Energy Information Administration, the Malacca Strait would be seen as an important chokepoint in Asia, due to its estimation of 15.2 million bbl./d [barrels per day] flow in 2011, compared to 13.8 million bbl./d in 2007 (World Oil Chokepoints 2012). Also, due to the congested traffic in the Strait, majority of the new model giant tankers that carried oil from the Middle East are forced to take an alternative, longer, route via Sumatra. This will possibly create additional cost and risk for most of the shipping companies.

To understand the congestion situation, a record high of 171 vessels passed by this route in a day. From the consistent growth of vessel transportation, in the year of 2007, the number of vessels that traveled along the Malacca Strait has increased from the previous figure up to 194 vessels per day. So from this viewpoint and understanding of current traffic condition in Malacca Strait, an alternative route is highly required to reduce the congestion rate of the strait. As we can see from the Table 2, the growth of the vessels transportation is in the upswing trend.

However, congestion issue is not the only challenge; studies have shown that environmental problem is also a threat. According to Mariner Group (2005), it is difficult to clean up the phenol, as it is soluble in water, with reference to the incident of the 533 ton MV *Endah Lestari* with 600 tons of poisonous industrial chemical liquid, and 18 tons of diesels spilt. The toxic killed large amount of marine life including fish and cockles. According to UNEP (2005), the oil leaking issue has now become the major environmental threat as Intelligence Report 1999 listed Malaysia and Singapore as hot oil spill spots from the ships concluded from 39 cases since 1960.

Coastline security is also a main part of the discussion of Malacca Strait. According to Mukundan (2008), the pirate's attacks in the recent years seem to be more violent and sophisticated in nature. The problems with sea piracies, robberies, and hijackings are types of social illnesses which are difficult to forecast in the situation of growing worldwide terrorism. Malacca Strait serves more than 70,000 ships each year, accounting for one-third of the world's trade and half of the world's oil tankers ply along it to countries like China, Korea, and Japan. Hence, terrorism activities in such a hotspot would cause adverse potential economic impact, not only regionally but also in the global

Table 2 Shipping traffic in the Malacca Strait (1999–2007)

Traffic type	1999	2001	2003	2005	2007
VLCC/DEPP Draft CR	2027	3303	3487	3788	3753
Tanker vessel	11,474	14,276	15,667	14,759	14,931
LNG/LNG carrier	2473	3086	3277	3099	3413
Cargo vessel	5674	6476	6193	6340	8467
Container vessel	14,521	20,101	19,575	20,818	23,736
Bulk carrier	3438	5370	6256	7394	9684
RORO/car carrier	1229	1764	2182	2515	3137
Passenger vessel	1919	3151	3033	2299	1870
Others[a]	1210	1787	2664	1609	1727
Total	43,965	59,314	62,334	62,621	70,718
Average traffic per day	120	163	171	172	194

Source MDM (2008). STRAITREP ship reporting system in the Strait of Malacca and Singapore has been operating since December 1998. The statistics cover only the Malacca Strait from One Fathom Bank to Iyu Kecil

[a] Includes livestock carriers, TUG/TOW vessels, government/navy vessels, fishing vessels, etc.

scale. Table 3 explains at glance piracy incidents in Indonesia, Malaysia, Singapore, and Malacca Straits.

To summarize from the above, pipelines poses the greatest risks (unstable supply) still; meanwhile, the cost of delivery by using others transportation mode such as train and the pipeline would be lot more higher than sea route. Furthermore, congestion and piracy issue that lies on Malacca Straits are all time seen as a threat to the world shipping activities. Hence, Kra Canal is viewed as a necessary new alternative sea trade route based on security reason by securing strategic energy for China.

Conceptual Framework

From the above investigations toward the current China's commodities sourcing situation, securing a new sea route is viewed as a necessity but, however, the Kra Canal execution process in this case might experience a certain degree of potential failure. In order to determine the sources of failure in this megaproject, this article adopts the five dimensions of Sovacool and Cooper (2013) to evaluate this Kra Isthmus case study. The five dimensions are namely, (i) social (governance), (ii) technological (systems), (iii) democratic (politics), (iv) externalities (economics), and (v) risks assessment (accountability).

Table 3 Piracy incidents in Indonesia, Malaysia, Singapore, and Malacca Straits

Places/year	2001[a]	2002[a]	2003	2004	2005	2006	2007
Indonesia	72	103	121	94	79	50	43
Malaysia	9	14	5	9	3	10	9
Singapore	4	5	2	8	7	5	3
Malacca Straits	11	16	28	38	12	11	7
Total	96	138	156	149	101	76	62

Source ICC-IMB (2008)

[a] Compiled based on the piracy maps available online http://www.icc-ccs.org/prc/piracyreport.php

- *Social (governance)* Megaproject can fail from the social point of view, just because of their size, construction difficulties, and complexity. Also, the involvement of numbers of stakeholders could trigger internal conflicts and fragmentation of the project execution, and heat up the international relation issues.
- *Technological (systems)* The technological experts stated that megaproject could slump technologically. The more complicated the project becomes, the more technical issue will occur such as delays, and cost overruns. Hence, it will increase the risk of the project execution.
- *Democratic (politics)* Megaprojects could fail because they are secretive and undemocratic. This is because most of the on-going projects executions are likely fail to present its transparency, and still remain as 'closed system' without any public declaration. This could impact the country's corruption issues.
- *Externality (economics)* From the externality economics theory, the megaproject will fail because they allow firms to mobilize technology to shift externalities from themselves to society as a whole. The bigger the scale of the system, the more opportunity to externalize costs.
- *Risk assessment (accountability)* The issue of overestimation from the megaprojects especially the perspectives of resources, benefits, and revenue could trigger execution failure. The reason why is being too skeptical toward its attraction to investors and meanwhile, the issues on environmental is underestimated.

In this article, we adopt Sovacool and Cooper's conceptual and methodological choices and at the same time, we refer to their work for a full explanation of our research design.

The Management of Energy Megaprojects

Before we examine the Kra Canal based on the above framework, we would like to present the two closest cases which reflected the construction capability in the eighteenth century with the first attempt by the French (1880–1889) and ended up with disastrous failure, and soon took over by the Americans after several years (1903–1914)—The Panama Canal. Eventually, Americans successfully constructed the canal and it is seen as one of

the successful megaprojects in the American history followed by its operation more than a decade before they handed over to the Panama government in 2000. The second case would be the current Nicaragua Canal contracted out to a Hong Kong-based company. By using the five dimensions proposed by Sovacool and Cooper (2013), the assessment of Panama Canal and Nicaragua Canal is discussed in the next section.

