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# Heading in the direction of bifurcated networks: Hong Kong's evolution amidst the global submarine cable system

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## Abstract

The full understanding of the importance of submarine cables as part of the global network infrastructure in the digital economy era, along with decades of knowledge accumulation in this field, has not prevented Hong Kong from facing increasing difficulties in gaining more access to submarine cable systems since 2017. Given that geopolitical differences between China and the U.S. are dividing the international network infrastructure, the business interests of Hong Kong enterprises and the urban development prospects of the Hong Kong government have been forced to defer to Beijing's security concerns. Meanwhile, in recent years China has been acquiring data power by modelling the "data collection – data sharing – data space governance" path that the United States and its allies set previously. During this process, the power shaped by China's unique technological, social and institutional characteristics offers an alternative to American dominance, although it exacerbates the global divergence of internet infrastructure. Many projects along the Belt and Road Initiative and the Digital Silk Road are the examples of China's data power projection, and will bring opportunities for Hong Kong's own submarine cables sector and for the city's role as a super connector in the coming years.

**Keywords:** Digital economy, Internet infrastructure, Submarine cables, National security, Data power, Hong Kong

## Introduction

In the digital economic era, the significance of the international submarine cable network is self-evident, as it handles approximately 97–99% of all data transmissions. Hong Kong, which serves as an international financial centre, an Asia–Pacific shipping hub, a crucial gateway for China's global interactions, and an aspiring regional data hub, needs to maximize its access to international submarine cable systems and actively participate in their construction and operation. For a considerable period in the past, Hong Kong's performance in this regard was satisfactory, and it acted as a regional data centre comparable to Singapore. However, the business of landing international submarine cables in Hong Kong has stagnated since 2017, and Beijing's opaque licensing system has blocked enterprises involving non-Chinese vendors from participating in laying cable systems

that pass through the South China Sea. The consequent difficulty in conducting business has prompted Hong Kong's communication service providers and their suppliers to repeatedly urge the Hong Kong government to coordinate with Beijing to alleviate the situation, but their hopes will almost certainly be dashed when Beijing insists that only trusted Chinese companies laying undersea cables can maintain its intelligence advantage over the United States in the South China Sea. Although scholarly opinion on its value remains divided, the Thucydides Trap – as a variant on the security dilemma theory – shows the competition between China and the United States spreading throughout the international undersea cable domain. Meanwhile, Hong Kong, like the small city-states that were forced to take sides in the Peloponnesian War, finds itself powerless in the face of competition between greater powers. However, the current situation indicates that if the necessary adjustments can be made, there are opportunities for new business and improved development.

### **Hong Kong's submarine cable industry faces tough times**

Submarine cable construction is vital to the digital economy, so the importance of access to more submarine cables for Hong Kong's economic development is obvious. However, many operators in Hong Kong's submarine cable sector have discovered that even on their home turf they are facing hindrances to their businesses, which are at least temporarily impeded by what appears to be an invisible barrier.

### **Growing demand of submarine cables**

Submarine cables are a crucial part of the internet communication infrastructure, and global demand for them continues to grow. According to the Global Undersea Optical Cable Industry Development Research Report (2023) (《全球海底光缆产业发展研究报告(2023年)》) released by the China Academy of Information and Communications Technology (CAICT, 中国信通院), over 97% of global internet traffic relies on submarine cables, and this reaches 99% according to *The Economist* (2024). By the end of 2022, a total of 469 submarine cables had been deployed globally, with a combined length of over 1.39 million kilometres (CAICT 2023).

Meanwhile, the global digital economy is thriving, and the number of high-traffic users is continuously increasing. The ongoing digital transformation of many industries is leading to a growing demand for data centres, and data traffic shows an exponential growth trend. Based on estimates from TeleGeography (2022), the global demand for international internet bandwidth has doubled between 2019 and 2022, reaching over 3,800 Tbps, and the Synergy Research Group predicts that over the next five years, the total capacity of all operational hyperscale data centres will almost triple (Reno 2023). Looking at development rates in recent years, the total length of submarine cables planned globally will reach approximately 440,000 kms during the five-year period from 2020 to 2025, an increase of almost one-third of the total length of existing global submarine cables. With the continued widespread adoption of cloud computing, artificial intelligence, and 5G networks, as well as the digital and intelligent transformation of traditional industries such as the oil and gas sector and marine exploration, the global demand for submarine cables will continue to grow from 2023 to 2028 (*The Economist* 2023).

### Hong Kong as a crucial node

The Asia–Pacific region is a key focal point in the global landscape of the internet, and approximately half of the world’s internet traffic now originates from the Asia–Pacific region. According to statistics from TeleGeography (2022), there are five major densely populated areas that act as landing stations of global submarine cables. These areas include the Eastern United States, Europe, the Arabian Sea region, Southeast Asia and the China–Japan–Korea region. Among these, submarine cable laying in European and Southeast Asian regions primarily takes place in inland waters, while the other three regions are most strongly associated with submarine cable access in the oceans.

According to the international submarine cable map, Hong Kong holds strategic importance in the Asia–Pacific region. Situated at the centre of the region and endowed with inherent geographic advantages, Hong Kong has long been one of Asia’s primary submarine cable hubs. It connects to 13 international submarine cable systems, and SUNeVision’s MEGA-i data centre in Hong Kong is the most carrier-dense colocation site in the world (TeleGeography 2022,21). The city possesses a comprehensive telecommunications infrastructure, and its external telecommunication facilities function at an international level. As well as serving as a crucial data hub in the Asia–Pacific region, Hong Kong acts as a vital gateway connecting mainland China to international submarine cable systems. Currently, over 50% of international data enters mainland China through Hong Kong (Yuan 2024).

Hong Kong’s significance as a node also lies in providing additional redundancy to the global submarine cable network. For instance, in December 2006, an earthquake in Taiwan damaged several submarine cables, impacting telecommunications services across the entire region. Given that submarine cable failures can result in interruptions to international communication, it is essential to increase the number of cables along different routes at critical nodes like Hong Kong. This helps enhance network redundancy, which is considered vital (HK Legco 2010,2).

### Strong competitiveness in Hong Kong

Hong Kong has become a crucial node in the global submarine cable network not only due to its geographical suitability as a landing point but also because of the competitiveness of its communications industry. Hong Kong possesses a well-established telecommunication infrastructure, a stable energy supply, and regulatory frameworks that are both standardized and pragmatic (OGCIO 2021).

