Chapter 14
Technology Transfer and Technological Spillovers from Chinese Tech Giant in North African Countries: The Case of Huawei in Algeria

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14.1 Introduction

South-South cooperation (SSC) has attracted the attention of development economists for decades with the hope they bear in building radically different relations between nation States. While the South-South cooperation charter dates back to the Groupe of 77's meeting in Algiers in 1967 (Muhr & De Azevedo, 2018), there has been a widespread sense recently that the time is ripe for putting SSC once again at the centre stage of world politics and economics to redraw the architecture of the global order (Grey & Gills, 2016).

China, as an emerging economy with an exceptional development path (Naughton, 2006), has shown strong support for South-South cooperation and commitment in recent years to increase investments in other developing countries through its Belt and Road initiative (BRI). It has also signalled through white papers and discourses its willingness to share with African countries its rich experience in technological catch-up and transfer of 'best practice' (Morais, 2008). For instance (Mu & Lee, 2005), the China–Africa Science and Technology Partnership Program (CASTEP) was launched in 2009 to establish a robust S&T partnership with African countries. In a recent move, China's engagement in Africa's digital sector materialized under the China–Africa Partnership Plan on Digital Innovation passed in August 2021. This partnership pledges to share digital technologies with African countries to promote digital infrastructure, connectivity and to help expand Internet access in Africa's

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remote areas. It constitutes perhaps the single most important foreign initiative to help the continent's digital transformation.

With the highest number of internet users worldwide, estimated at around one billion (Tomala, 2022) and a thriving digital economy, China has expanded its global digital footprint since the early 2000s. Chinese information and communication technology (ICT) multinational corporations (MNCs) have built the backbone infrastructure used by millions of internet users across developing countries (Gagliardone, 2019; Oreglia, 2012). China stands to become an even more critical actor in the ICT industry in the foreseeable future through the Digital Silk Road (DSR), the digital component of Beijing's multibillion-dollar BRI (Hillman, 2021).

While China's BRI is best known through its two central paths: the "Belt", which refers to the overland routes, known as "the Silk Road Economic Belt", and the road, which refers to the sea routes, or the "Maritime Silk Road", the BRI's digital dimension is significant. In 2016, China's State Council published the "13th Five-Year Plan for National Informatization," dedicating an entire section to the creation of an "online Silk Road" and encouraging the full participation of Chinese tech firms (CCCPC, 2016). In May 2017, speaking at the first BRI forum in Beijing, Chinese President Xi Jinping announced that big data would be integrated into the BRI to create the "Digital Silk Road of the twenty-first century".[1]

The digital Silk Road brings to BRI countries advanced telecommunication infrastructures such as fibreoptic cables, 5G networks, data centres, satellites, as well as e-commerce hubs and smart cities. It aims to deepen digital cooperation, develop common technology standards, and improve the efficiency of security systems across BRI countries (Shen, 2012). The Digital Silk Road aims to build what Beijing calls "a community with a shared future in cyberspace" (Oreglia et al., 2021; Wei, 2019). This ambitious plan is primarily driven by China's tech giants, most notably Huawei and ZTE (Zhongxing Telecommunication Equipment), who can deliver high-quality fibre optic cables at much lower costs than their European and US competitors, namely Ericsson, Nokia and Cisco. Huawei's ICT equipment generally sell 5–15% cheaper than its main international competitors, Ericsson and Nokia, while ZTE has in the past offered equipment up to 30–40% cheaper (Cisse, 2012; Hart & Lind, 2020; Joo et al., 2016). In 2012, Huawei overtook the Swedish-headquartered company Ericsson in revenue to become the world's largest telecommunications equipment vendor (Lee, 2012).

With the announcement of the Belt and Road Initiative (BRI) in 2013 and the Chinese government's 2016 Arab Policy Paper, China has shown renewed interest in the region. Beijing has committed to increasing investments in high-value-added sectors and to boost cooperation in science and technology with countries across North Africa and transfer technology through academic exchange and R&D activities (Cheney, 2019).

[1] Keynote speech delivered by the Chinese President Xi Jinping at the opening ceremony of the Belt and Road Forum (BRF) for International Cooperation in Beijing, capital of China, May 14, 2017 (Xinhua/Wang Ye).