Why the French Failed to Build the Canal?

- *Social* There were complications in the stakeholders and the government relationship issue with the French back in those days before the first French Canal Company, La Societe International du Canal Interoceanique was awarded this project construction undertaking with an exclusive concession from Columbia. It started with the exploration and survey team with the incomplete result then submitted to the congress for decision making. Out of 136 delegates from France, Germany, and United Stated and other countries, only 42 were engineers while the remainders were promoters, politicians, speculators, and personal friends of De Lesseps.
- *Technological* The canal's promoter, De Lesseps had made a fatal mistake by having a miscalculation of the entire project cost. From the engineering commission cost, estimation of the canal's construction was at $168 million in February 1880 but as for the engineering congress the costing was agreed at $214 million. But, De Lesseps estimated only at $131 million, a reduction from the two previous calculations, which he subsequently reduced to $120 million without any concrete reason. Also, the engineering congress estimated that the construction timeline would be seven or eight years but under De Lesseps's optimism, it was reduced to 6 years. The consequences of cost overrun and delay issue of the French eventually back-fired the project excavation (Avery 2001).
- *Democratic* As the prospect of the canal came to an end without any earlier notification or formal announcement and the construction failure had triggered one of the biggest scandals in the global financial history, it directly affected 800,000 people who had pawned their assets, intently following De Lesseps. After that, it went bankrupt and a liquidator was appointed to take charge. As a result, the exposure of the scandal put De Lesseps and his son Charles to five years imprisonment.
- *Externality* Ineffectiveness in funding management caused leakages and cash channeling externally. The welfare disparity level between the French workers and the Blacks was extremely quite a gap, from the economy's perspective; the French were treated with extreme generosity, for instance, the average pay for clerk was $125 per month, division chief from $200 to $300 per month. After 2 years' service, 5 months vacation, with free traveling expenses to and from France, were granted. The clerical force was awarded free quarters, furniture, bedding, lamps, and kitchen utensils. As during that time, there was no system of accounting in vogue. Many of them did quite a profitable business by selling the company's furniture (Avery 2001).
- *Risk assessment* De Lesseps' overoptimism cost him largely on labor's death toll, the underestimation issue on yellow fever's infection, while more than 2,000 French workers had no immune toward it. When malaria and yellow fever struck and caused a fatal blow for the French' construction effort, De Lesseps had tried to revive the situation by building up two hospitals named Ancon and Colon with the cost of $5.6 million and $1.4 million. But due to mismanagement of the hospital (not trained nurses), from 1881 to 1889, there were 5618 deaths reported from the hospital's record. There were large amount of workers that fell sick but did not enter the hospitals, as they will being charged one dollar a day for the treatment. Therefore, the total death of the laborers who died during the construction period from 1881 to 1889 is estimated at 22,189 (Avery 2001).

The American Takeover

- *Social* The conflicts between the militaristic background chief engineer George Goethals and the workers on strike during the construction period over the wages increased negotiation, but then it was soon settled by replacing with new workers. Also, he was given the sweeping authority over the entire canal project that granted him the right to sack commission members. For instance, Maurice Thatcher had proposed that US government should create an elected civil government in Panama Canal Zone, aiming to promote permanent settlement. Eventually, Goelthals had terminated Maurice's idea with the President's backup (Jen 2014).
- *Technological* The advancement of the technological tools applied by the American was far more efficient than the French— usage of Bucyrus steam shovels moved the earth three times faster than the French equipment. Also, the progress of electrical engineering by the 1890s made hydroelectric power possible, it motorized the lock systems with controls that performed superbly for decades.
- *Democratic* The US approached with an entirely different method just to acquire the canal's construction

permission and operation by putting their military force in position to form pressure Columbia, this is to detach Panama from Columbia's colonization, also it could also work against the new Panamanian government to negotiate a better deal for the canal (Gilbert 2010).

- *Externality* From the economics perspective, French' failure on relocating funding and forming an unequal payroll toward the different hierarchy workforce created a huge issue on capital flow and caused leakages. To maximize the worker's output of the construction site, John Steven, the second chief engineer improved the railway system by capacity, then he tripled the workforce by the end of 1906 with base salary of 10 cents per hour, 10-h work days, and 6 day a week. By 1910, it was reported that there were 40,000 workers on its payroll.
- *Risk assessment* America's biggest effort was by putting out malaria and yellow fever after they learned from French's tragedy. They sent out epidemiologist Dr. Carlos Finlay with an army doctor, William Gorgas to Panama, and they applied the same method to suppress mosquitoes breeding in the canal area that was used by Walter Reed, a U.S. Army physician in Havana, and put the yellow fever and malaria cases under control.

Next, forming the cases comparison as rectification purpose of the theory, we hereby add Nicaragua Canal case which had commenced work at 2014, contract has been awarded to China authority, a Hong Kong base company called Hong Kong Nicaragua Canal Development (HKND Group). This act will trigger business competition between the Panama and Nicaragua, which is quite worthy for exploration and examination based on the Sovacool's model. Despite of all the controversies such as transparency issue, environmental management problem, the project is expected to cost at total $50 billion and estimated to take five years to complete.