Hong Kong’s mature and advanced telecommunications infrastructure offers a wide range of services that are both innovative and cost-effective. According to the Office of the Communications Authority (香港通讯事务管理局办公室, OFCA), the territory’s telecommunications network was connected to 12 international submarine cable systems as of March 2022 (OFCA 2023).<sup>1</sup> In addition to these, the Asia Direct Cable (ADC) landed in Hong Kong in January 2023 (PR Newswire 2023). Despite the fact that many other submarine cable systems are in the process of being established, by the end of 2023

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<sup>1</sup> The 12 cables are Asia Africa Europe-1 (AAE-1), Asia–America Gateway Cable System (AAG), Asia Pacific Cable Network 2 (APCN-2), Asia Pacific Gateway (APG), Asia Submarine-Cable Express (ASE), EAC–C2C, FLAG Europe Asia (FEA), FLAG North Asia Loop (FNAL) / REACH North Asia Loop (RNAL), Hainan to Hong Kong Express (H2HE), Sea–Me–We 3 (SMW3), South–East Asia Japan Cable System (SJC) and TGN–Intra Asia Cable System (TGN-IA).

Hong Kong had a total of 13 international submarine cables connected through eight cable landing stations across the territory. These landing stations are managed by six major telecommunications firms in Hong Kong, including China Mobile, FLAG Telecom Asia, and GB21 (Hong Kong). Any international submarine cable company wishing to connect to any of these landing stations must first submit application to the OFCA for approval. Additionally, with approximately 300 licensed providers offering broadband internet services, Hong Kong maintains a competitive market and provides multiple options for data centre operators (OFCA 2023).

The power supply in Hong Kong is reliable and stable, and there are two electricity supply companies in Hong Kong, China Light and Power Company (CLP Power Hong Kong Ltd., 中华电力有限公司) and the Hongkong Electric Company (港电灯有限公司). Although the two companies operate independently, their transmission networks are interconnected, and they can support each other in case of emergencies (ibid). The companies rely on diverse fuel sources for electricity generation to ensure additional power generation capacity and maintain a stable power supply. In recent years, the region's two power companies have achieved a reliability level of over 99.997% in power supply (ibid).

In addition to its geographical conditions and infrastructure, Hong Kong also excels in software provision. The Hong Kong government does not intervene in the operation of data centres, nor does it censor content, and no laws exist in Hong Kong that would allow such intervention or censorship. Since the implementation of the Personal Data (Privacy) Ordinance (《个人资料(私隐)条例》) in 1996, Hong Kong has processed legal protection in the collection, use, and transfer of personal data. Furthermore, Hong Kong's information and communication technology (ICT) professionals and its business environment also have significant advantages. Hong Kong boasts a large pool of highly mobile, adaptable, and technically proficient ICT professionals who are fluent in many languages, allowing large-scale telecommunications operations and data centre operations to be carried out. Hong Kong's advantages in terms of expert personnel ultimately stems from its immigration policies, straightforward taxation system, and low tax rates attract professionals from all over the world to work in the region.

### **Invisible barriers**

As the overall level of demand in the global submarine cable industry continues to increase, the significance of participation in this industry is clear, and Hong Kong's submarine cable sector is competitive in this regard. However, only one new submarine cable landing point has been added since 2017. According to experts, the reason for this is that any enterprise – including Hong Kong headquartered telecommunications providers – once they include non-Chinese vendors, are refused permits to lay submarine cables in the South China Sea. The problem is that any new submarine cables that land in Hong Kong must first pass through the South China Sea (Fig. 1).

Apparently, neither the Chinese central government nor the Hong Kong Special Administrative Region (SAR) government has ever issued any explicit instructions stating that non-Chinese enterprises cannot participate in submarine cable projects in the South China Sea. However, in reality, information from various channels confirm that this is the case. The last submarine cable laid in the South China Sea by a non-Chinese vendor was the Asia Direct Cable (ADC), which applied for a South China Sea permit



**Fig. 1** Map of South China Sea Claims. Source: Burdette 2021

in 2019, according to an anonymous knowledgeable source in Hong Kong's submarine cable sector. Since then, no publicly available information indicates that any Hong Kong telecommunications service provider that accepts non-Chinese vendors through Engineering, Procurement, and Construction (EPC) contracts will be granted to approval from the Chinese authorities to lay submarine cables in the South China Sea. This also means that HMN Technologies Co., Limited (HMN Tech, 华海通信), a private mainland China enterprise, established in 2008, and its predecessor is Huawei Marine Network Co. Ltd. (Huawei Marine, 华为海洋), has taken a de facto administrative monopoly over submarine cable laying operations in the South China Sea (HMN Tech 2020).

My anonymous source informed me that most businessmen in Hong Kong are aware of the implications to the government if certain aspects of their business require approval from the mainland authorities. They strive to “inquire” (打听) and “smooth” (疏通) the processes involved with key individuals, but as yet they have failed on the submarine cable issue. According to the source, Alcatel Submarine Networks (ASN), for example, one of the world's leading submarine cable suppliers, officially reported this restriction and sought help from the French Ministry of Foreign

**Table 1** Highest capacity international internet hub cities. Source: TeleGeography, 2022

Affairs in January 2022, prior to a meeting between French President's Diplomatic Advisor Emmanuel Bonne and the Ministry of Foreign Affairs in China. ASN then claimed that they received an unofficial confirmation from the French Ministry of Foreign Affairs after the meeting that “non-Chinese vendors will not be granted any permits”.

However, time waits for no man, and Hong Kong's hesitation is taking place in a golden age for its competitors. It is undeniable that in striving to become a financial, shipping, aviation passenger and data hub in the Asia–Pacific region, Singapore has long been a strong competitor to Hong Kong (Table 1). In recent years, Singapore has gained advantages over Hong Kong in many areas, despite the fact that the two cities have complementary businesses. According to experts in the matter, although Hong Kong now has 13 submarine cables, at least 4 additional cables have not been able to connect to Hong Kong in recent years due to geopolitical factors (Infocast 2023). In an ideal scenario, the number of submarine cables in Hong Kong is expected to increase to 17 over the next three years (ibid). In comparison, Singapore currently has 26 submarine cables (Dobberstein 2023). Meanwhile, according to Singapore's “Digital Connectivity Blueprint,” one of the city's five strategic priorities is to enhance its infrastructure. By 2033, its current 26 submarine cables will be doubled (ibid; IMDA 2023, 13, 42). By then, Hong Kong may be left behind by Singapore and by Indonesia, which had 20 connected submarine cables in 2020 (Dong 2020, 47). The Philippines will also catch up in the next three years, with 17 submarine cables, the same as Hong Kong (Infocast 2023).

