The Open Innovation Paradigm:
from Outsourcing to Open-sourcing in Shenzhen, China

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Introduction

Having once been the headquarters of 'Made in China,' Shenzhen's industry is currently undergoing profound change. The appearance of new urban places for technological innovation is reviving the ageing industrial processes of this manufacturing city.

This new 'Made in China' plan, first suggested by experts (Li, 2015) and a few academics (Lindtner, 2014, 2015), is supposed to transform Shenzhen into the Silicon Valley of hardware. Two groups, one local *shanzhai*[1] community and the other a more international maker community, are thought to be the main drivers of this change using values of open innovation. This idea of rebooting 'Made in China' is widely present on the Internet and of course, has the support of the Chinese government (*zhongguo zhizao 2025*).

While both communities, the international makers and the *shanzhai*, draw on open innovation, they do not have the same goals nor the same values. For the *shanzhai*, open innovation means total deregulation and a kind of coopetition that poorly masks fierce competition. For the makers, open innovation does not entirely eliminate the classic tension between 'open' and 'closed' common in the world of makers (Garnier, 2014). These two communities, while both located in Shenzhen because of the advantages the city offers, still rarely collaborate.

This study, based on extended field research, focuses primarily on describing the models of open innovation in the Shenzhen electronics cluster. The first section presents the concepts involved in open innovation and the second section, its relationship to business strategies and to the characteristics of the society, the region, and the organizations involved. The third analyzes the electronics cluster's history and changes over time and the various models of open innovation places that developed in Shenzhen. The article concludes with a more detailed discussion of our findings about the various configurations of groups working in innovation.

1. Conceptual Framework: the Broad Paradigm of Open Innovation

Open innovation

The open innovation paradigm described by H. Chesbrough (2003), referring to strategies of R&D co-opetition, externalization and partnerships, gained currency among researchers at the turn of the millennium. Over the next ten years, the concept took on a broader meaning, no

[1] *Shanzhai*, literally meaning 'mountain village,' refers to counterfeit or coarse imitations of big brand name goods by artisans or small Chinese companies, particularly in electronics.

longer limited to the market. It came to be understood as a combination of an innovation model based on cooperation between firms (compatible with a market economy and new economic models) and a societal model, embodied primarily in the open-source software movement and more generally the spirit of ODOSOS (*Open Data, Open Source, Open Standards*) (West & al., 2014). This broadening of the open innovation paradigm occurred within the "spatial turn" movement (Dale & Burrel 2008, Warf & Arias 2009, Van Marrejick & Yanow 2010), which examines issues through their anchoring in a given geographical space, the capital (spatial, social and cognitive) in those spaces, and 'third places.'

Hacker spaces and fablabs: open production

With the generalization of digital manufacturing equipment and networks for exchanging content, the appropriation of open production triggered by open-source spread to hardware, now known as 'open hardware'. Rapid digital prototyping enabled bottom-up innovation, enabling the market to trigger industrial production and even financing processes based on participative funding platforms such as crowd funding. In broader terms, these new trends, boosted by urban production spaces (fablabs) and technological experimentation (hacker spaces), can be seen as a form of technological re-appropriation by urban users. Beyond the industrial planning of smart cities, a "fab city" was envisioned as "a city where citizens could have access to a new array of infrastructures, including public fablabs with close ties to private initiatives" (Diez, 2014).

Organizational learning and transformations in the supply chain

Digital technologies, as networks and as production tools, have helped expand the spaces of 'innovation by doing'. They enable, accelerate and concretize initiatives involving co-construction and/or collaboration between different actors in the innovation process.

2. Methodology

The innovation economy is built around the circulation of so-called intangible assets (ideas, designs, creative skills, design thinking, etc.) that constitute the intellectual capital of economic actors (individuals, businesses, manufacturing) (Dumay et al., 2011). Recent research using a relational view of economic actors (Bathelt & Glückler, 2011) have called into question

econometric approaches (OECD, 2013) by showing the importance of non-economic activities in increasing businesses' productivity.