The China's Nicaragua Canal Dilemma

- *Social* The involvement of different strategic partners into this canal project building, an adequate distribution of power would be highly required. Especially HKND has no construction or engineering experience as their initial business background is in telecommunication sector, just like De Lesseps had no expertise in construction either, when he attempted Panama Canal (Kasuga and Tamura 2014). Based on what methods and approaches that HKND would use to tackle the governance issue in the Nicaragua Canal more or less, possibly could stir the investor's confidence.
- *Technological* The issue of cost estimation of the canal is still questionable where now it fixed at the level of $50 billion compared with the previous calculation at $18 million, then $26 billion, followed by $30 billion and $35 billion, till the recent price at $40 billion (Rogers 2013). Furthermore, the construction time for it is only 5 years with longer route than Panama which is at 178 miles to 48 miles. Even though the 'ground breaking' ceremony was back in December 2014, the key feasibility studies have been postponed to April and excavation work is not scheduled to begin until the second half of 2015. Yet despite the delays, HKND is insisting its five-year completion schedule. The chief project adviser of HKND insists that the construction will be managed by cut-and-suck technology, while the later stages can be completed with the world's biggest dredgers, which have powerful cutting heads.
- *Democratic* The entire inauguration process from Nicaragua government to the Chinese remains questionable due to its undemocratic method by having less than 48 h of public debate and speculators criticise this action from the Nicaragua's president Daniel Ortega 'too rush' to close the deal (Rogers 2013). Also, the details of the contract were not publicly declared to the citizens, till now, the contract's content still remains doubt and secretive. Also, HKND won the deal under no bidding from other competitors as this was not an open tender project. Therefore, critics slammed the president's rusty action of not verifying the transparency issue in it and could possibly see that corruption maybe part of the deal. Meanwhile, the officials claim that Nicaragua will remain as the majority stakeholder with 51 percent ownership over the canal, but as for the Chinese's term it is mostly unclear. Furthermore, China and Nicaragua do not have diplomatic relations, which adds a level of complexity to the project.
- *Externality* The larger size of the project, the higher the chance of externalizing the cost. By looking at the current size of canal that is worth $50 billion, from the concession of operation, HKND Group would have to pay Nicaragua $10 million a year for the first decade of operation, then increasing percentages of the profit in the subsequent years. But so far, only $200 million had been identified as solid source of the project investment, and the rest of the total funding would probably be risen from the public through initial public offer (IPO), targeting the investor cash flow into the canal business. In short, HKND does not have the financial ties to construct the canal (Sweet 2015). The ecologists and conservationists had warned the canal will disrupt the lake ecosystem with pollution, traffic, noise, salinity, and oxygen depletion. By the cut-and-suck technology that is mentioned above, the chief project adviser claimed that, "We are absolutely determined

not to blast Lake Nicaragua, we don't believe we will impact the environment of Lake Nicaragua." Despite the optimism from HKND and criticism from the local people, the execution of the project would still be carried on (Watts 2015).

– *Risk assessment* This was done by hiring the environmental expertise—Environmental Resource Management, a London-based company to assess the environmental risks and impacts from this construction. Even though they claimed that the damages could be minimal, the major concern from the indigenous people is that they could be losing their land, and even a greater concern lies on Lake Nicaragua, since the canal is going to cut through several natural reserves and protected areas (Fig. 5).

Is Kra Isthmus Canal the Remedy?

As China is developing in fast pace and as described in the previous session, seeking for new and alternate trading route to secure the country's strategic commodities such as petroleum and gas would become China authorities' main priority in the coming decade. Over reliance on the current pipeline strategic partners such as Kazakhstan, Russia, Burma, and Pakistan also poses risks to China if there is any other event of dispute. Also, extreme reliance on Malacca Strait is seen as a potential threat after the current situation analysis based on the fact of over-crowded traffic, piracy, and environmental issue. China would probably face difficulties in the future if there is no new shipping route to secure strategic commodities and to avoid the potential risks from happening as mentioned in the previous discussions mainly from the overland pipeline issue that involved several of controversial countries.

History of The Kra Canal

The historical background of the canal can be traced back to seventeenth century when the idea of building the canal was initiated from the Kingdom of Siam. Back in seventeenth century, the objective of this megaconstruction was to open up their country for traders particularly from Europe, thus enabling Siam to become one of the biggest trading centers of SEA. The first proposal from the canal was made by M. De La Mar, a French engineer whose part of the investigation and task was to find a new sea-trading route between the Gulf of Thailand and the Andaman Sea (Rouillard and Saito 2013). Eventually, the project suddenly came to a halt, when Siam severed its relationship with France in 1688, expelling all French from its capital, Ayutthaya.

According to Sulong (2012), Thailand's authorities once again restored the megaproject during the late 1990s in the hopes of reviving the country's economy after the massive recession during the 1997–1998 Asian financial crisis. A feasibility study of the Kra Canal, conducted in 1999 by Japan's Global Infrastructure Fund (GIF) estimated that the development of this 50-km-long waterway across Thailand's Kra Isthmus would approximately cost at least 20 billion USD (Billington 2011; Thongsin 2002; Chong 2003). During the year of 2001–2006 Thai Prime Minister Thaksin Shinawatra reconsidered the canals with the approval from the senate. The attempts failed once again due to internal political conflicts in which the Thaksin's government was overthrown through a military coup (Sulong 2012). After the long suspension of the project, now, once again the Kra Canal assignment is back on the negotiation table. This is because of the tremendous victory of Pheu Thai Party in July 2011 election, and Yingluck Shinawatra was selected as Thailand's new prime minister. At the same time, the party had renewed its commitment to once again re-evaluate various development constructions

Fig. 5 The Panama Canal and Nicaragua Canal. *Source* Carrie (2014)

such as the Kra Canal, which is targeted to contribute to their country's growth.

Will China Cruise Pass the Kra Canal Construction?

Based on the assessment from the Panama and Nicaragua canal, we came to know that there are similarities between the China approaches on Nicaragua and De Lesseps methodology on Panama from the Sovacool's model especially from the factors of democratic and risk assessment. Now, from the lesson and perspective that we have come across in the two cases, we knew that the examination through the model has given us huge knowledge from the five hypotheses. So, in order for us to estimate and investigate Kra Canal in this case, once again, we will adopt the Sovacool's theory under this situation where the canal is still under feasibility study.