### **Reasons for the problem**

From the perspective of Hong Kong-based submarine cable companies that are eager to do business, there is a strong demand, and they certainly possess the capability. However, the difficulties they face in entering the market has caused worries over the Hong Kong SAR government's inaction. Furthermore, submarine cables may not be a topic on which the SAR government can lobby central government. The fundamental issue lies in the mutual distrust between China and the United States on security issues, and the restrictions they have imposed upon on each other adversely affects Hong Kong's submarine cable industry.

### **The SAR government is not neglectful in its efforts**

When it comes to the development of submarine cables and related industries such as data centres and telecommunications services, the Hong Kong government has always been fully aware of the stakes involved and has strived to create a favourable environment by considering foresight and potential activities. As early as 2010, the Legislative Council clearly pointed out in a report that submarine cables play a pivotal role in Hong Kong, contributing to job creation and economic value (HK Legco 2010,3-4). Being connected to submarine cables is crucial for supporting the operations of Hong Kong's key service industries, such as financial transactions, shipping services and offshore trade (HK Legco 2010,1,3). The 2023 Policy Address, focusing on economic development, primarily emphasized the consolidation of Hong Kong's position as a financial, trade and shipping centre to maintain a leading position in tourism, logistics, aviation, and shipping services (HK Gov. 2023). The Hong Kong government has also been consistently hopeful for the development of innovation and technology in recent years (HK Gov. 2022). The authorities are well aware that all of the aforementioned goals require data centres that are supported by submarine cables.

From another perspective, although Hong Kong is already an important node in the international submarine cable network, the lack of new international cable landings to expand its communication capacity has resulted in a slower decline in the cost of bandwidth compared to other regions. According to some experts, this could significantly reduce the attractiveness for international telecommunications or tech investment companies and related talent to invest in Hong Kong, and may even jeopardize Hong Kong's role as a strategic data gateway connecting the world to mainland China (Fang 2023; Wepro180 2023). In recent years, the Hong Kong business community has been continuously issuing warnings to this effect, and the government is not unaware of these concerns.

In terms of responding measures, the Hong Kong government has undertaken at least three valuable initiatives. First and foremost, for those interested in investing in submarine cable laying, landing, and maintenance-related businesses in Hong Kong, clear and explicit guidelines are provided on the Office of the Communication Authority (OFCA) website. Secondly, in the formulation of plans related to submarine cables, there is a focus on leveraging trends. The Hong Kong government plans to use submarine cables as infrastructure to support professional services, data centres, and innovation and technology development. These plans align with regional and national policies and are even

integrated into them. For example, Hong Kong's plans are embedded into the Memorandum of Cooperation on Promoting Cross-Border Data Flow in the Guangdong-Hong Kong-Macao Greater Bay Area (《促进粤港澳大湾区数据跨境流动的合作备忘录》), the Outline Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area (《粤港澳大湾区发展规划纲要》), and the 14th Five-Year Plan (《十四五规划》). Lastly, the government is willing to make flexible arrangements if necessary. Not all companies are willing to work strictly according to the expectations of the Hong Kong government and its businesses. The Chief Executive therefore proposed in the 2009–2010 Policy Address to review the procedures for submarine cable landings in Hong Kong, making it easier and faster for interested parties to deploy new submarine cables, either with or without affiliated data centres in cable landing stations (HK Gov. 2009,17).

### Beijing's security concerns

The Hong Kong government's inability to act is directly attributed to legal restrictions. The Law of the People's Republic of China on the Exclusive Economic Zone and the Continental Shelf (《中华人民共和国专属经济区和大陆架法》) is a national law included in Annex III of the Basic Law and subsequently implemented in Hong Kong. According to article 11 of this Law,<sup>2</sup> the authority to grant permission for laying submarine cables comes under the central government's jurisdiction (MNR 2019). In other words, despite lobbying, the ultimate (and currently insurmountable) step is to convince Beijing. The Ministry, which controls the licensing for submarine cable laying in waters surrounding Hong Kong, theoretically does not oppose the development of submarine cable business in Hong Kong. In Beijing's public rhetoric, the Outline of the 14th Five-Year Plan (《“十四五”规划纲要》) supports the construction of an international innovation and technology centre in Hong Kong. The outline proposes fostering and expanding emerging digital industries such as artificial intelligence, big data, blockchain, cloud computing and cybersecurity in the digital economy era (OGCIO 2022).

However, in practical terms, the situation is becoming increasingly unfavourable for Hong Kong. From Beijing's perspective, submarine cables are not just an economic issue but also a national security concern. In Beijing's view, gaining intelligence advantages through methods such as weaponizing underwater cable facilities is an integral part of its South China Sea strategy. However, this stance inevitably leads to conflicts with Washington's global intelligence systems. The United States and its allies have a long history of conducting espionage activities using communication infrastructure such as submarine cables (Hengtong, 2003, 85-86). As early as the 1970s, the U.S. Navy and the National Security Agency conducted Operation Ivy Bells (Sontag and Drew 2000; Williscroft 2014), spending nearly a decade intercepting intelligence from cables in the Sea of Okhotsk, thereby steadily expanding their strategic advantage in competition with the Soviet Union (Blitz 2017). In the twenty-first century, the focus of U.S. and allied surveillance has shifted towards China. In May 2014, the China Internet News Research Centre pointed out in the Record of U.S. Global Surveillance Actions (《美国全球监听行动记录》) that the United States frequently used submarine cables to eavesdrop on China's

<sup>2</sup> Article 11: "... The routes for laying submarine cables and pipelines must be approved by the competent authorities of the People's Republic of China".

national leaders, government departments, universities, and businesses (Xinhua 2014). In September 2017, the secret mission submarine *Jimmy Carter* returned to its naval base, and the U.S. military remained tight-lipped about its specific tasks. The submarine had reportedly lingered near the Yalu River, leading media to speculate that it had used unmanned submersibles to install monitoring devices on the cable from Sinuiju, North Korea, to Dandong, China (Mizokami 2017).