To analyze the dynamics of open innovation driven by "third places," this study therefore adopted a relational perspective. We consider that a given region's ability to innovate is based on situated processes of creation and knowledge transfer and on its ability to bring together local actors as well as other actors with complementary activities outside the area.

This study examines places, which are synapses of a physical and virtual network for the creation of intellectual capital, and the key actors in these places, as nodes of the network.

Fieldwork occurred during two periods. In the first, from June to September 2012, a field study[2] was conducted on *shanzhai* telephones. Conducted in partnership with China Unicom, the purpose of this first phase was to analyze the ecosystem of the *shanzhai* telephone, the business models of the companies who makes these phones, the reasons for their success, their limitations, and the new dynamics at work in 2013 with the arrival of *shanzhai* smartphones.

Next, a period of desk research identified three meta-models of innovation places. The key places and actors in these meta-models were then identified by mapping the physical and relational spaces. This mapping sough to determine the emblematic character of the places for each model.

The first model identified a group of 'third places' mentioned in the relevant literature, namely a coworking space, a hackerspace, a hybrid of the previous two, and TechShop. These spaces are those of 'makers' with their media events, Maker Faire and the maker Carnival. As the analysis of these places has been discussed elsewhere (Renaud et al, 2015), the present paper will only briefly touch on these aspects.

The second model identified was that of an incubator/accelerator for hardware startups (Seeed Studio and Hax). The main goal of organizations with this model is to support creation and business development in open source. These places serve as bridges between the West and China.

The third meta-model identified was the cluster model with its various forms, such as the *shanzhai* where innovation is often confused with intellectual property violations. Examples are Huaqiangbai, the giant cluster of electronics suppliers and a synapse between the worlds of

[2] Three months of fieldwork in the Research Department for Electronics of the China Unicom telephone company, which resulted in a research report (Liang, 2012). All the data in section 3 can be found in this research report.

shanzhai and makers, and Bao'An, a creative cluster and an emblematic place of the proposed transformation of Shenzhen into the Silicon Valley of hardware.

These models were then tested in the second period of fieldwork of participatory observation from December 2014 to February 2015 in Shenzhen. For each of these places, fieldwork was conducted on site, including visits, an inventory of the objects and machines present, and interviews with the key actors of these places. Using the "person-to-person" method of the Chicago School (Gotman & Blanchet 2007), we gradually validated or enriched our study design through interviewing these networks' key informants.

Twenty-seven key informants were interviewed in nine different places, covering all three models observed.[3] Participants were questioned about the value proposition and business model of the place, the sociological profiles of users for models 1 & 2, relations with local and international actors (institutions, users, competitors, etc.), the image of open source, and the actual practices of open source in their daily work context. These site visits were supplemented by meetings with several important people of the innovation ecosystem in China.[4]

2. Ecosystem Dynamics in Shenzhen

Starting in the early 1980s, Western firms took advantage of major reforms in China (*gaige kaifant*) to relocate manufacturing to the Shenzhen area in the Pearl River Delta (Al & Al, 2012; Richet & Ruffier, 2014). As this was China's first 'special economic zone' and was close to Hong Kong's legal and banking systems, it became an ideal location for electronics manufacturers (Magretta, 1998).

The Shanzhai *Cluster*

With the rapid growth of the components market in the 1990s, suppliers created standards to accelerate their products' commercialization. The appearance of kits containing a set of parts

[3] For the clusters, which we consider here as one space, several different companies within them were interviewed.

[4] All of the data is housed on a server of the French National Research Agency (ANR) as open data. As part of the larger research project funded by the French National Research Agency (http://www.agence-nationale-recherche.fr/?Project=ANR-13-SOIN-0006), other 'third place' models of innovation were examined in other regions of China (Shenzhen and Nankin) that corresponded to different socio-economic configurations.

and a manual (Chien & Wang, 2010) enabled a host of small manufacturers to produce countless models of mobile phones at a low cost. These phones are known as *shanzhai* (Keane & Zhao, 2012; Liang, 2012), that is, midway between counterfeits and originals.

In the 1990s, some entrepreneurs took advantage of the city's geography, in that it is close to Hong Kong and close to parts suppliers, to counterfeit Nokia and Samsung handsets for the domestic market. The initial letters of Shenzhen (SZ) on the phones enabled them to circumvent national quality controls. Gradually, these phones came to be called *shanzhai* phones.