- *Social* Till date, there is a lack in international investors backing this project and it is seen as one of the main reason why the canal dream never realized. As for today, there is still unclear message to the public who will participate into this construction. There is a reported news saying that there are three Chinese companies will take part in this project: Sany Heavy Industry Co Ltd, LiuGong Group Co Ltd, and Xuzhou Construction Machinery Group Co Ltd. But, however, these companies denied that they are not having any cooperation deals with Thailand in building this canal (Wang 2014). So far, the potential shareholders are still the Japanese GIF which is backed by several Japanese ministries and companies, meanwhile, Thai government issues bonds that are worth 489 billion baht and granted a 30 billion baht loan to the Canal Development Authority. The World Bank and Asian Development Bank would likely provide a further 244 billion baht as long-term loans and 197 billion baht would be raised from the private sector from developers of a planned canal-side free-trade zone (Porter 1999).
- *Technological* One of the reasons may be from the aspect of engineering difficulties to cut through the Isthmus, also it involves large amount of construction fee estimated at $20–25 billion. For the methods proposed by the American scientists toward the building process, it may include the nuclear explosives which are proven to be the most efficient way to ease the construction process and save the costs by approximately 40 %. But, however, this is a controversial approach toward the environment even though it can save time and cost to avoid cost overrun and delays. According to Thai Science Minister Arthit Urairat, the canals could possibly start within the next 3 years, and then take 6 years to complete. Also, the total distance that needs to be cut through from Isthmus is only about 27 miles while the length of Panama Canal is 48 miles, perhaps by stating this reason the canal building will be on schedule. It would remain questionable given Thailand's capability in completing big infrastructure project as they have terrible track records before (Kinder 2007).
- *Democratic*: From the previous diplomatic agreement back on 1st Jan 1946, United Kingdom, Thailand, and India had agreed that Thailand government would not build the Kra Canal as Singapore was still a British colony during that time, but however the deal was canceled in 1954. Now, China has reopened the discussion by offering Thailand with a plan of providing 30,000 Chinese workers, including Chinese port facilities, refineries, warehouses, and other infrastructure. However, Thailand in this situation is still non-committal because of certain contradict terms that will still need to be re-negotiated due to basic Thai's principles clashes such as no foreign funds and labor, full control over the canal, etc(Kinder 2007). The approach toward the separatists is also one of the political issues China or Thailand should consider; this is to reduce the possibility of sabotage activities around Canal Zone. To be more specific, Thailand's politics is currently undergoing an unstable period and it is single-party democracy; it also involves countries more prone to corruption. Furthermore, the corruption perceptions index in 2014 for Thailand ranked 85 in the world out of 175 countries. This information is certainly worrying the investors and China for its transparency and credibility problems at all time (Transparency International 2015). Next, due to the perceived risks like political instability from the current government in Thailand, especially from the Southern Thailand which consists of multi-racial and multi-cultural nature, plus the unpredictable civil wars triggered by ethnic, religious, and/or tribal differences, these could cause massive issues during its construction. For instance, the risks from separatist violence, ethno-religious conflicts, and terrorism reflected Thailand's weakness on its management and security ability. Activities from terrorists and separatists remains active especially around Bangkok, and in the southern provinces of Yala, Narathiwat, and Pattani.
- *Externality* The cost of ecology point of view will be larger than we can imagine; A study suggested that to shorten the excavation time and process using peaceful nuclear explosion (PNE) will be the best idea , but as far as the environmentalists, concerns would be the unjustified fears of the radiation release that would damage the environment. But, however, the level of

explosion and its safe technology involved into this excavation would pose minimal destruction to the nature especially thermonuclear technology and the estimation of the pollution that is released from the explosion would only be the same as in any traditional explosion methods such as ground shock, air blast, dust cloud, and most importantly not the radiation. So if the PNE program is initiated, the technology can guarantee the radiation issue will pose no problem (Rouillard and Saito 2013).

– *Risk assessment* There are certain issues that need to be highlighted. One of which is the environmental concern about the usage of the nuclear option as a blasting tool for the canal construction and whether this method would harm the nearby reserve. Using PNEs by planting over 20 nuclear devices and each with approximately twice the explosive energy of the bomb dropped on Hiroshima to bomb the canal, this method would probably trigger the local environmentalist movement although it is one of the most efficient and fastest ways to construct the Canal and this idea is initiated by Executive Intelligence Review (EIR)/ Fusion Energy Foundation (FEF). As from the viewpoint of environmentalist, it would be an immoral and unethical way if the discussion of the 'nuclear option' is avoided (Rouillard and Saito 2013). The answer for this question will now still remain unknown. Also, to clear out the people that live nearby the canal will not to be an easy task as it involves social costs which relate to relocation of the residents, depending on the route decided upon. Also, another aspect to investigate is if Thailand accepts China's offer by bringing 30,000 Chinese workers to the site, and can the workers adapt to work under hot tropical climate just like the French who worked in Panama previously.

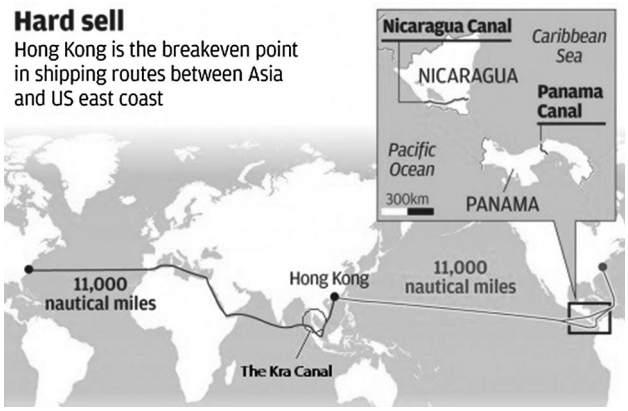

Fig. 6 Eastward bound and westward bound traffics. *Source* Jing and Toh (2015)

As for the summary, the building of the Nicaragua Canal would enable China to establish Hong Kong as the world central breakeven point in terms of the supply chains from the eastern coast of New York. As from the West, the shipping vessels will have to cross through the Suez Canal, and both sea routes would mark exactly at 11,000 nautical miles (20,350 km). In the event, if the Kra Isthmus Canal is successfully constructed, the distance will be reduced to about 10,350 nautical miles (19,140 km). See Fig. 6 for the expected opening of the Kra Isthmus: Eastward bound traffic would save approximately 650 nautical miles (1200 km). Also see Fig. 7 for the entire Kra Isthmus Canal.

Forecast Benefits of Kra Canal to China

After the consideration of congested traffic and its pressure on the environment in the coming decades, researchers are seeking a possible alternative route to reduce the volume of traffic in the Straits of Malacca. This view was also supported by Mitropoulos (2004) who stated that approximately one quarter of the world's commerce and half of the world's oil tankers pass through the Straits of Malacca every year, and the traffic is showing significant growth and it is piling pressure toward the Malacca Strait and Singapore seaport, which will exceed its capacity in the next few decades if the alternative routes setups are not introduced.