Prior to 2017, international submarine cables landing in Hong Kong did not face significant difficulties. At that time, the main tone in the field of submarine cables between China and the United States and its allies was one of cooperation and mutual benefit, despite some suspicion and even confrontation in certain areas. Many in China believed that a fundamental change began to emerge with Trump's election in 2016 and the initiation of the U.S.-China trade war in 2018 (Shen 2022; Hengtong, 2003, 83,91,99). During the Trump administration, driven by strategic considerations such as maintaining its global dominance and restricting competitors, the U.S. spared no effort in using its national power to suppress Chinese companies, according to Jiang and Cui (2021,24–25). After Trump, the Biden administration views China as its “most serious competitor” and a “systemic competitor”, emphasizing an extreme long-term strategic competition with China (Zhao 2021). In this context, submarine cables, because of their crucial strategic value, have become a major lever for the United States to exert pressure on China. Hengtong (2003, 83-90) pointed out that the U.S. coordinates and promotes actions on multiple fronts, employing measures such as technological decoupling, submarine surveillance, and the involvement of third-party forces to intensify its strategic competition with China in the submarine cable domain. This has led to a series of strategic moves, many of which directly involve Hong Kong.

The U.S. measures include technological decoupling, using submarine cables as a key leverage, and capitalizing on Hong Kong in its strategic competition with China. Hong Kong has long been the preferred location for American multinational corporations to lay submarine cables, benefiting from its geographical position, well-established infrastructure and rare natural disasters. However, after the enactment of the Hong Kong National Security Law, the United States, citing concerns about national security, claims that the law may lead to electronic surveillance, loss of data privacy and restricted access to information (Brock 2023). The US has prohibited companies from connecting submarine cables to Hong Kong on the pretext of national security in terms of safeguarding data privacy. For example, in MNR, *haidi dianlan guandao pushe shigong (han jungong) shenpi fuwu zhinan 海底电缆管道铺设施工 (含军用) 审批服务指南 (Submarine Cable Pipe Laying Construction (Including Military) 2019*, the U.S. Committee for the Assessment of Foreign Participation in the United States Telecommunications Services Sector (Team Telecom) rigorously reviewed the Pacific Light Cable Network (PLCN) project. Informed sources indicated that within the review team, representatives from the U.S. Department of Justice strongly opposed the project, which in part would directly connect cables to Hong Kong (Qiu 2019). The U.S. Department of Justice believed that this project involved investment from the Chinese company Dr. Peng, and the company's chairman was a former Shenzhen government official, making the PLCN vulnerable to control by the CCP (ibid). In June 2020, Team Telecom urged the Federal Communications Commission (FCC) not to approve the operational

license for the PLCN project, claiming it posed a threat to Hong Kong's freedom and U.S. national security (DOJ 2020). As a result, Google and Facebook withdrew their application for the original PLCN in August 2020, before the FCC could rule on it. Subsequently the two companies made additional efforts but were unsuccessful, and in the end several other cable license applications aimed at connecting with the PLCN were either withdrawn or amended to exclude passage through China, showing that the reviews by the FCC and Team Telecom had achieved the intended results (Chan 2021). By 2020, the US government went as far as to establish the Clean Network initiative, effectively prohibiting the direct connection of any new cables between the United States and mainland China or Hong Kong (Gross et al. 2023a).

Meanwhile, the U.S. Department of Defense – with the Navy at its core and the National Security Agency (NSA) representing intelligence agencies – intensified monitoring of and data interception from China's nearshore submarine cables using submarines such as the *Seawolf*, *Connecticut* and *Jimmy Carter*. According to Edward Snowden's disclosures, the NSA's Upstream Collection Program, through projects like Oakstar, Stormbrew, Blarney and Fairview, intercepted calls, browsing records and sensitive data from at least 200 submarine cables globally (Khazan 2013), with China being a focal point for surveillance (Hengtong, 2003, 86). Reports in 2014 and 2017 indicate that the U.S. conducted cable surveillance on Chinese leaders, government and businesses. Some analysts suggest that the USS *Jimmy Carter* may also have eavesdropped on Chinese submarine cables in the South China Sea (Mizokami 2017), while the stranding of the USS *Connecticut* in the South China Sea sparked speculation about the U.S. military eavesdropping on Chinese submarine cables (LaGrone 2021). Naturally, Beijing considers it reasonable to eliminate unnecessary risks in the South China Sea, including restricting non-Chinese companies from engaging in submarine cable operations. After all, the South China Sea is one of the most crucial areas for China's military strategy: "In this area, every aspect and component of infrastructure must be controllable" (Gross et al. 2023a, b). As far as laying submarine cables to connect to Hong Kong, all cables will need to pass through the South China Sea, so Hong Kong's submarine cable sector finds itself being forced to adhere to this new situation.

The United States has also been handling third parties as an entry point to strengthen strategic competition with China in the field of submarine cables, and now implements a combination of soft and hard measures in the Indo-Pacific region, restricting cooperation between Chinese enterprises and countries along the route (Mori 2019, 101). The U.S. has also constructed the "Fish Hook Undersea Defence Line" to improve underwater monitoring systems in the Pacific and Indian Oceans, preventing Chinese submarines from breaking through the first island chain (Hengtong, 2003, 88-90). Both steps involve Australia, Japan and India, essentially making them part of United States' so-called Indo-Pacific strategy. In response, if China wants to counteract this, it also needs to expand its globally controllable submarine cable system. To achieve this, reliable companies like HMN Tech would be Beijing's first choice.

Admittedly, Chinese scholars' perspective on the submarine cable issue is one angle among many. In recent years, disputes in the submarine cable domain between China and the United States have become an increasingly heated topic, and many analyses from outside mainland China are also worthy of attention (Ganz 2024; Keller 2023;

Zeng 2023; CRS 2022). From the information in these studies, it appears that China's use of submarine cables is not limited to civilian purposes alone, although China strategically rationalizes its operations by citing its exclusion from some submarine cable projects by the United States and its allies (Burdette 2021). In fact, China's trust in Western powers led by the United States has historically been tenuous. Even during times when Sino-U.S. relations seemed amicable in the 2000s and early 2010s, China still took confrontational steps of its own for security reasons, for example by accelerating the construction of an underwater monitoring network in the East and South China Seas since the 2010s to counter the increased presence of U.S. spy submarines near Chinese submarine cables (ETtoday, 2018). As early as 2012, the Chinese Ministry of Science and Technology invested 2.5 billion yuan to build the first South China Sea Underwater Observation Network Experimental System (Wang and Zheng 2013). In 2017, China invested a further 2.1 billion yuan (US\$290 million) to build a national underwater observation network in the South and East China Seas for scientific and national security purposes (Wong 2017). According to some reports, China plans to build two more submarine cable maintenance bases in the East and South China Seas in 2021 (Zhou 2021). It is reasonable to assume that after years of development, the key technologies of China's underwater observation network have significantly matured, so China and its competitors – especially the United States—have their own strategic plans in place regarding the global submarine cable issue. The underwater competition is definitely not one-sided, as both sides are weaponizing the submarine domain (Brock 2023; Keller 2023; Burdette 2021).