With its strategic location, connecting Asia, Africa, and Europe through the Suez Canal, North Africa holds a central position in China's BRI (Abdel Ghafar & Jacobs, 2019). All of the five North African countries have signed memorandums of understanding to join the BRI, and the region is home to several hallmark BRI projects. From Mao Zedong's "Three World" theory to Xi Jinping's Belt and Road Initiative, China and North Africa have developed and sustained strong relations rooted in a shared experience of colonial domination (Pairault, 2017). In recent years, the region became host to several hallmark DSR infrastructure projects, including data centres and smart cities built by Chinese firms (El Kadi, 2019). Between 2004 and 2020, trade between China and North African countries grew from $4.9 billion to $33 billion, nearly seven times more in just seven years[2], Between 2005 and 2016, Chinese companies carried out contracts around $ 22 billion (Ghanem & Benabdallah, 2016).

While North African countries have different political economies, four of them (Algeria, Tunisia, Egypt and Morocco) middle-income status and have in common growing numbers of tech-savvy young people, a relatively high rate of internet penetration, and proximity to the EU market (World Bank, 2019b), making the region a strategic hub for the DSR. Like elsewhere on the continent, after rapid socio-economic progress in the aftermath of independence, the 1980s and 1990s were characterized by rapid deindustrialization and a rise in inequalities across North Africa. The region's economies are stuck in low added value sectors, and for some of them, primary-commodity exports with chronic unemployment representing a distinctive feature of North Africa (Azmeh & Elshennawy, 2020; Kabbani, 2019). In this context, the DSR is perceived by North African governments as an opportunity to accelerate digital transformations and escape the middle-income trap while creating quality jobs for millions of unemployed people in the region. Although commentaries on the BRI's implications abound (Ahrens, 2013; Hillman, 2021; Kennedy, 2006), China's ambition to extend its digital footprint has so far been marginalized in both academic and policy circles, despite its importance.

Existing writings on China's global digital expansion have predominantly focused on the potential threat this could represent to the West's hegemony over the Internet (Hillman, 2021) and, more specifically, to Washington's supremacy over the cyberspace with the fear that Beijing would reap the economic, political and intelligence advantages that once flowed to Washington (Segal, 2018). Mainstream accounts have expressed concerns regarding the reproduction of China's Internet model abroad, a model that has been dubbed as digital authoritarianism, or even more vaguely as "digital Leninism".

A major problem with some of this literature is that it tends to marginalize domestic agency and depict China as an "all-powerful actor able to transpose its model into poorer nations, convincing them through attractive loans, while Beijing advances its masterplan. An emerging body of empirically grounded studies has challenged this assumption, showing wide variations between companies depending on local

[2] "China–Africa Trade," Johns Hopkins School of Advanced International Studies China Africa Research Initiative, 2020, http://www.sais-cari.org/data-china-africa-trade.

context, sectors, and ownership type, i.e., whether a company is private or state-owned (Brautigam, 2009; Oya & Schaefer, 2019; Calabrese & Tang, 2020). In the digital sphere, emerging evidence suggests that China's engagement supports nationally rooted visions of the Internet, with Chinese companies expanding by forming various partnerships with local actors and adjusting domestic needs and preferences (Gagliardone, 2019). To date, empirical research on the developmental contribution of Chinese digital multinationals, especially with regard to technology transfer remains scant (Agbebi, 2019; Tugendhat, 2021; Demena et al., 2019). Using the case study of Huawei in Algeria, one of the largest recipients of Chinese capital in North Africa, this chapter investigates the technological spillovers emanating from the Chinese tech giant. Going beyond the West's grim picturing of China's presence in Africa as a new form of colonialism, this chapter seeks to tell an empirically rich and nuanced account of the Chinese contribution to digital transformation of North African countries through the Algerian experience and more specifically answer a key question: to what extent Huawei has been able to transfer technology through knowledge spillover to local.