In 2004, the Taiwanese company MTK developed and sold its 'turnkey' processors at a low price, which 'democratized' telephone manufacturing. Gradually, as the market in *shanzhai* phones grew, manufacturers turned away from simply copying others and started improving the materials and the features. In short, they realized they could innovate. They then acquired the capacity to make smartphones that were sold worldwide. 80 million units, accounting for one third of the phones made in China, were sold in 2011 (Liang, 2012). This *shanzhai* smartphone industry employed three million people in the Pearl Delta Region. In 2012, about 10,000 companies worked in this industry in the Shenzhen region (including approximately 2,000 phone manufacturers, 200 solution providers, 100 design firms, 1,500 national and regional buyers, and 3,000 materials suppliers.

> Shanzhai phone manufacturers understood the needs of modest communities and so they made cheaper phones. They were successful thanks to these small communities, even though the *shanzhai* phone industry has had some problems.[5]

Extreme competition led *shanzhai* phone makers to want to differentiate themselves, and thus they adopted an iterative innovation model used by small production units around Shenzhen.

Shanzhai phone manufacturers followed a different strategy than that of major manufacturers. Of course, they were able to incorporate all the latest technologies (MP4, television) at a lower cost thanks to MTK processors. But above all, their success resulted from the fact that they were able to target each community of consumers differently, their manufacturing cycle is shorter than the big brands (six weeks), and almost seasonally they adapt to market demand with agility and flexibility. Shanzhai manufacturers need neither patents nor essential technologies, as they get the latter from the ecosystem leader, MTK. However, coopetition is ruthless and when a success story such as Xiaomi emerges from the

[5] Excerpt from the interview of the Head of the Electronic Products Research Team at Shenzen.

mass of startups, their growth strategy comes to resemble that of well-established manufacturers: creating proprietary distribution networks, increasing R & D, and 'rediscovering' intellectual property and its rights. In addition, research laboratories and telephone providers have developed thanks to support for innovation provided by the city of Shenzhen.

Huaqiangbei, the Suppliers Cluster

These clusters have grown thanks to the advantages of the Pearl Delta region: the international port of Hong Kong, half of all telephone factories in Dongguan, materials suppliers, distribution centers, and sales platforms.

Products and components are sold in the Huaqiangbei district of Shenzhen, the world's largest electronics marketplace: a giant cluster consisting of a dense network of retailers and wholesalers. Huaqiangbei serves as a showcase both for international buyers and for the local industry, which it supplies with accessories, machines, and components. In recent years, Huaqiangbei businesses have been feeling the effects of competition from the Internet and orders for equipment and components are mostly B2B. Mass producers of components have also set up marketing and sales services that directly rival retailers. These manufacturers' lack of technological expertise often prevents them from diversifying to more advanced technological fields.

Nick has worked in Huaqiangbei for several years as an exporter to India and Bangladesh:

> Let me explain the *shanzhai* business. The manufacturers invest zero in research, absolutely nothing. First, they buy design from design houses that will provide them with the hardware design and the software. Then it is all about competing on prices. Who knows the right guy to get cheaper parts and components, who can save one on this and two on that, who has faster machines, that guy will win the market. They all use same package, same model name even, same everything, but the parts are getting cheaper really quickly. If you have a new product coming out, I know that the price will usually go down very quickly in a few days.

Nick also explains the end of Huaqiangbei:

> All the businesses in HQB are family businesses. They don't do much work

outside the family. Shanzhai manufacturers don't take part in anything else: they don't design, they don't sell. People just focus on executing what they know in a better or cheapest way. Now that manufacturers are getting in sales and marketing as well, nobody knows how to continue.