The behaviour of the United States and China in the context of international relations, are not particularly surprising, nor is it unreasonable. When an existing great power faces a rapidly emerging power, both sides become ensnared in a security dilemma. Given the significant differences in ideology between the United States and China and their differing attitudes towards the existing international order, it is difficult to avoid this “arms race” based on security considerations in sensitive areas such as submarine cables. If conflict were to break out between China and the United States or its proxies in the South China Sea, such an arms race would certainly contribute significantly to that conflict. In extreme circumstances, the idea that China and the United States would have a conflict in the South China Sea merely due to the other party's espionage activities using undersea cables is not beyond the bounds of possibility. The competition between China and the United States in the submarine cable sector can be understood to some extent by referencing the Thucydides Trap theory mentioned earlier, which was popularised by American political scientist Graham T. Allison (2017).

However, it should be noted that as a theoretical model, the Thucydides Trap is not without flaws. Some criticisms suggest that the theory assumes that as power grows, the rising state will inevitably pursue hegemony, which may not necessarily be the case (Liu and Fan 2019; Sabaghi 2022). Others argue that the driving force towards war is not necessarily the threat of being overtaken by existing powers, but rather the changes in behavior of emerging powers due to their transition from rapid growth to economic stagnation (Brands and Beckley 2021). The Thucydides Trap theory also assumes that a stable international order can only be unipolar, which is not necessarily true (Li 2021). A multipolar world could potentially maintain a comparatively dynamic balance, with

ongoing localised confrontations and occasional upheavals but without overall loss of control. In such a scenario, the rising great power may seek to establish “co-rule” with the hegemon, or at least refrain from taking extreme risks to supplant the existing hegemony by choosing to benefit in the long term within the existing order (Yang 2018). The official Chinese position is largely consistent with these views. For example, Xi Jinping has stated in public that he does not agree with the fatalistic view of competition between China and the United States. He argues that conflict can be avoided as long as differences are managed and misunderstandings are eliminated (Berggruen and Gardels 2017). This means that the competition between China and the United States in submarine cables is indeed fundamentally a security issue, although the Thucydides Trap model does to some extent depict the United States’ current standoff with China. However, the ultimate outcome need not necessarily be entirely pessimistic.

It must be pointed out, however, that in discussing the Thucydides Trap, the role of smaller players is often overlooked, just as many city-states were caught between Sparta and Athens and forced to take sides in the conflict. Similarly, the current predicament faced by Hong Kong’s submarine cable sector largely mirrors its entanglement in the geopolitical crossfire between the Chinese mainland and the United States.

#### **Solutions for Hong Kong’s submarine cable sector within established geopolitical frameworks**

Despite the aforementioned circumstances, the submarine cable sector in Hong Kong is not necessarily at a dead end, and there are still some efforts that could be made to resurrect it. These efforts will involve necessary compromise within the existing order as well as seizing new opportunities in a changing political landscape.

#### **Necessary compromise with reality**

For communication professionals in Hong Kong – including those involved in submarine cable networks – Beijing’s stance is already clear: although Hong Kong based telecommunications operators can be either Chinese companies or foreign companies, if these companies want to lay submarine cables through the waters around Hong Kong via EPC contracts, the subcontractor must be a Chinese company trusted by the authorities. Therefore, for telecommunications operators wishing to continue to survive in Hong Kong’s telecommunications market, the quickest and most effective solution would be to collaborate with enterprises in mainland China that would guarantee the license.

In the pre-internet era, laying and operating submarine cables was mostly carried out by multinational telecommunications companies in joint ventures with various national telecommunications service providers. In recent years, however, high-tech companies such as Microsoft, Facebook, Amazon, Google and Huawei have been actively laying their own submarine fibre-optic cables, showing a trend of catching up with the more established players (Tang 2020). Between 2018 and 2020, the total length of international cables laid or planned by these companies reached 260,000 kms, and by controlling or leasing bandwidth via submarine cables, these five companies now control more than half of the world’s existing bandwidth capacity (Tang 2020; Satariano 2019). Nikkei (2022) compiled data from research firms such as TeleGeography in the United States listing investors in optical cables spanning more than 1,000 kms, primarily used

for international communication. Between 2023 and 2025, an estimated 314,000 kms of new cables are expected to be laid globally, with 45% funded and operated by Google and Meta. Following closely on their heels are major players such as Vodafone, Orange, China Telecom, China Mobile and Singapore Telecommunications, among other telecom groups (PR Newswire 2024).

In Hong Kong, hi-tech giants such as Meta and Google's parent company Alphabet find only limited business opportunities. Telecommunications and fintech companies from diverse backgrounds are the primary entities involved in landing international submarine cables and conducting any related operations. These companies include SUNeVision Holdings (新意网集团), a top ranked data centre services provider and connectivity hub in Hong Kong; China Telecom Global (中国电信国际), which is headquartered in Hong Kong and is wholly controlled by its mainland China parent company; New World Telecommunications (新世界电讯), which was renamed HKBN Enterprise Solutions (香港宽频), and Telstra PBS (澳太科技). These entities act as demand providers and entrust the construction of submarine cables (and landing points) to submarine cable integrators through EPC contracts (ibid).

EPC integrators are the primary providers of comprehensive solutions for submarine cable systems. According to the Global Undersea Optical Cable Industry Development Research Report (2023) (《全球海底光缆产业发展研究报告(2023年)》), there are only four submarine cable integrators with global intercontinental delivery capabilities, namely SubCom from the United States, ASN from France, NEC from Japan and China's HMN Tech (华海通信). Among these, SubCom, ASN and NEC entered the market first and have a first-mover advantage. SubCom has delivered over 200 submarine cable projects with a total length of approximately 840,000 kms, while ASN has delivered more than 220 submarine cable projects with a total length of around 600,000 kms and NEC has deployed over 300,000 kms of submarine cables globally. HMN Tech, established in 2008, has gradually expanded its market share and has so far undertaken 134 submarine cable projects, signing contracts for the delivery of approximately 94,000 kms of cables. In the global delivery of 106 submarine cable systems from 2018 to 2022, ASN, SubCom, NEC and HMN Tech accounted for 22%, 12%, 7% and 23% respectively of the number of cable contracts delivered. In terms of the length of submarine cables delivered, ASN, SubCom, NEC, and HMN Tech accounted for 29%, 40%, 7%, and 18% respectively (CAICT 2023,14).