14.2 Technology Transfer and Spillover Through MNCs Operations in the South: Literature Review

Several contributions have highlighted the issue of technology transfer in relation to building capacity in the host country (Kim & Dahlman, 1992; Mowery & Oxley, 1995). Kim and Dahlman (1992) argue that many of the 'late-industrialisers' of the postwar period, such as South Korea, Taiwan (China), and Hong Kong (China), initially exploited foreign sources of relatively mature technologies. Such technology could be transferred through channels that relied on *arm's length* transactions, such as licensing, turnkey plants, and capital goods imports. The economies that have benefited most from inward technology transfer had national systems of innovation that include public policies strengthening their 'national absorptive capacity" (Cohen & Levinthal, 1990). Similarly, at firm level, the exploitation of external technology requires the creation within the firm of some 'absorptive capacity', an ability to understand an externally sourced technology and apply it internally. Inward technology transfer during the postwar period supports the conclusions that the mix of channels through which an economy obtains technology from foreign sources (FDI, arm's length, licensing etc.) but most of all the overall effort to exploit foreign sources of technology**.**

But broadly speaking, technology transfer, seen as the dissemination of technical knowledge and know-how embodied in products, processes, and management (Wahab et al., 2011), seem to be primarily through foreign direct investment (FDI) long been regarded as a significant engine of technological upgrading and capacity building (Globerman, 1979; Markusen & Venables, 1999; Amsden, 2001; Saggi, 2002; Blalock & Gertler, 2008; Fu et al., 2011). While technology transfer takes on

several modes and shapes, the attention of scholars seem to privilege spillovers as an important channel, when it comes to FDI (Hoi Quoc and Pomfret, 2011) Technology spillovers reflect the unintended transfer of technology, while technology transfer has a more intentional/deliberate connotation (Smeets, 2008). Similarly, knowledge transfer implies a broader, more general type of knowledge, while technology transfer is narrower and more targeted (Holm et al., 2020). For the sake of this chapter, these terms are used interchangeably.

There are several mechanisms through which a host country can reap the benefits of inward technology. At macro-economic level, technological benefits generally assume the form of spillovers, or external effects, that go beyond such direct sources of economic benefit as higher-productivity, higher-wage manufacturing jobs.' Important sources of spillovers are 'reverse engineering, which may result in the development of similar products for indigenous manufacture and export, and skills acquisition through 'learning by using'. The extent of these spillovers depends on several factors: the age of transferred technology, the channel of transfer and the level of indigenous technical capabilities. Potential spillovers are greatest for the most up-to-date technologies, but exploitation of these spillovers is limited by the controls imposed by the transferring firm, and by the level of indigenous technical capabilities (Mowery & Oxley, 1995).

The basic premise underlying the existence of technology spillovers is that foreign invested firms are technologically superior to local ones. Thus, their interaction is assumed to lead to technology transfers which, in turn, lead to productivity gains (Saggi, 2002; Javorcik, 2004). Given the lower technology base within developing economies, these spillovers may help local industries build up their domestic technological capabilities and catch up with the international technology frontier (Lall, 1992; Ning & Wang, 2018). When multinational firms venture abroad, they cannot always maintain full control over their managerial and technological knowledge, allowing local ecosystems to learn from them. These instances are known as knowledge spillover (Crespo & Fontoura, 2007). Demonstration effects are recognized in the literature as the most powerful channel for technology spillovers: local firms (customers, suppliers, subcontractors) observe and potentially adopt new practices and techniques by collaborating with multinational firms, something that leads to productivity gains (Blomstrom & Kokko, 2001; Crespo & Fontoura, 2007). A second important mechanism of spill over is labour mobility; this is when local employees trained by foreign firms move to domestic firms, taking with them new managerial and technical knowledge (Görg & Strobl, 2005).

The empirical evidence on the transfer of technology and spillovers through FDI by Western MNCs are, 'at best' mixed. In their seminal study on technology spillovers in Morocco, Haddad and Harrison (1993) found that if domestic and foreign firms compete to capture the same market, then the latter does not have incentives to promote technology linkages. In some instances, foreign firms were found to operate as enclaves with little connection to the local economy (Liu et al., 2009; Aitken & Harrison, 1999; Matija & Knell, 2018). Measures adopted by foreign companies to limit technology transfer, and spillover include protecting their intellectual property, trade secrecy, hiring mainly foreign workers, and preventing labour turnover

by providing wages that are significantly higher than local industry averages (Liu, 2008; Liu et al., 2009). In other instances, research showed that foreign subsidiaries did more harm than good to the local economy by capturing the domestic market and crowding out local competitors without engaging in any meaningful form of technology transfer (Amendolagine et al., 2013). This is often explained by the wide technology gap between Northern companies and their counterparts from the South (Sazali et al., 2011).