As from the shipping route perspective, the Kra Canal will definitely become one of the important lanes for shipping companies as it helps to reduce the journey by up to 1000 km and this saves the companies labor and fuel costs, as well as shortens the lead time (Chong 2003; ASEAN Affairs Magazines 2009). So the construction of the Kra Canal is most likely beneficial to countries that are currently using the Malacca Strait to trade goods, especially China. The trade volume between China and ten ASEAN countries in the past two decades has expanded rapidly, and SEA is a crucial market for Chinese companies where it consists of over 600 million of population (van Efferink 2012). Sulong (2012) also stated that if the Kra Canal is successfully built, China will have a direct and quicker link to all its trading partners across the globe, hence boosting China's economy. Sulong also stated that with the Canal's diplomacy, China will also strengthen the relationship between Thailand, Burma, and Vietnam. Zhang from China Institutes of Contemporary International Relations remains positive on Thailand's Kra Isthmus Canal as it "could…provide a strategic seaway to the Chinese navy.", and Zhang added "Fleets could…more easily protect the nearby sea-lanes and gain access to the Indian Ocean." (Xuegang 2007). The main purpose of the Kra Canal and its benefits toward China would be focusing

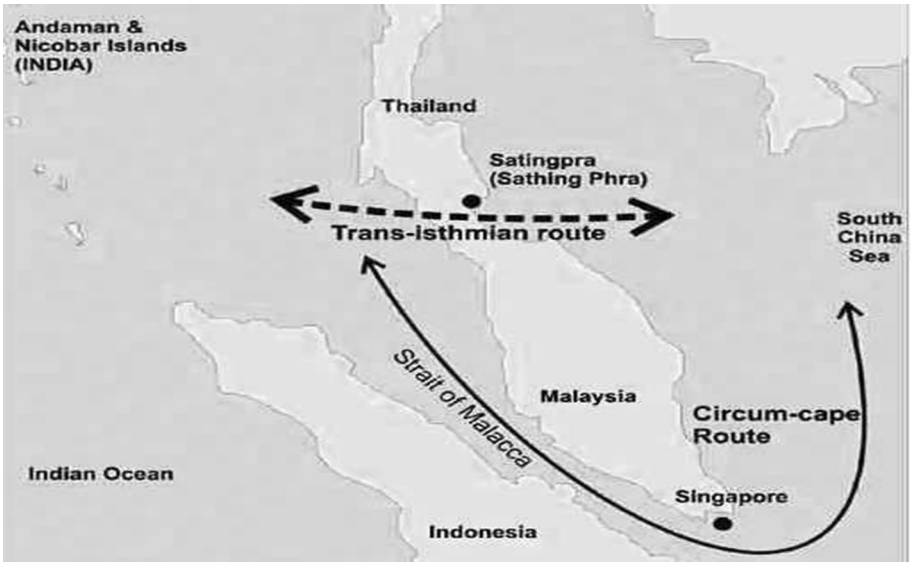

Fig. 7 The Kra Canal proposed route. *Source* Google Images

in the way of protecting their economic interests and enhance China's security especially securing alternative sea route to ensure their oil supplies from blockade issue in Malacca Strait, and this is viewed as a way to reduce the U.S. influence in the territory.

Forecast Benefits of Kra Canal to Thailand and Southeast Asia

Thailand could transform into trading a hub as well as help reducing maritime traffic from the increasingly crowded Malacca Strait. This is also supported by Pakdee Tanapura, the chairman of the Subcommittee on International Affairs of the National Committee on the Kra Canal Project Feasibility Study where in an exclusive interview with ASEAN Affairs, Pakdee stated that "Kra Canal can serve as a crucial stimulus package for the economy of Asia Pacific region as well as for Thailand and ASEAN countries" (Sulong 2012). Kra Canal Countdown (2009) claimed that the development of Kra Canal would benefit the Songkla Port, as well as the local industries' growth and international trading, workplace creation, and infrastructure and real estate development. Sulong (2012) also stated that, international trading in Thailand and the region as a whole will give all the facilities and mechanical supply that an important international deep-sea port should have if the development of Songkla Port takes place. Furthermore, from the study claimed by GIF, the megaproject will also stimulate socio-economic benefits to the communities in the country and in the region. For instance, the projected 10-year construction required nearly 30,000 workforces, (Kra Canal Special 2007). Another study of GIF feasibility reported that "the Kra Canal will benefit from an annual trade turnover estimated at USD280 billion as it straddles a region of 1.2 billion people within a radius of 2400 km" (Chong 2003). Next, Thailand authorities would be able to generate profit from port's related activities such as navigation, toll fees, income tax, export tariffs, and shipyard activities (Kra Canal 2007).

For Thailand, as example, they have had a long and successful strategic economic relationship for over three decades, and the trading volume has shown a significant growth over the years. In the recent year, Sino-Thai bilateral trade in 2011 accounted more than USD 60 billion. China has become Thailand's second largest trading partner, largest export market, and second largest source of imports (Aming 2012).

Besides that, China is not the only one which will benefit from the Kra Canal construction but others like Burma, Cambodia, and Vietnam will benefit too. According to Sisovanna (2012), the project called Southern Economic Corridor (SEC) will transform the coastal regions of above countries including Thailand itself through commercial, industrial, and tourism activities along the eastern Thailand. Burma will definitely act as an opportunist in the case of Kra Canal creation, because Burma and Thailand signed a Memorandum of Understanding in May 2008 pertaining to the international deep-sea port construction in Dawei, also known as the Dawei port whereby with the support from Kra Canal creation that would be linked to an industrial estate in Dawei (Boot 2012; BBC News Asia–Pacific 2011). For Vietnam, this country has great potential over its unique geographical condition that relies heavily on its seaport. It handles over 90 % of their traded goods transferring and transporting through sea activities

(Jensen 2009). The creation of the Kra Canal will allow more shipping vessels get into South China Sea, and this allows Southern Vietnam develop its ports. Jensen also added that there are 23 major ports located in Southern Vietnam which is handling more than 78 million metric tons of goods annually. Laos, the inland country where it could not access and benefit from waterway commerce, could also benefit from the boost of Thailand indirectly because of its high volume of trade with the neighboring countries (Sulong 2012). Sulong also added additional information regarding the Canal's policy; this development has the potential to unite the countries of Mainland SEA both economically and politically. Although there has been many studies to prove that the megaconstruction would benefit China, Thailand, and others SEA country, it could also bring negative impression and impact between Thailand and other ASEAN members; instability of Thailand politics is also a main concern where this could lead to socio-political risk (Sulong 2012).