From a technical lineage perspective, HMN Technologies (HMN Tech, 华海通讯), is essentially the former Huawei Marine Network Technology Company (Huawei Marine, 华为海洋). Huawei Marine was a global leader in providing advanced marine communication solutions, and possessed integrated capabilities for global transoceanic submarine cable systems. The company accumulated contracts for 63,752 kms of newly built marine optical cable systems as well as 54 expansion projects. Up to 2019, it was one of the four major global integrators of transoceanic submarine cables (Nan 2020). By 2019, Hengtong Optic-Electric (亨通光电), a subsidiary of Jiang Su Hengtong Group (江苏亨通集团), had acquired a 51% stake in Huawei Marine from Huawei, and in the first half of 2020, Jiangsu Hengtong Group (亨通集团) completed the acquisition of an 81% equity interest in Huawei Marine. Regarding the aforementioned changes in equity, Hengtong Optic-Electric, the submarine cable business brand associated with Huawei

Marine, switched to HMN Tech (HMN Tech 2020). As of 2023, Hengtong and the group jointly hold 93% of HMN Tech's shares (Hengtong, 2003, 1). Meanwhile, on December 16, 2021, the U.S. Department of Commerce included 34 Chinese enterprise in its so-called Entity List, including four submarine cable companies or their parent companies, namely Jiangsu Hengtong Marine Optical Network Systems and its parent company Jiangsu Hengtong Group as well as ZTT Submarine Cable (中天海缆) and HMN Tech.

### **Opportunities beyond US dominance**

Given this backdrop of a strategic standoff between China and the United States, there is not a great deal of choice for laying submarine cables and establishing landing points in the South China Sea, including the waters around Hong Kong. HMN Tech inherited Huawei's technological genes, and its controlling entity, Jiangsu Hengtong Group, is China's top EPC integrator. Undoubtedly, cooperating with HMN Tech is the most pragmatic solution, and in fact since 2017, the only submarine cable landing in Hong Kong has been achieved through collaboration between the Hong Kong-based New World Group (新世界集团) and HMN Tech.

Nevertheless, in terms of submarine cable operations, even if the influence of the United States and its allies is strong, this does not necessarily mean that they monopolize the entire market. First and foremost, aside from the geopolitical impact, the market is entering a new boom phase purely from the perspective of increased commercial demand within the submarine cable industry. According to plans already announced, an additional 80 submarine cables are scheduled to be put into operation between 2023 and 2026, with a total length of approximately 390,000 kms (CAICT 2023, 1). Meanwhile, there is also a substantial amount of business involving the replacement of old cables with new ones. Currently, out of the 464 submarine cables worldwide, 82 were constructed before 1998 and have reached their designated lifespan. Over the next 10 years, 148 more undersea cables will reach their retirement age. There is also an increasing need for routine maintenance (CAICT 2023, 25), and the combined demand for new installations, replacements and maintenance cannot be solely absorbed by the capacity of the United States and its allies in the submarine cable industry.

More importantly, considering the geopolitical factors, U.S. dominance is relative rather than absolute. Firstly, not all allies or partners are willing to blindly follow the United States. In its ongoing efforts to counter China, if the U.S. continues to erode the interests of its allies without providing substantive benefits, it will increase centrifugal tendencies among these countries, weakening the closeness of their relationship with the U.S. (Hengtong, 2003, 90). To explain this, we can cite the example of the "Peace Cable". As France Telecom operated the Marseilles landing station for the "Peace Cable", Washington pressured French President Macron to suppress Chinese companies involved in cable construction, but this effort ultimately failed (Fouquet 2021). In Asia, projects involving HMN Tech, China Telecom, China Mobile and China Unicom, such as ADC, Asia Link Cable (ALC), and New Crossing-Pacific Cable (NCP) also involve allies of the United States including Singapore and Japan. While these countries have some control over the projects, they have not rejected cooperation outright.

China's presence in the international submarine cable domain does not rely solely on the fairness of certain Western political figures or Asian political entities, but



**Fig. 2** Chinese supplied cables globally. Sources: Gross et al. 2023a, b

more from China's own technological strengths and their strategic deployment. From a practical perspective, by leveraging the Belt and Road Initiative (BRI) and Digital Silk Road (DSR), China is expanding its communication infrastructure to bypass the U.S.-led system (Bloomberg Technology 2021). Despite obstruction by the U.S. since 2017, China's involvement in submarine cable projects has been thriving at a global level (Fig. 2). For instance, in November 2018, the South Atlantic International Submarine Cable (SAIL), in which China Unicom participated, was officially launched. The cable spans 6,000 kms and forms a new channel for fast direct submarine cable connections across the South Atlantic, linking the Africa and South America (Gross et al. 2023a, b; Fiberatlantic 2018). Serving as a crucial communication infrastructure for the southern hemisphere, the SAIL cable opens new internet channels from Western Africa to South America, facilitating deeper international cooperation in the digital economy (CNII 2023). Another example is the Asia Direct Cable (ADC) project, a significant initiative by China Unicom in conjunction with the BRI. Launched at the end of February 2020, the cable is jointly funded and constructed by China Unicom and international operators and was completed in the third quarter of 2023. This cable lands in countries including China, Japan, South Korea, the Philippines, Vietnam, Thailand and Singapore, with a total length of over 6,500 kms (ibid). In February 2023, the Cambodia Sihanoukville to Hong Kong Submarine Cable Project, managed by China Communications Construction Company's Harbor & Marine Division, held a groundbreaking ceremony in Cambodia's Ministry of Posts and Telecommunications to mark the official start of a 2,715-km submarine cable project connecting Hong Kong to Sihanoukville (Pisey 2023).

Is Hong Kong's business community capable of collaborating with mainland Chinese submarine cable companies to join their "going global" (出海) efforts and carve out a share in these submarine cable projects, even though many of them are offshore for Hong Kong? It is entirely possible – and in fact there are already precedents. The

SEA-H2X submarine cable project is a case in point. Initiated by major state-owned telecommunications operator China Unicom, the project has attracted many international companies, including Hong Kong's SUNeVision Holdings. Construction began in May 2022, with operations expected to commence in 2024. The cable will connect the Hong Kong SAR and Hainan Province of China with the Philippines, Thailand, Malaysia and Singapore, and may in future extend further to include Vietnam, Cambodia and Indonesia (Ma 2023).