Consequently, Chinese firms emanating from a developing nation raise new hopes. Unlike Ericsson and Cisco, who are dispatched from rich countries, Chinese tech giants like Huawei could thus represent a greater opportunity for host middle-income countries to extract new technology and, like China, upgrade to producing high-tech equipment and services for the digital era. This is substantiated in several contributions. According to the literature, the smaller the technological gap between the country from which the MNC is dispatched and the host economy, the more likely the foreign subsidiary will transfer technology and know-how that can more readily be absorbed and applied locally (Glass & Saggi, 2002: 497). South-South investments are thus assumed to generate more meaningful technology transfer than investments from industrialized countries, increasing the likelihood of technological learning and innovation (Takii, 2005; UNCTAD, 2012; Kubny & Voss, 2014).

14.3 Methodology

From a methodological point of view, this work uses a qualitative case method, felt more appropriate in this situation (Cunningham et al., 2017). It draws from fieldwork research carried out through in-country interviews in Algeria's ICT ecosystem conducted between July 2021 and February 2022. Interviewees included Huawei representative in Algiers and employees, Algerian subcontractors, customers, former assembly line managers and workers, Algerian ICT students and students receiving training from the tech giant. They also included, policymakers, ICT experts and university faculty/researchers. It also draws on the lead author's observations during employment at the Algiers office of Huawei between 2015 and 2016. This work experience has allowed for a better understanding of the dynamics shaping the localization of Chinese firms and the bargains around knowledge transfers. In addition, a large documentary search was conducted in both Latin and Chinese language, thanks to the fluency of the lead author in Chinese language. Among the obstacles met the difficult of access to several relevant documents, which are not publicly disclosed for reasons ranging from commercial secrecy to national security.

14.4 Huawei Localization in Algeria and Technology Transfer and Spillover: Main Findings

This section analyses technology transfer and the extent to which Huawei's presence in Algeria generates such spillovers. It looks first at Huawei's activities in North Africa in general and then analyses the two main components: technology transfer through training and technology spillover through labour mobility.

14.4.1 Huawei and Its Activities in North Africa

Founded in Shenzhen in 1987, Huawei has grown exponentially to become the world's leading OEM (Original Equipment Manufacturer) by moving into new markets as it began constructing telecommunications networks for phone carriers, making mobile devices for consumers, and providing a myriad of cloud, big data, and other services to other firms (Li & Kee-Cheok, 2017). In 2020, Huawei had more than 197,000 employees, operated in 170 countries and regions, and estimated that its equipment served over 3 billion people worldwide.[3] Huawei adopted a more strategic approach to R&D and strove to boost its patents by increasing considerably its investments in R&D, and particularly after adopting appropriate policies to boost "indigenous innovation" in strategic areas (Shen, 2012; Kennedy, 2006). In 2020 alone, its R&D spending reached a staggering amount of $22.3 billion (Kirton, 2021). Finally, a less-recognized factor behind Huawei's success lies in the firm's capacity to adjust to disparate cultural, political, economic, and institutional settings in different regions around the world (El Kadi, 2022). Thus, Huawei has played a significant role in North African digital transformation: in Tunisia, with the deployment of broadband networks and the training of thousands of Tunisian ICT engineers, in Egypt, with the project of the first systems for cloud computing and artificial intelligence in Africa and an Open Lab in Cairo and in Morocco with the construction of $10 billion smart city in Tangier.[4] In Algeria, Huawei played an important role in the country's telecom industry with its price-competitive equipment and managed to open its first mobile phone factory on the African continent in Algiers and in training thousands of Algerian students, staff members, and subcontractors.

Since the drop in oil prices in 2014, Algeria has adopted a series of measures aimed at diversifying its economy and moving towards higher value-added activities. Among other things, it has invested heavily in upgrading network infrastructure and has undertaken several digital initiatives. Internet penetration rate in the country reached 60.6% in 2020.[5] By the same date, mobile broadband access is correlated with a surge in mobile-cellular subscriptions and the expansion of 3G and 4G

[3] Huawei, "Our Company," Huawei, https://www.huawei.com/en/corporate-information.

[4] The North Africa Post: https://northafricapost.com/44913-mohammed-vi-tangier-tech-city-project-moving-forward-with-new-partnership-agreements.html.

[5] https://datareportal.com/reports/digital-2022-algeria.

networks coverage. Although the recent reduction of the gap in terms of connectivity is significant, the region's internet penetration remains just slightly above the world average, estimated at 57%, (World Bank, 2019a) something that creates important opportunities and demand for ICT infrastructure provided by OEMs like Huawei.