Forecast Threats of Kra Canal to China

If the Kra Canal has been built, will China's companies fall into huge debt as this megaproject will be funded by China? At the moment, Sulong (2012) stated that China nowadays is highly dependent on the Strait of Malacca and this leaves the shipping vessels to various threats, also, the high traffic congestion rate in the Strait can lead to shipments delays to and from China, and this could cause ships vulnerable to seaborne risks like collision and piracy. If China realized the canal dream, this would heighten the U.S concern about China's plans to strengthen its maritime capabilities. Besides that, energy security and supply chain issue that bother China will externally link with geopolitics problem if the canal dream is realized, just because growing energy demand will increase its supply chain activities, and at the same time, frigates and battle vessels would too have to be increased to protect the shipment. Also, with the geopolitical issue, the US is watchful of China's growing power in the continent. Chong (2003) also added that US has worked closely with India to setup joint military to reduce China's dominance over the Malacca Strait. India, another growing power in the region, is worried when China authorities had supported the Kra Canal construction because it will once again strengthen China's "string of pearls" strategy where the objective is to create and connect a network of strategic ports, services stations, and routes for both military and economic use. The increase in US-India joint military presence in the Indian Ocean is a highly probable threat to China.

Forecast Threats of Kra Canal to Thailand and Southeast Asia

From the previous discussion of the fragile management ability of Thailand, the security aspects would remain a question as to how will Thailand solve the terrorism activities and secure the parameter, and up until today, the answer still remains unclear. Malaysia, on the other hand, is believed to suffer from the development of the Kra Canal, and no doubt, it will swing maritime activities away from the Strait of Malacca (as well as the Straits of Singapore), thus, it will slash Malaysia's and Singapore's main source of economic growth (Sulong 2012). Over 80 % of Malaysia's trade passes through the Strait, and the ships fully utilize the major port like Port Klang and Port Tanjung Pelepas (Kusunagi et al. 2008; World Oil Chokepoints 2012; Storey 2006). However, the consideration of Trans-Peninsula Pipelines Project (TPP) in Malaysia will be resumed if Kra Canal's suffered from construction or geopolitical difficulties. The project was first proposed in 1994 and it had been halted for about 10 years. The 310-km pipeline will transport oil from the coastal city of Yan in Kedah state to Bachok in Kelantan state and out to the South China Sea. The New Straits Times reported during the Fifth World Chinese Economic Forum held in Kuala Lumpur in October 2013 that China had shown interest to restore the privately funded TPP at an estimated cost of over USD7 billion and Chinese President Xi Jinping is yet to confirm how this is to be carried out (Hazmi et al. 2014). Unfortunately, the project came to a halt in 2010 due to some difficulties. The question being asked by the Malaysian government now is, is China still interested in turning the pipeline dream into reality. If the TPP is successfully executed and fully functioned on time, it could save up three days of transit time, and it is expected to decrease the shipping cost of crude by USD 1.50 per barrels as well provide safer waterway compared to Malacca Strait and the shipping traffic of the Malacca Strait will be reduced by at least 25 % (Hazmi et al. 2014). The Malaysian government would still have to see TPP as an alternative and backup business plan if Kra Canal in the future is diluted or it weakens the profit margin of major ports. But as for China, the Kra Canal and TPP would definitely even strengthen the crude oil supply further. Figure 8 indicates the proposed plan for Trans-Peninsula Pipeline Project (TPP).

The impact on Singapore could be even larger and this is because according to Energy Factsheet (2011), Singapore is currently the region's premier hub for oil and gas and this sector contributed nearly 5 % of Singapore's GDP in 2007. As the Asia's top three leading trading hub, the country acts as the world's third largest oil and oil products trading hub just behind New York and London, and the

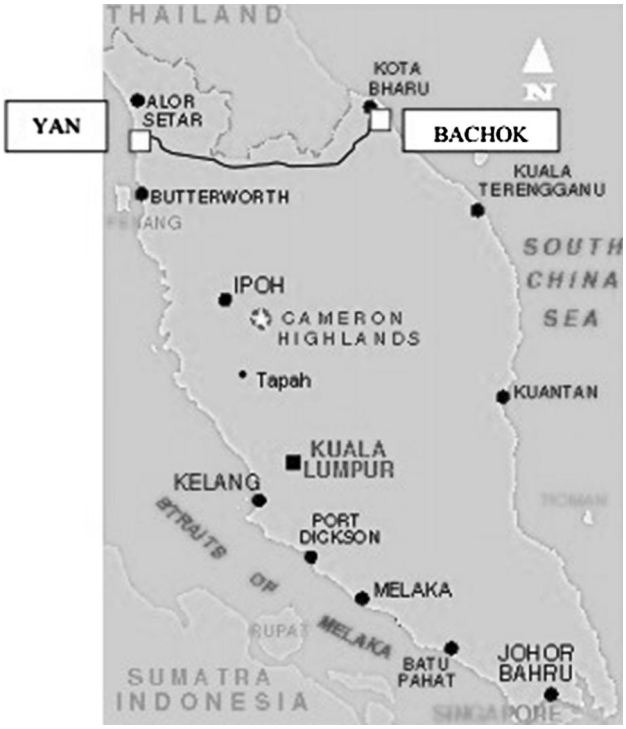

Fig. 8 Proposed TPP project. *Source* Nazery Khalid (n.d.)

physical oil trade alone was USD375 billion in 2007. From the historical background of Singapore, back in seventeenth century, Great Britain back in those day protected the then Singapore colony and of course it is of strategic importance for shipping and security. This new sea route across Thailand and its avoidance of the Malacca Straits is bound to give suitable conditions to develop port hubs in Thailand with China and Malaysia as hinterlands; while Malaysia is also bound to compete vigorously to retain the two trading ports of Klang and Pelepas. Yet, the Kra Canal will place the Hambantota Port (Sri Lanka) directly on the Asia trading route. The current cargo transshipment from the far east is transiting largely through Singapore. If the Kra Canal is successfully built in the future, Thailand, Malaysia, and Sri Lanka are most likely to replace Singapore under the new trading hub competition (Syosa 2008). Thailand will definitely be one of the strongest maritime and trading competitors for Singapore and no doubt Thailand has the potential to transform due to its labor supply and strategic location of the Kra Canal.

China's Environmental Management Strategies on MegaEnergy Projects

Environmental destruction for the future development of Kra Canal seems inevitable if the construction is carried out. If China can accommodate the above issues based on the Sovacool model, it could minimize the damages. However, there are examples from the past that China had adjusted effectively their environmental management strategies in megaenergy project constructions such as Three Gorges Dam (TGD), even though they had challenges in the beginning but then the strategies had adapted well after a few years of the construction. In this case, we are examining the environmental management strategies and policies implemented by China at international and domestic levels, namely, the Nicaragua Canal and TGD, which could possibly be valuable benchmarks for the Kra Canal construction.