During the 6th China International Import Expo (November 5th to 10th, 2023), Shanghai Lianhe Investment Company's (上海联和投资公司) subsidiary, Shanghai Lingang Special Area Cross-Border Data Technology (上海临港新片区跨境数据科技有限公司), reached cooperation agreements with PCIN Link System PTE.LTD from Singapore, Telstra PBS Limited from Hong Kong, and Shanghai Wangying Information Systems (上海网赢信息系统有限公司). It is reported that a contract was signed with PCIN to invest \$200 million in constructing a new submarine cable from Shanghai Lingang to Singapore, connecting with the PEACE cable. Plans for collaboration with Telstra PBS and Wangying aim to provide professional ICT solutions and security management services for domestic enterprises' secure cross-border data transmission (Bagh 2023).

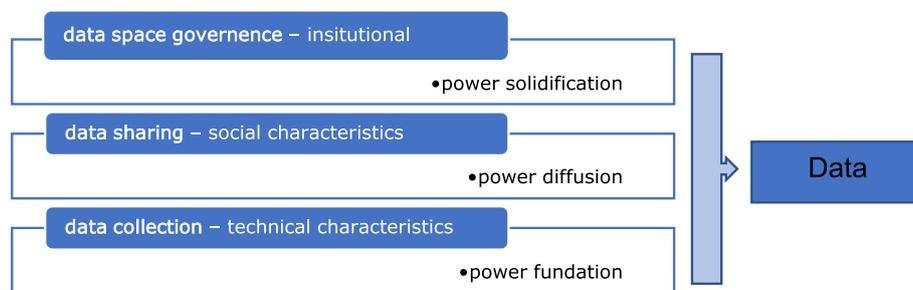
#### **Reflection on the supply of network infrastructure in the digital economy**

Hong Kong-based submarine cable enterprises may find ways to overcome difficulties, but the international infrastructure supply in the global digital economy era could be on the verge of a network bifurcation. Under the new order, Hong Kong's previous hub status may be reshaped.

#### **Bifurcated global network infrastructure**

In terms of the global network infrastructure, the total number of connections and the amount of traffic is increasing, and regions that were once considered marginal or late-comers are increasingly benefiting. Although there are undeniable potential risks, the basic order and common standards make the entire system resilient and ensures reliable data services under normal circumstances. However, commercial interests and even international law are becoming increasingly powerless to coordinate and restrain the disagreements arising between countries due to security concerns. As the two largest economies in the world increasingly manifest their geopolitical assertions in the economic and technological fields through a process of decoupling, including international submarine cable systems, the trend of divergence in international public infrastructure networks has become more pronounced (Clarke 2021).

Submarine cables, as the backbone of international network systems, are particularly susceptible to bifurcation effects, but other fields are no less impacted. In hardware sectors related to networking, such as submarine engineering equipment, land-based stations, satellite and aircraft launches, and in software realms including the installation and use of certain super apps, operating systems for mobile phones and personal computers and banking exchange systems, competition is no longer solely commercial but geopolitical (Burdette 2021). In recent years, it has become increasingly clear that once security issues are brought to the forefront, other variables, including science, technology and commerce, have to make way. As more



**Fig. 3** The data power framework according to Shen's theory. Source: Shen (2022)

countries are drawn into the security standoff between the United States and China, and inevitably find themselves taking sides, the submarine cable industry has been changing. In response to this, Shen (2022), whose view is representative among scholars in mainland China, has analysed the sources and construction of international data power and built a three-layer model of "data collection, data sharing and data space governance" to provide a very deterministic interpretation (Fig. 3):

Firstly, international submarine cables, as a data infrastructure, play an increasingly decisive role in the global geopolitical economy (Winseck 2017). International submarine cables and the locations of data centres at both ends of the cables serve key regions in the world, and the control and utilization of these infrastructures now constitute a form of power in the digital economic era – namely data power (Shen 2022).

Secondly, the source of any power has to have a foundation, and the international data power of a country is no exception. The infrastructure that generates and collects data and the technical facilities that apply the data constitute the basis of this source of data power (corresponding to "power foundation"). When a state acquires data, it can only generate greater value through the international promotion of data sharing and data flow (corresponding to "power diffusion"). As data are shared and flow across borders, governance issues in international data space will also trigger power struggles between states. Therefore, data space governance must be introduced (corresponding to "power solidification") (ibid).

Finally, based on the framework of "data collection, data sharing and data space governance", international data power comes from three levels: the lowest layer is the data collection and application layer, in the middle is the data flow and sharing layer, and at the top is the data space governance layer. These three forms of international data power endow power with three characteristics: the bottom layer of data collection and application fully relies on technical foundations and has technical characteristics; the middle layer of data flow and sharing requires support from various relationships and has social characteristics; while the top layer of data space governance cannot be separated from the construction of mechanisms and has institutional characteristics. Any discussion of international data power should therefore be based on three dimensions: technical power, relational power and institutional power. From the perspective of the development path of power, these three dimensions also

constitute a development chain of international data power from power foundation to power diffusion and then to power solidification (ibid).

Furthermore, it is important to note that in international relations theory, liberals argue that mechanisms can constrain state power. However, major powers such as the United States and its allies can in fact fully exploit international mechanisms to consolidate their international power (Shen 2002). In the power foundation stage, the United States and its core allies such as the United Kingdom, Australia and Japan took advantage of their technological advantages in areas such as communication infrastructure, algorithms and search engines to gain the initiative (technological empowerment). In the power diffusion stage, they promoted data openness through industry relationships and protected data security through geopolitical relationships and used cultural relationships to share sensitive data and construct a digital alliance (relational empowerment). In the power solidification stage, the United States has strengthened international data power by building mechanisms and setting rules, while its core allies use existing mechanisms to enhance their international data power or attempt to build mechanisms to enhance international data power (institutional empowerment). Throughout the process, the United States and its allies have used international mechanisms to consolidate their own international power (Shen 2022).

The three-layer empowerment model of technology, relationships and mechanisms is not only a representation of the three dimensions of the development of international data power but also constitutes the complete development chain of international data power from the bottom layer, through the middle layer to the top layer (ibid). In other words, the development path of power is fundamentally consistent in reflecting the three-layer empowerment model of technological, relational and institutional empowerment. At the same time, according to Shen (2022), this also means that in the process of consolidating and strengthening its own data power, China will be able to follow a similar path by strengthening submarine cable construction and big data analysis technology, emphasizing the use of industry relationships and cultural relationships to diffuse international data power and strengthening international mechanisms to promote data space governance and deepen cross-border cooperation on data.