After extensive negotiations between Huawei and the Algerian government, the decision to build the factory was made. Algeria was severely impacted by the 2014 hydrocarbon price collapse because 60 percent of its budget is based on oil and gas. In order to conserve foreign currency, the government decided to cut back on imports and implement an import substitution strategy. The import of 900 products, including cell phones, was prohibited by the government in 2018. The government introduced a number of policies aimed at foreign companies for increasing local manufacturing in its quest to diversify the national economy and increase added value, notably, in order to localize production, the Algerian government entered negotiations with a number of cell phone producers including Samsung of South Korea which pledged to open a smartphone assembly plant in 2018 with a production capacity of 1.5 million units annually the creation of 400 direct jobs.[6]

Huawei complied with the government's request to localize production out of concern that Samsung would take market share away from it. At the factory's opening ceremony in 2019, Huawei representatives emphasised that the plant would be outfitted with the newest technologies and would be used to transfer cutting-edge technologies and production techniques. Huawei's smartphone factory in Algeria is one of the most important Digital Silk Road projects in Northern Africa and the most compelling example of Huawei's localization strategy, making it the first of its kind outside of China and in Africa. A joint venture between Huawei and the Algerian company AFGO-Tech, the factory has a monthly production capacity of 15,000 smart devices. Around 100 people work in the production unit, including 18 engineers who were trained in Shenzhen in Huawei's production methods. The Y7 prime smartphone was the first model that was put together as part of the plan. This product, in the opinion of the Chinese tech giant, was best suited to the needs of the Algerian market.

The Chinese company managed to establish a solid presence and is currently the leading network equipment provider, in terms of market share, in the Algerian telecom industries through its subsidiaries, Huawei Telecom Algeria. It employs more than 500 workers with about 83% of the staff made up of local employees and the remaining 30% of Chinese and other foreign engineers.[7] Huawei played a key role in the upgrade of 3G and 4G and is likely to continue playing a key role in the country's move to 5G. It signed a contract with Sonatrach, Algeria's state-owned

[6] APS (2017) https://ambalg-sofia.org/samsung-launches-first-smartphone-assembly-plant-in-algeria/.

[7] Express DZ: https://www.express-dz.com/2019/03/20/huawei-telecommunications-algerie-devoile-sa-strategie-2019/.

oil company, to upgrade its digital systems by providing cloud services and big data applications.[8]

The Oued Smar factory, like other Huawei facilities, plays a crucial strategic role in the company's internationalization. Through a supply chain that combines Chinese inputs into the assembly of the finished product in Algeria, it ensures ongoing access to the promising 43 million-person market in Algeria. Prior to the opening of the factory in December 2018, Huawei had a market share of about 6% of Algeria's phone market; by August 2020, it had increased to 12.34%, outpacing Condor, a domestic manufacturer in Algeria. Huawei Algeria disputes these figures, claiming that it holds nearly 18% of the mobile phone market in the country, just behind Samsung.

Concurrently to these projects, Huawei has partnered with several government institutions, universities, research institutes and local firms to expand its footprint in Algeria. The firm's public relations have stressed Huawei's role as not just the one of a turnkey project provider but as the one of a development partner willing to adjust and accommodate local development needs. Through training Algerian students and opening its manufacturing plant, the firm managed to embed itself in the local ecosystem and consolidate its image among policymakers. We will examine that in more depth in the following section.

14.4.2 Technology Transfer Through Training Initiatives

In Algeria, our fieldwork shows training initiatives are multi-faceted and include several components: training of new recruits, training within universities, training of subcontractors.

Firstly, for high-tech firms, providing regular training is crucial to ensure that employees are competent in new products and processes, which are vital to their functioning. Interviewees in Algeria indicated that new graduate intakes at Huawei go through rigorous training and induction within the first weeks of their employment. This training continues throughout their employment, with mandatory tests undertaken at different stages of their careers. Local engineers and managers are also reported going through training programs when they were first hired. The training covered technical and soft skills and continued throughout their employment period, with mandatory tests undertaken at different stages of their careers. In addition, Huawei also sends their local employees abroad for further training. A key motive driving many young engineers to work with the corporation, as reported in field interviews, is the learning opportunities they are given to upgrade their skills and know-how through training abroad and through observation.