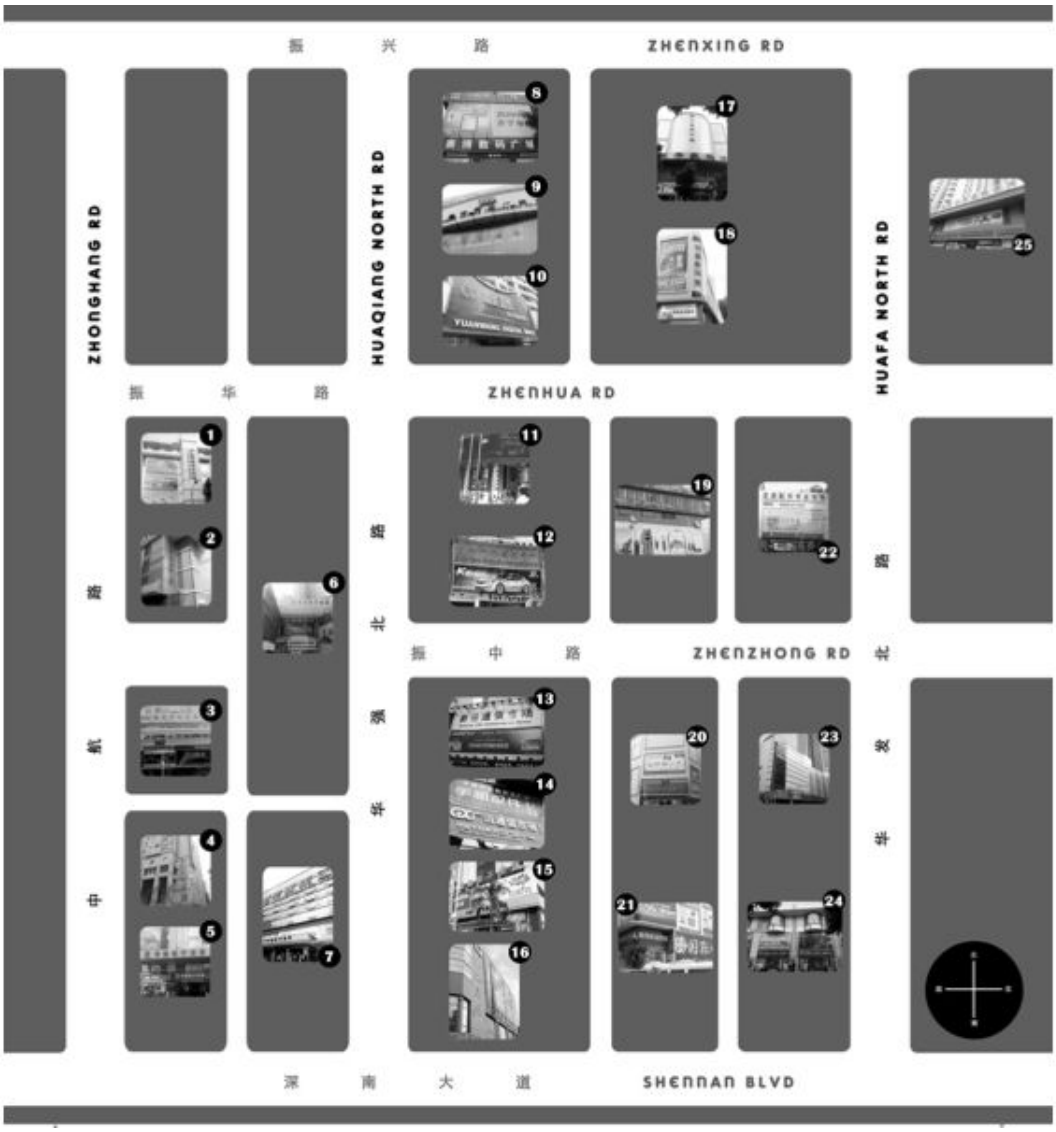

Figure 1. The Makers' Quarter of Shenzhen (source HaxLR8 modified by the authors)

1. Golconda Electronics Market
2. Sun Asia Electronic Market n.2
3. Sun Asia Electronic Market
4. Duhui Electronic Market
5. HQ-Mart Shenzhen n. 3
6. HQ-Mart Shenzhen n. 2
7. HQ-Mart Shenzhen n. 1
8. Matihar didital plaza Branch