What are the China's Strategies on Environmental Management Strategies in Nicaragua Canal?

Rehabilitation/Landform Management

The HKND are currently working with several universities of studies in developing protocols and the procedures for rehabilitating land for agricultural reuse. There are several ways HKND would attempt to do which are (1) creating usable agricultural and pasture land after restoration, (2) ensuring long-term stability of the constructed surfaces, and (3) effectively manage rainfall, catchment, and overland water flows. For example, HKND plans to strip topsoil and grade the excavated material placement area (EMPA) for slopes suitable for agricultural use, then with the replacement of the topsoil with adequate depth as this is to create productive farmland (HKND Group 2014).

Slope Protection and Water Management

By protecting the environment of the Canal Zone, HKND will adopt a few common protection methods which include planting suitable vegetation; soil nails; rock bolts meshing; rock sheeting; and so on. Also to mention that the water management facilities main purpose is to supply storage behind the material placement facilities and to use as water divider around the excavation through a series of drainage channels and tunnels into other catchments or return into the canal at particular locations but it is not seen as long-term dam storage, hence, an additional reservoir will be built at the Rio Agua Zarca. To prevent erosion of these watercourses, drop structure will be used in this construction as watercourses cannot be diverted.

Land Expropriation and Resettlement

The HKND and the Nicaragua government will establish temporary and permanent land expropriation boundaries, they will also negotiate and discuss with the land owners for the temporary expropriation needed for canal

construction, which might be needed for short-term resident relocation. The company would return these lands to the owner after they complete the construction in similar or better condition than received, or to provide them with compensation for damages. As for the permanent land expropriation negotiation with the land owners needed for the canal operations and currently HKND and the government intend to bring in the Resettlement Action Plan (RAP).

Job Opportunities and Transportation Arrangement

The estimation of the direct employment during this operation would increase from about 3700 employees in 2020 to around 12,700 employees in 2050 as the number of transits will increase from time to time and it is required all the employees will be based in Nicaragua. Furthermore, there is free ferry service on regular basis across the canal at Acoyapa–San Carlos Road for vehicles, bikes, and pedestrians and also this ferry service will be provided indefinitely until new access across the canal was provided such as bridge (HKND Group 2014).

Other Environmental Management Control and Strategies

In other forms of environmental control, avoidance of nighttime blasting near residential area and underwater blasting in Lake Nicaragua, has remained in HKND operation plan so far; to reduce the pollution issue, the company will also use low sulfur diesel fuel (500 parts per million) for all land-based construction equipment and worker camp power generation. Besides that, the company will halt the excavation activities during severe weather and also provide dust suppression in the disturbed areas. Next, the company would enforce all ships that transit through the canal to company with the International Convention for the Prevention of Pollution from Ships (International Convention for the Prevention of Pollution from Ships [MARPOL] 73/78). As for the humanity ground, the company will provide emergency transport to hospitals in this remote area for any communities whose access is temporarily interrupted during construction. Meanwhile, the company will allow pedestrians to cross the canal at Camilo Lock and so build a bridge at Pan-American Highway as transiting point (HKND Group 2014).

The China's Environmental Management Strategies on Three Gorges Dam (TGD)

Water Management

One of the project's objectives is to tackle the flood issue that lies on Yangtze Rivers for years; by creating the reservoir, it can store the flood water at about 145 m high when the dam release water downstream. Besides that, the objective is also focusing into storing more clean and clear water and release the muddy water.

Land Expropriation and Resettlement

For relocation approximately 1.2 million citizens will be moved out from the Yangtze River zone, also to mention, the construction will inundate 17,160 ha of farmland, about 4000 ha of riverside land will be flooded, from the estimation in 1949. China initially will compensate these people with one lump sum payment for their properties lose, and due to inadequate working conditions and opportunities, the citizens will call up the government for help once their payment was exhausted. To solve this issue, this one-time payment compensation policy has been replaced with the policy of 'population relocation for development', which is, this policy tends to raise the living standard of the relocated citizens by providing them better employment and living conditions after the move. To further ease the pressure on the land, the relocation policy was official amended , promising free land and financial help for people who allocated to other provinces (Yardley 2007).

Marine Ecosystem Restoration and Preservation

The TGD Corporation is running the artificial breeding technology on certain endangered species such as Acipenser Sinensis. The technology has been proven successful and more than 100,000 of the baby fishes are released into the river every year. The artificial breeding technology is also used in helping growing a number of Chinese paddle fish and long nose surker (Gao 2007).

Cultural Heritage and Relics Protection

The Three Gorges Region is rich with relic wealth and archeologists have already identified more than thousand important relic sites so far. As for the construction going on in the past, there are more than 1000 experts from 110 institutions gathered to speed up the excavation and collection tasks from the sites. But however, some historical sites will be drowning under the reservoirs and it relies on the future advanced technology, such as underwater archeological technique, which would certainly help to retrieve those relics. For protection example, Stone Treasure Fortress in Zhongxian County is being surrounded by high wall to be protected from the river's water released out. Another example will be Zhang Fei temple in Yunyang County, which are being disassembled, moved, and then reconstructed. Next, some of the region's ancient and

historical villages have been relocated and rebuilt (Gao 2007; William and Freeman 2001).

Transformation of Tourism and Others Environmental Management Control Strategies

When the project is completed , the outcome is to influence the landform as some of the natural beauty will be preserved and it will also interest the tourists to differentiate and compare the modified landforms with those recorded in historical poems, prose, photographs, and books. For example, some tourists landmarks will be created by the artificial lake as the dam itself can become an interesting place for tourists, hence, according to this point, even though landscape is changing as compared to previous years, the tourism industry in this case will not be affected. Deforestation and soil erosion along the Three Gorges region in upper reaches of the Yangtze had been a disaster for long time; to solve this issue, Beijing official had issued a national ban on timber cutting and began reforesting millions of acres along the Yangtze including the Three Gorges region (Gao 2007; Yardley 2007).