[8] https://e.huawei.com/fr/publications/global/ict_insights/201902271023/Success-Story/201904170833.

Secondly, beside industry-specific training, Huawei's enterprise business has been particularly dynamic in establishing cooperation agreements with universities for training students in the region. Huawei counts two types of partnerships with local universities through their two academies: the *Huawei Authorized Network Academy* (HANA) and the *Huawei Authorized Information and Network Academy* (HAINA). According to the tech giant, the objective of these academies is to participate in capacity building to enable the digital transformation of local economies by connecting talents to local industry. More specifically, these academies aim to promote certifications in Huawei technologies among ICT university students. These certifications attest that their holders are competent in using and maintaining the technologies of a specific manufacturer. Students then go on to find employment with mobile operators, OEMs, or other firms that use these technologies. Alternatively, some graduates join channel partners who sell and install OEM's equipment for customers such as governments and large corporations. More specifically, in Algeria Huawei has ramped up efforts to create ICT academies across the country in recent years. Through a partnership with the ministry of higher education signed in 2021, Huawei launched five major ICT labs within leading universities: these are the National Institute of Post and Information and Communication Technologies of Algiers and Oran, the University of Saida, the University of Sciences and Technologies Houari Boumediene of Algiers, and the National School of Computer Science of Algiers. The labs are equipped with high-performing computers and cutting-edge equipment to be used for students' training. Participating universities also have access to ICT courses taught by accredited Huawei instructors who train both students and future instructors. The Chinese company claims to have trained over 2500 young Algerians in 2020 in various fields related to ICT. Besides ICT academies, the firm has launched a myriad of Social Corporate Responsibility (CSR) programs, such as the "Seeds for Future" scholarship, which takes some of the brightest students to Huawei's headquarters in Shenzhen and offers them exposure to cutting-edge technologies and immersion in Chinese culture. Huawei also organizes large scale ICT competitions within and across countries. In 2019–2020, Algeria's student teams won first place in the ICT Global Contest.[9]

Thirdly, Huawei offers training to local subcontractors for installing, troubleshooting, and maintaining the equipment they sell to customers. Usually, OEMs would have different subcontractors covering the various regions of the country where ICT infrastructure is being rolled out. Beyond training in universities, Huawei has provided regular training to subcontractors and workers. Local engineers and managers at the two Chinese firms, both on in-house and leased contracts, are reported going through training programs when they were first hired. The training covered technical and soft skills and continued throughout their employment period, with mandatory tests undertaken at different stages of their careers. They also send their local employees abroad for further training. A key motive driving many young

[9] https://aptantech.com/2020/11/18/algeria-egypt-nigeria-teams-among-winners-at-huaweis-global-ictcontest/.

engineers to work with Chinese MNCs, and Huawei in particular, is the learning opportunities provided by the companies.

Finally, they provide training to customers, like mobile operators and big firms, on the use of purchased equipment. In this respect, Huawei guarantees that major key players remain attached to the corporations' standards and branding and better equipped to resist attractions from other competitors.

14.4.3 Technology Spillovers Through Managerial Practices and Labour Mobility

Fieldwork findings suggest that the majority of high-level positions were filled with Chinese managers reaching 920 in 2015, third largest behind the French (1963) and the Lebanese (1146) (Hanniche & Bellache, 2020). Algerian workers were placed under the supervision of 20 Chinese experts sent from the company's various factories during the first few months of operation to ensure strict adherence to Huawei's standards. But due to growing labour costs in China, Huawei has, in recent years, localized a bigger share of their labour in North Africa, including in managerial positions.

This being said, interviewed workers at the plant highlighted the importance of the training provided and its role in boosting management skills in the manufacturing sector. In fact, the factory started operating with about 40 workers, among which 18 local engineers were sent to China to observe Huawei's factories and learn about production processes. Later the factory expanded to 140 workers as extra production lines were added. The plant is equipped with the latest generation equipment and uses the most innovative technologies and all of Huawei's know-how according to a Huawei representative. This means that local employees and engineers in particular could have access to latest technologies within a relatively short time and could upgrade their skills and know-how allowing thus for leap-frogging.

As trained workers at multinationals move to domestic firms or start their businesses, technology may be disseminated from MNCs to other firms within the same industry. Within the instances of labour mobility, former employees interviewed highlighted they had grasped a great deal of managerial knowledge that they could apply to their new work.