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9. Matihar Commercial Co
10. Yuanwang digital mall
11. Cyber mart
12. Industrial production exhibition
13. Shenzhen SEG Communication Market
14. China mobile phone accessories Factory shop
15. Baohua building (SEG electronic market n. 2)
16. Seg electronic market
17. Zhenhua digital market
18. Ming Tong Digital city
19. Huitong security digital harbour
20. Tai Ping Yang security equipments market
21. International electronic mall foreign trade wholesale market
22. Longsheng accessories professional market
23. Golconda cyber plaza
24. Zhong dian digital market
25. Sed electronic communication market

The industrial economic downturn prompted China to jettison the labor-intensive model and instead to develop a more sophisticated manufacturing sector. The Chinese government announced a ten-year plan called *Made in China 2025* (*zhongguo zhizao 2025*) to promote R&D initiatives and nurture high-tech industries. The Chinese Premier has been to Shenzhen to visit *Chaihuo,* the city's hackerspace, where he pledged to support these new innovators who are at the forefront of China's modernization (PRC, 2015).

While the government's discourse at national level is that of modernizing factories from the old Made in China era, at the local level in Guangdong province in particular, we observed that these small factories, instead of evolving, are closing and are being replaced by large companies offering a range of integrated services including design, sales, marketing and production. More specifically, in the field of telephony, five companies now have 60% of the mobile phone market of Chinese brands (excluding foreign brands).

2015年二、三季度中国智能手机市场份额

厂商	2015/3	2015/2
华为	18.7%	17.9%
小米	12.7%	14.0%
联想	12.7%	12.5%
TCL	10.4%	9.7%
OPPO	8.7%	9.7%
其他	36.8%	36.2%

数据来源：TrendForce

智能手机市场份额

2015 Q3 Market Share of China Mobile Phones. Source: Sina Finance[6]

4. Models of Places and Innovation in Shenzhen

The challenge for Shenzhen is to bring together the required skills in engineering, design and marketing and existing manufacturing resources. Several hybrid models between the factory, the incubator, the coworking space, and the applied research center have thus emerged around the city,

[6] Caijin, http://finance.sina.com.cn/chanjing/sdbd/2015-12-21/doc-ifxmttme6044290.shtml, accessed 2 December 2012.

resulting in highly innovative initiatives.

Figure 2. Map of the Makers' Ecosystem (source HaxLR8R, modified by the authors)

Bao'an District: a Creative Industrial Cluster

Bao'an District is a cluster of factories specialized in manufacturing and assembling electronic products (Ng, 2011). Well-connected to transport networks and Shenzhen's underground subway, the Xixiang neighborhood in Bao'an offers attractive rental rates for small businesses and a local government open to innovation proposals (Want & Ze, 2010).

Although little research has been done on this area, this largely industrial district offers several interesting case studies such as the F518 cluster, located at the center of the district. This creative cluster caters to a specific demand: the design and production of connected devices. Based on a strict recruitment of firms by sector to ensure that the cluster has a portfolio of complementary competences – including design, electronics assembly, marketing service, and packaging – this cluster run by the local government offers a single point of contact. From the idea to the sale, the cluster meets customers' demands not only for design but also production: "We work with the

hundreds of factories in the area. In recent years we have learned to know them well, and there are too many to name them all," explained Huang Xi, the manager. With over twenty products designed and manufactured, this cluster is constantly growing and is currently having new offices built to house more firms.

The majority of companies in the 518 cluster are subcontractors established in the Bao'an district. The manager of the cluster of companies in 518 explains:

> Let's say you want to make a phone. You can do everything at 518: industrial design (electronics), appearance. Any design can be made here. Then you can also do the packaging design. Once finished, you can also print in Bao'an. . . .From idea to market, the businesses of 518 and the Bao'an district can do everything. This is what we call the supply chain model.

Thus, cluster 518 groups together subcontractors whose services are mainly for factories wanting to design their own goods.