However, when the U.S. and its allies and China complete power consolidation for different security interests, what remains for the world is a bifurcation in the global infrastructure network, which will include the management of submarine cables. In this regard, unfortunately, states that are currently engaged in international geopolitics still tend to use strategies that are aimed at building and consolidating their own power superiority to solve problems. This is particularly evident in major powers such as China and the United States which are caught in the Thucydides Trap. In terms of the negative economic impacts caused by this power coercion model, including the construction of parallel submarine cable systems globally, the solution is far from economically rational, but states can't control everything they seek to dominate, and this is reflected the frustrating nature of security issues.

#### **The transformation of Hong Kong's role as a super-connector**

Returning to the challenges facing Hong Kong, a divided international infrastructure supply order does not necessarily mean that China would lose its role as a core provider.

Despite U.S. constraints, the proportion of cables landing in China is expected to double to 20% by 2030 (Fouquet 2021). China could then “pursue a separate technology stack, replete with its own standards-setting process that includes a subset of BRI and DSR countries” (Greene and Triolo 2020). In this process, Hong Kong-based enterprises in the submarine cable industry could survive by making necessary adjustments and participating in offshore business. However, as a city, Hong Kong’s future connection to more international cable systems to consolidate and develop itself as a regional data hub will face stricter requirements. In other words, while China may continue to rise and individual businesses may transform, Hong Kong’s once proud position as a super-connector and the prosperity it enjoyed as a result will come under threat (Super Media 2020). Despite its advantageous position as a bridge and network node between China and the West, Hong Kong’s development during the next stage cannot rely solely on developmental inertia, and structural reforms are imperative.

For a city or region, even in the midst of intense geopolitical conflicts between major powers, maintaining prosperity in an arena of great power rivalry may not necessarily be hindered. Some cities or regions become super-connectors between various forces due to their unique competitive advantages in geographical location, information channels, business infrastructure, legal systems and even ideology. They meet needs that lie beyond direct confrontation and receive lucrative commissions. Examples include Brussels and Zurich during World War I, Paris, Istanbul and Shanghai’s foreign concessions during World War II, and Berlin, London and Vienna during the Cold War. This pattern also explains why key cities in the Asia–Pacific region like Hong Kong, Singapore, Seoul and Taipei developed so rapidly during and after the Cold War.

However, a vital and often overlooked aspect of being a super-connector is the necessity for the city to be firmly embedded in a network that is capable of continually providing resources to sustain prosperity. If this is not the case, the city may lose all its previous prosperity once the resources of the connected system become depleted. This is why West Berlin was able to thrive during the Cold War while East Berlin was not. Conversely, places once obscure, such as Gwadar Port in Pakistan, or historically declined nodes like Alexandria Port in Egypt and Piraeus in Greece, may experience rapid development by being integrated into a powerful rising system such as the BRI (HK TDC 2019a, b,4).

Discussions must therefore include an examination of Hong Kong’s structural position, as a hub city within the international system. From the end of World War II to the handover in 1997 and the two decades after that, Hong Kong served as a meeting point between socialist China and the capitalist world and played a pivotal role in the global capitalist system in finance, shipping, telecommunication and other market operations. However, while Hong Kong retains its capitalist system today, it has found itself embedded a framework of socialism with Chinese characteristics. Although the city continues to act as a bridge between China and the West, its role as a node in the global capitalist system has gradually been replaced by Singapore. When the capitalist camp led by the United States and its allies is no longer willing or able to treat Hong Kong as one of its own nodes, the resources they allocate will inevitably decrease. In other words, for Hong Kong to maintain its previous level of prosperity, it needs to align itself with the bigger picture of national development big picture (融入国家发展大局) and substitute

previous resources from the network into which it is trying to integrate. So to maintain its position as a super-connector in the digital economy era, Hong Kong needs more than a few additional submarine cable landing stations; it needs structural reconfiguration to become a data harbour beyond the U.S.-dominated capitalist system by becoming an important offshore player in China's BRI and DSR (HK TDC 2019b).

### **Conclusion**

For Hong Kong to solidify its role as an Asia–Pacific hub for finance, maritime and air transport and professional services and to expand opportunities in high-tech fields such as data storage and flow, it needs to make efforts to gain access to more submarine cables and engage in related businesses. However, it is no secret that companies in Hong Kong that are engaged in the submarine cable industry are experiencing a challenging period. The current reality is that there is effectively an administrative monopoly of certain mainland Chinese companies on submarine cable laying in the waters surrounding Hong Kong. The underlying reason lies in the competition between China and the US, where submarine cable issues are regarded as matters of security for both Beijing and Washington. Given this, there should be no room for wishful thinking. Whether it is Western-style or Chinese-style lobbying, neither are sufficient on their own to affect Beijing's stance on issues related to national security.

Beijing regards submarine cables as a security issue, indicating that in this aspect the competition between China and the Western camp, notably the United States, revolves around data power. From China's perspective, the country has already demonstrated distinctive technological, social and institutional characteristics in data collection and application, storage and flow, as well as data space governance. This to some extent has empowered China with digital capabilities that rival those of the United States and its allies. This power could potentially be diffused and institutionalized to a certain extent. In fact, the ongoing projects under the BRI and DSR are currently validating this perspective. For Hong Kong, which is seeing its past unique advantages being overtaken by competitors while still aspiring to maintain its role as a super connector, integrating into the national development agenda and participating in BRI and DSR projects offshore may well be the most rational choice to protect its presence in the submarine cable industry at this stage.

In the future, unless the Thucydides Trap that exists between China and the United States plays out to its conclusion and triggers a war between the world's two largest economies, it is unlikely that Hong Kong will completely lose its role as a conduit between China and the West. However, the challenges that currently face Hong Kong's submarine cable industry at present and the necessary transformation it needs to undergo in the future serve as a reminder that compared to major powers trapped in the Thucydides Trap as ancient Sparta and Athens were, and as present-day United States and China now are, smaller players caught in between often bear the brunt of the consequences earlier and more heavily, and these consequences are more difficult to compensate for.

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I affirm that I did not obtain ethics approval for the research conducted, as it was undertaken independently and autonomously, without specific focus on individual subjects.

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