Similarly, interviewed start-up owners in Algiers who had previously worked for Huawei highlighted that they had gained significant managerial knowledge. Managerial knowledge tends to be overlooked in the literature on knowledge spillovers from FDI. Yet, just as technology, management practices can have a significant impact on a firm's productivity (Fu et al., 2011). The rate of integration becomes thus an opportunity for the MNC to enhance spillover both within its eco-system and outside.

This implies that more and more employees should be given the opportunity to hold managerial position in Chinese MNCs. Labour mobility should not be viewed

as a threat by Chinese firms but rather as a vehicle to expand Chinese management style to other companies and to other sectors in the country.

14.5 Discussion

Huawei's presence in Algeria is a good example of how flexible Chinese IT companies are when they venture outside, both before and after the Digital Silk Road. Aspects of what is universal are always present in particular circumstances, notwithstanding the evident constraint of generalizability on other Chinese actors from a single case study. Unpacking Huawei's tremendous dynamism in North Africa requires an understanding of large-scale training, CSR initiatives, and, more recently, manufacturing and R&D. With the help of this localization strategy, the Shenzhen based company was able to establish close relationships with a wide range of ecosystem participants and position itself as an active participant in the region's transition to the digital economy. Huawei has responded to Algeria's demands for greater value addition from foreign firms by embarking on a range of initiatives that promote technology transfer, such as large-scale training and manufacturing. We find that these initiatives have resulted in managerial knowledge spillovers even though the transfer of more technical knowledge has remained limited. These managerial skills spillovers, which specifically refer to the adoption of foreign management practices by domestic firms, have been recognized as powerful tools for promoting innovation and increasing productivity (Javorcik, 2004; Ning & Wang, 2018).

The spread of managerial information from Chinese multinational firms operating in North Africa could be significant if localization practices spread more widely among Chinese and local companies. First of all, localization enhances the integration of the foreign firm into the economic structures of the host country by promoting the employment of local human resources. Increased interactions with local players, particularly suppliers and subcontractors, means more chances for them to pick up knowledge from the international company. Second, localization fosters further spillovers at the managerial level by giving local staff members specialized training and first-hand experience with managing huge projects. The most seasoned local workers may then transfer these new talents deeper into the home economy through labour mobility (Auffray & Xiaolan, 2015).

Opportunities for managerial knowledge spillovers remain, with important implications for productivity gains in the digital sector. Moreover, with its energetic efforts in organizing ICT competitions, providing scholarships to students and grants to promising startups, Huawei may have a greater footprint on skill building than its competitors.

By bridging the cultural and linguistic divide between Chinese management teams and their local partners and employees, a good localization plan could also enhance the environment for managerial knowledge spillovers. Thus Huawei, had all the chances to bring the cultural and linguistic gap in Algeria, between its managers and its partners and employees. This was done through its training activities directed

towards local employees. Thus the 140 workers trained locally and then sent to Huawei were put in the cultural and linguistic bath in China. This contributed to making communication a lot easier and interpersonal relationship more frequent and intense going sometimes beyond work matters. In this respect Huawei managed to build bonds of trust in the relation and made it easier for local employees to acquire the technology.

The hiring of local managers who will deal directly with the firm's local stakeholders and workers is likely to boost communication and interpersonal interactions. This should make it easier for coworkers to become trusted, which will improve mentorship possibilities and learning environments, both of which are crucial for management knowledge spillovers. It's also feasible that regional managers are more suited to teach their associates and partners new knowledge.

However, following field investigation, the extent to which these knowledge transfer initiatives contribute to technological upgrading remains questionable. In an empirical study on Huawei's role in human capital development in Nigeria, Agbebi (2019) finds that the Chinese firm has contributed to skill building through its numerous training programs, including training activities targeted toward its local employees, suppliers, and customers, through organizing ICT competitions and providing scholarships to local students. In contrast, Tugendhat (2021) finds in a study looking at Huawei's training centres in Nigeria and Kenya that Huawei's presence fell short of offering meaningful opportunities for knowledge transfers that could promote technological upgrading in the two countries. He argues that international equipment vendors limit the scope of the knowledge they are willing to share with local employees and actors.