From Electronic Design to Production

Another typical example is that of electronics designers who are gradually turning to production to become Small Electronics Manufacturers (SEM). We analyzed two such young firms, Mixtile and Cubietech, located at the heart of Chegongmiao, the neighborhood occupied by most electronics designers. Both develop open-source development boards based on ARM processors, which can easily be used to produce a prototype. The founders of Mixtile, Eric Dong and Martin Liu, said that they chose open source to be able to focus on quality: "Designing hardware products is difficult…. In traditional *shanzhai,* one has to move fast, very fast. Products are outdated immediately. With open source one can take more time and aim for quality, find good suppliers and develop a brand." In the case of Cubieboard, Mike Lee agrees, "We can develop new models progressively. If necessary, we can add on or take off functionalities to meet our customers' specific demands. Our Cubieboard 2 is used by a Singapore firm that designed a 3D printer." Located in the Bao'an district, Cubitech as access to the manufacturing resources of the surrounding firms, but the relationships are not always good. The founders of Mixtile have the same problem, as they explained, "The factories are dirty places and we don't want to go there. In fact, all the orders go via Internet." Both firms want to become better known and to acquire more clients thanks to their open-source products. They thus want to propose manufacturing services based on modified

versions of their products, as well as design and customization services. Open source provides them with an opportunity to orient production towards a quality approach, to counter the bad image of 'Made in China', and also to avoid the terrible pressure of the rhythm of *shanzhai* products:

> We have classmates in the shanzhai phone business, and it is very tough. For instance, he has to get his products out before August to make money, because the product lifecycle is 3 months maximum. If he doesn't success, then it will bankrupt. So he is always running, rushing, working… This is very hard work, very tiring. You can make a lot of money but it is very dangerous. For instance, for a phone costing 100 yuan the designer maybe just get 5 yuan, so he needs to produce a lot to make money. If it is good and on time, he can have big return on his investment. If not, he is finished. For guys in *shanzhai* business, a deadline really means dead!

Based on open source, the value proposition for these companies is quality design, based on the agile method (designs are sent to production via the Internet), and meeting demand.

The Incubator-Factory: a Step Up from the Fablab

The strong trend in information technology and innovation markets towards connected devices is naturally found in Shenzhen where resources abound. Several initiatives have sought to build bridges between the Californian innovation culture and Shenzhen's resources.

One of these, Seeeds Studio, founded in 2008 by former Intel employee Eric Pan, makes hardware models for open-source projects. It has an assembly line, a warehouse for inventory, a prototyping laboratory, and produces electronic objects for small and medium-sized series. Projects are often started with crowd funding and then presented to Seeeds Studio as a prototype. Seeeds then takes care of industrial design, production, and shipping the products throughout the world. This fast-growing firm with over 180 employees helps start-ups scale up production from "ten to 10,000 units." It is located in the industrial zone of Liuxiandong in the Nanshan district, close to electronics producers and assemblers. Since 2011, it has also had a space called Chaihuo in the Overseas Chinese Town cluster, one of Shenzhen's key areas for designers and easily accessible for visitors. Every year, the firm also heads the organization of Shenzhen's Maker Fair, now a forum for encounters between these new Chinese industrial innovation models and the global community of innovators. Moreover, Seeeds Studio recently opened offices in California to facilitate access to its services for start-ups in connected devices, whose number is growing

exponentially.

Another organization bringing Californian start-up culture to Shenzhen is HAXLR8R, an incubator for hardware projects located at the heart of Shenzhen's electronics market. Founded in 2011 by a group of Californian investors, it has created a project-development methodology called Lean Hardware, based essentially on using resources in Shenzhen to build the supply chains of the startups that are supported by HAXLR8R. The incubation program lasting 111 days covers all important points from production to export regulations and marketing strategies. The majority of projects are launched in a campaign on crowd-funding websites. Projects are also launched on Demo Day in San Francisco to take advantage of the presence of California's media. The early results of this incubator are highly encouraging, since the start-up success rate is over 85%.

All of these places serve as nodes for an upstream funding network for the crowdfunding of open source and for producing small and medium series with a balanced cost model thanks to open source. In fact, open source enables companies overcome certain problems:

- economies of scale / scope

- re-design / design for making / production / distribution

5. Discussion: Innovation Models Grounded in the Local Context and Promoted by Open Management Processes

The essential idea is the role of open source in the emergence of new value chains, driven by new kinds of fablabs, which manufacture in small and medium series. Open source lowers the design and production costs and meets a variety of demands. It also enables an optimization of the design for agile production and re-designing due to the low cost of prototypes. Moreover, open source facilitates the emergence of small companies specialized in complex electronic design (for the Internet of Things) for manufacturing distributed via the web.