Discussion and Future Research

The pipeline's political issue has haunted China for over a decade, where China's authorities see that the current crude supply may not satisfy the strong internal market. The construction of the pipelines also faces various kinds of doubts and uncertainties which is part of the unpredictable scenario. The act of the pipelines incidents had urged China to seek for a brand new supplies route particularly for the crucial and strategic commodities sourcing activities. Furthermore, discussions regarding the importance of the Malacca Straits at the moment will be seen as 'unavoidable' quests for most of the shipping companies especially for China. No doubt, China will maximize the shipping up to 40 % whereby this figure represents the strong evidence toward the reliance of seaborne transportation. From the analysis of the current situation located in Malacca Straits, problems between the environmental issue such as pollution, over-crowded sea traffics, and coastline security issue like piracy and shipping accidents would still remain as major concerns for China. Also, the competitiveness between powerful countries like the United States, India, and Japan in using Malacca Straits would pose national security issue for China if a crisis in the Straits causes a disruption to the flow of energy resources into the country (Storey 2006; Zhang 2008). Also to mention, from the above scenario, China soon realizes the needs and importance of Kra Canal toward its country's benefits and contribution. This is because once if there is any sea route disputes or blockade from the East, Kra Canal will soon be seen as one of the necessary routes to secure the supply chain route; it is worth if both supply chain route would work together to complete China's supply chain needs. This is made possible only if Thailand had successfully resolved the separatist movement in southern provinces of Patani and Narathiwat. With the development of the Kra Canal, the direct beneficiary would be Thailand, and from the economics perspectives this would include an estimated USD280 billion projected annual revenue, toll fees, and tariffs. The separatist's bombing incidents at Southern Thailand carried unpredictable costs on Thailand. Not only that, the environmental impacts such as using PNEs method for the excavation, although it was proven that by using 'nuclear option' would be the fastest way for the construction, the questions looms as to whether this methodology was proven safe enough to protect the environment and the living condition of the local people who lives nearby the Isthmus region. Until today, there are studies lacking regarding the safety level of 'nuclear option' usage toward this proposed Kra Canal construction. Furthermore, there are several major questions that will be raised during the progression of Kra's event as future topic discussions.

Fragility and transparency of the government are questionable in this case; the question now is can Thailand, by now, take care of such a huge project which involved a number of uncertainties? Uncertainties that included relationship between ASEAN members especially Malaysia, Singapore, Thailand, and China that would definitely be damaged in the sense of economy and diplomacy; the benefits provided by the Kra Canal—its better seaborne security, water traffics, and shorter route compared to current Malacca Strait. If Kra Canal has been built, it will provide greater incentives for China to further utilize the canal passageway rather than the usage of controversial pipeline and Malacca Strait. But, the second question regarding the authority/permission to use it, and how it can be used are also part of the topic discussions for China in the future since the Kra Canal had encroached into Thailand's land and territories although China is financing the construction. Will Thailand charge China a premium price package of tolls and tariff equivalent to the cost of using Malacca Strait to maximize their own revenue since they had realized China is in dire need to secure strategic commodities in an urgent manner if the Kra Canal has been built? And, what if this scenario were to happen, the outcome would most likely go back to square one and what can China do about it to prevent this from happening? The third major question that lies on Kra Canal development is: will this project once again remain stagnant due to its uniqueness of historical background and strategic landmark which could possibly cause another wave of geopolitical

issue? The fourth question will be on China's security parameters on its defense system mechanism, which they see the Kra Canal will become one of the landmarks in order to protect 'String of Pearls' strategy across the Arabian Gulf, Indian Ocean, and South China Sea after capturing the Port of Gwadar, Pakistan, and soon Port of Hambantota, Sri Lanka, after the Chinese had invested approximately USD6 billion on building a power plant, an arts center and a special economic zone, and most importantly, the China's Export–Import Bank is financing roughly 85 % of the cost of this USD1 billion port's project (Bajaj 2010). Is the Kra Canal in this position to enhance or weaken the collaboration between the South Asia relationships especially India? As one of the trading partners for China, Malaysia in this case, survives through exporting goods to China such as electronics devices, agricultural products, and natural resources (oil and gas). Port Klang remained one of the main income sources for the country and competitor for Singapore seaport. Will the China authorities in this case lose its diplomatic charisma when they are likely to switch the trading route since they are funding for Kra project? Will the ASEAN relationship between its members once again be weakened by the Kra Canal's creation especially within Thailand, Malaysia, and Singapore due to the possibility of reduced export income?

The viewpoints and questions that the authors highlighted in this topic, together with the current pipeline policy of China should be seen as potential problems in the coming timeline, and based on the views and evidences toward this article, China will have to keep the strategic commodities sourcing quests active, and building an alternative route (Kra Canal) seems inevitable in the coming decade. Our view points toward this debate, from the economic perspective, are that China and Thailand will become the direct beneficiary after the Kra Canal has been built.

Conclusion

The Kra Isthmus Canal was discussed within the context of the five dimensions of energy megaproject success as postulated by Sovacool and Cooper (2013) and China's strategic energy supply chain. From the social dimension, the Kra Isthmus project is lacking in international consensus. The project in relation to technological dimension may involve large construction costs of about USD 20–25 billion of using conventional technology. But with the application of nuclear demolition, the cost could be reduced by about 40 %. With Thailand's dismal record of completion of megaprojects, the Kra Isthmus may be subject to cost overrun. The Kra Isthmus success discussed from the perspective of the democratic dimension has not revealed clear indication of any concrete agreement between China and Thailand. In addition, the discussion from the externalities dimension seems to suggest that the vocal environmentalists are concerned with the ecological and environmental implications of the PNE methods. Lastly, from the perspective of risk assessment dimension, the Kra Isthmus megaproject is expected to affect the communities within the region in terms of dislocation, relocation, and resettlement which have high social and compensation costs to both Thailand and China. Hence, until and unless the Kra Isthmus project can address these issues associated with the five dimensions of megaproject success, the authors are of the view that with the current developments in the 5-year Nicaragua Canal project and in the light of the issues discussed above in relation to Sovacool and Cooper's five dimensions, the Kra Isthmus project may be kept on hold for at least another decade.

The dependence of China on the transnational pipelines had presented security and economic issues to China because of geopolitical instability and threats in many of the countries which the pipelines cross. Since China's seaborne crude oil imports form about 40 % of the total crude oil imports, it makes strategic sense to create, maintain, and secure stable energy supply sea routes. The construction of the Nicaragua Canal which is in progress could be a strategic move by China in ensuring a more stable and secure energy supply chain by making Hong Kong a world central breakeven point whereby there is equidistance in the westward and the eastward routes of the supply chain to China. With the Kra Canal construction, the eastward route will be shortened by almost 1200 km hence ensuring an even faster route. Besides these, the Kra Canal could also enhance the "string of pearls" naval strategy of China which could expect heightened tension between the USA and China.

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