This is also the case in North African economies and Algeria in particular, in our view. Chinese tech players have helped to build sustained production capacity in telecommunications hardware and software, including a reservoir of well-trained local engineers. Yet, they perceive the risks of imitation are high and make deliberate efforts to hinder any meaningful understanding of the deeper functioning of their cutting-edge technologies. Some interviewees commented, however that by bringing more Chinese staff locally than other foreign competitors, Chinese firms like Huawei and ZTE provided more opportunities for exposure to engineers working on cutting-edge technologies and learning the latest practices and standards (Mattli & Tim, 2003).

While the Chinese corporation has pledged to contribute to upgrade local capacities through outsourcing, the rate of technological integration in the factory continues to raise questions, though as it did in other parts of Africa (Rwehumbiza, 2021). The assembly line's reliance on imported SKD (Semi Knocked Down) and CKD (Completely Knocked Down) kits, which are produced in China before being exported for the final stages of assembly, raised concerns among the experts interviewed. Thus, there is little room for technology transfer and little room for value addition in the manufacturing process. Authorities in Algeria called the practice "fictitious production" and "disguised import," which has become standard among various manufacturers.

These initiatives have not resulted in the meaningful transfer of technology and technical knowledge but have created instances of managerial knowledge spillovers that could support innovation in Algeria in the future.

14.6 Conclusion

Although the expansion of digital technologies in North Africa could drive economic and social development, this trajectory is not automatic. We will go along Tsui's questioning 'Do Huawei's Training Programs and Centres Transfer Skills to Africa?' (Tsui, 2016) in view of some limitations of knowledge transfer in Huawei's training centres (Tugendhat, 2021). Without pro-active policies aimed to maximize the gains from the digital economy, digital infrastructure built as part of the digital silk road risk increasing the technological dependence of North African countries, weakening their capacity to learn, innovate and move into competitive positions within the global knowledge economy. On the other hand, this is also the result of the absorptive capacity (Cohen & Levinthal, 1990) of local engineers and local firms. Furthermore, while joint venture requirements have been effective tools for technology transfer in practical terms (Blomström & Sjöholm, 2001), the experience of Huawei's factory in Algiers shows that these are unlikely to result in meaningful learning opportunities without more extensive local content requirements.

This study bears a variety of policy ramifications that might be relevant to nations beyond Algeria. If the region's leaders are serious about the digital economy stirring up growth and creating jobs, it is imperative to stop adopting the posture of mere consumers of tech products and services and start acting more like potential producers. This strategy may well also be the safest for protecting national data and ensuring cybersecurity.

In the coming years, North African governments, and Algeria in particular ought to ensure that cooperation agreements with China entail comprehensive knowledge and technology transfer mechanisms, including cooperation in research and development, and that Chinese investments yield quality jobs for the region's young population.

BRI countries should implement a set of digital industrial policies that encourage technology localization and productive linkages to reverse present trends. Governments would benefit from putting in place regulations that protect and assist the expansion of local businesses, simplifying their integration into intricate production networks (Ernst & Linsu, 2002), in addition to increasing investment in human resources and investing in domestic R&D skills. By drawing on China's own development history, regulations might help to guarantee that up-and coming tech leaders have the financial means and the necessary protection from intense international competition they need to successfully seize domestic markets and join and advance within global value chains. By increasing the quantity and calibre of exchanges, digital industrial strategies should also aim to promote learning from international digital enterprises. To do this, one strategy would be to mandate consortium bidding between domestic and foreign businesses. The tasks would need to be divided

between the successful bidders with explicit rules for technology transfers and clear compensations for each party.

Local public institutions also have a role to play in making local businesses visible to international businesses and compatible with them. Partnerships with both Chinese and non-Chinese businesses operating in the country could be facilitated by reducing information asymmetries and by building databases of available local companies and their skills. In the spirit of South-South exchange, greater regional cooperation could enable smaller economies to reap the full benefits of international digital initiatives like the Digital Silk Road. Smaller developing countries may find the concept of a regional digital policy, similar to the one governing the European Digital Single Market, advantageous (Azmeh et al., 2019). To boost their bargaining power with major tech corporations, African countries should further their regional integration. It should be possible to level the playing field for all African countries by moving past fragmented bilateral commercial deals with China and its tech giants, and doing so would ultimately increase opportunities for local agencies to design institutions that support inclusive digital development. The African Continental Free Trade Area (AfCFTA) adopted in March 2018 may constitute a favourable setting for pushing ahead the idea of a single African digital market.

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