The birth of the "maker movement" (Anderson, 2013) has raised new questions on not only

about the creation of physical objects and devices connected to Internet, but also, more broadly, on their role and their status throughout the urban fabric. How can the new industrial dynamics by driven by innovation be integrated into regions with different histories and identities? The city of Shenzhen offers one example of the appearance of new models that have directly grown out of its history and its regional characteristics. Here, the city's industrial past (capital, workforce, basic knowledge and recent knowledge) served as a base for building and attracting communities of innovators and for connecting with another land of innovation, California.

In California, the high-tech industry benefited extensively from open-source technologies and open innovation. They significantly accelerated the development of start-ups that went on to become large firms, especially in the field of the Internet. In the Shenzhen ecosystem, the *shanzhai* open innovation model was a catalyst for the rapid development of a "distributed" manufacturing fabric, alongside the classic industrial model. This *shanzhai* model of multiple small companies specialized in manufacturing has since served as a resource for the growth of a high-tech industry that in many respects echoes the Fab City project[7].

An important ingredient of the modernization of this industrial fabric making Shenzhen an innovative ecosystem has been open access to documentation on the technologies involved and their associated practices (open source). This documentation not only enables users to learn new, collaborative ways of working on a global scale, but also for manufacturers to guarantee the quality of their products validated by the user community, and to benefit from this community as a marketing resource. Open innovation is at the center of the modernization process because it accelerates business development and employee training. This culture of continuous learning and re-use of existing resources thus sometimes takes place in places that already exist, but which are now occupied by new actors who promote open innovation dynamics.

Thus, what is the 'maker' culture in China today? DIY has its places in the hackerspaces that emerged in Shenzhen, but everything happens around Seeed Studio, the main physical 'enabler' and a physical third place helping US do-it-yourselfers manufacture and market their products. Seeed Studio thus helps startups scale up to the level of industrial production.

This industrial network is also adept at *Shanzhai* methods of absorbing / adapting / prototyping and testing new products very quickly. The *shanzhai* ecosystem became an innovative

[7] http://fab.city/, available 2016/01/22.

manufacturing system mainly because it bypasses the legal system of intellectual property. It is hardly surprising that this attitude toward copyright has received a favorable response in the maker movement.

Ultimately, the Chinese market blurs maker identity by contributing different qualities and values. For example, a "pressy" button for phones financed by a crowdfunding campaign sold for $27 in October 2013. Three months later, a "speed" button was sold for $3; six months later, Xiaomi sold its version Mikey for $1, before Qihho gave the "smart" button to developers for free. Here, they copy, they lower prices, and end up giving products away for free hoping to create an ecosystem around themselves, similar to MTK in Shanzhai. In China, the externalities and the DIY ecosystem are different from those in the West. WPG Holdings, one of the largest electronics distributors in Asia, makes Chinese version open source. They design cards for factories and for designers that will be integrated to phones, tablets, watches, computers, etc. In another example, ATU designs 130 cards per year, free of charge, because what they mainly sell are the components of these cards, allowing them to attract creative companies (but not always very rich or necessarily Western) in order to design new cards.

This new form of open innovation follows the tradition of the *Shanzhai* ecosystem headed by MTK and is similar to Western open source innovation, but should not be confused with it; this story is not simply that of Western empowerment.

Conclusion

This case study of electronics manufacturing in the Shenzhen area shows that open innovation models can support and accelerate the modernization of declining industrial sectors when these models are based on the economy and the industrial characteristics of the region. By examining the various models of innovation observed, we found that all were based on pre-existing technical and economic circumstances that they used in new ways to grow their business. Hence, the Californian innovation model that underpinned the development of the Internet and the Shenzhen innovation model in the hardware field cannot be applied or reproduced elsewhere, for they are intrinsically bound to the territories in which they emerged.

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