Is Disruptive Innovation in Emerging Economies Different?

Evidence from China

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ABSTRACT

Most studies on disruptive innovations have focused on developed economies and very little work examines this type of innovation in and from emerging economies. Moreover, previous studies on disruptive innovations have not investigated the processes behind these innovations. This study begins to fill these research gaps. Analysing disruptive innovations in and from China, we identify three important differences from the kinds of disruption observed in developed economies. First, rather than being based on launching products with inferior performance, disruptive innovations in China focus on offering different value propositions. Second, the rate at which Chinese disruptive innovations are improved and extended is typically faster than in developed markets. Third, Chinese disruptive innovations are often launched directly into a mass market rather than a niche. Besides identifying these differences, we also discuss how Chinese firms generate disruptive innovations. The findings of our study expand our understanding of disruptive innovation and hence enrich the existing literature on this important phenomenon.

1. Introduction

Since its introduction two decades ago, disruptive innovation has become one of the most influential concepts in management and innovation research, drawing enormous attention from both managers and academics (Adner, 2002; Christensen, 1997; Christensen et al., 2018; Danneels, 2004; Immelt et al., 2009; Dedehayir et al., 2014; Markides, 2006; Radnejad and Vredenburg, 2019; Si and Chen, 2020; Tan et al., 2020; Tellis, 2006). A Google search on "disruptive innovation" returns over 3 million entries, easily making it the most popular innovation term. Books on disruptive innovations especially by the late Clayton Christensen have become global best sellers and are widely read by MBA students and business executives, including two iconic figures, the late Steven Jobs and Andy Grove, the former chairman of Intel. It is, therefore, not an exaggeration to claim that the notion and theory of disruptive innovation have become a cornerstone not just for innovation management and research but for wider general management's theories and practices.

However, despite the theoretical significance of this theory and the increasingly important role played by innovations, in particular disruptive innovations, in driving the growth of firms and overall economies, this theory suffers from two main limitations. First, very little academic research has focused on investigating the phenomenon of disruptive innovation in and from the emerging economies. Most of the research on disruptive innovation has been conducted in the context of developed economies. Yet there is increasing evidence that disruptive innovations observed in emerging economies such as China exhibit different characteristics from those observed in developed economies (Wan et al., 2015). Christensen et al. (2018, p. 1044) foreshadowed the idea that the nature of disruptive innovation might vary with its context, alerting us to the fact that: "*given the contingent nature of disruption theory, applying a one-size-fits-all solution is a particularly egregious mistake*". The significance of this omission is increasing as emerging economies, especially

China, become an important source of disruptive innovation, impacting both local and global markets (McKinsey, 2015).

Second, few studies have examined the processes through which a firm can systematically generate disruptive innovations (Wan et al., 2015; Yu and Hang, 2010). Understanding the underlying innovation processes is important for both incumbents and new entrants in either launching or defending against disruptive innovation.

This article begins to fill these research gaps by investigating two research questions. First, what are the key differences in the nature of disruptive innovation observed in developed versus emerging economies such as China? Second, what are the processes through which Chinese firms effectively and systematically generate disruptive innovations and how do these differ from those typically observed in developed economies? In answering these questions, we first present an in-depth analysis extant theories of disruption innovation in order to establish a baseline for the phenomenon in developed markets against which disruptive innovation in China can then be compared. By analysing a series of case studies of disruptive innovation launched by companies in China, including Huawei, Xiaomi, Chint, Lenovo, and BYD, we then compare and contrast these with the base-line characteristics of disruptive innovation in developed markets.

Based on this comparison, key findings are threefold. First, while disruptive innovation in developed markets generally begins with challengers launching products with inferior performance in the face of over-specification by incumbents relative to customer requirements, disruptive innovations in China focus on offering a range of differentiated value propositions. Second, Chinese disruptive innovations tend to be launched at an earlier stage in the product life cycle (Williamson and Yin, 2014; Zhang et al., 2017) and are also improved and extended more rapidly than in developed markets. A third finding is that

Chinese disruptive innovations often rapidly achieve large scale sales volumes because they are directly launched into the huge mass market rather than into niche segments.

In addition to characterising these important differences between disruptive innovations in and from China and those in developed economies on which the original theories were based, our study has also identifies five major processes through which disruptive innovations in China are generated by firms in various industries. These processes involve substituting high cost materials with low cost ones without compromising performance, de-automating the production process, R&D industrialization, parallel product development, and modularization in product development.

These findings have important theoretical and managerial implications. In terms of theory, our study is to our knowledge the first to explore whether the characteristics of disruptive innovation vary according to the economic context. Specifically, whether the nature of disruptive innovation differs between developed economies and emerging economies, in this case represented by China. The systematic differences we identify suggest how existing theories of disruptive innovation might be further developed and extended to incorporate the ways in which the context of emerging economies shape the fundamental characteristics of the disruptive innovation phenomenon.

Managerially, by extending and deepening our understanding of different types of disruptive innovation and the processes Chinese firms use to generate it, our findings can help firms from other parts of the world to more effective develop and launch their own disruptive innovations.

The remainder of the paper proceeds as follows. First, we distil the key characteristics of disruptive innovation developed in the extant literature. We then compare and contrast these with the characteristics we observe across our sample of case studies of disruptive innovation developed in China. Next we turn to investigate the processes and mechanisms Chinese

companies use to generate their distinctive types of disruptive innovations. In the concluding section, we discuss the theoretical and managerial implications and suggest directions for further research.

2. Characterisations of disruptive Innovation in extant literature

Building on a series of previous research on innovation (Abernathy and Clark, 1985; Henderson and Clark, 1990; Schumpeter, 1942), Christensen (1997) first comprehensively examined the concept of disruptive innovation primarily in the context of the disk-drive industry in his seminal book titled *The Innovator's Dilemma*. This phenomenon was later studied in the context of other industries such as steel production (Christensen, 1997), semiconductors (Christensen, 2006), motorcycles and cars (Christensen and Raynor, 2003), pharmaceuticals (Kapoor and Klueter, 2015), and digital video recorders (Ansari et al., 2016).

According to Christensen, disruptive technologies are technologies that provide different value propositions compared with mainstream technologies and are initially *inferior* to mainstream technologies along the dimensions of performance that are most important to mainstream customers. In its early development stage, each product based on a certain disruptive technology could only serve *niche* segments that value its non-standard performance attributes. Subsequently, further development could improve the performance of the disruptive technology to a level sufficient to satisfy mainstream customers by focusing solely on key attributes. This was often possible because the performance of the mainstream technology may have already exceeded the demand of mainstream customers, resulting in 'performance overshoot' with over-served customers. Market disruption then occurs when, despite its inferior performance on focal attributes valued by existing customers, the new product displaces the mainstream product in the mainstream market. There are two preconditions for such a market disruption to occur: there is performance overshoot on the

mainstream attributes of the existing product, and there are asymmetric incentives between an existing healthy business model and the potentially disruptive business model. Christensen documented these processes in numerous contexts including hard disk drives, earthmoving equipment and motor controls.

In *The Innovator's Solution* (Christensen and Raynor, 2003) the authors proposed that the innovator's dilemma could be resolved by well-managed incumbent firms by developing disruptive technologies from their sustaining competitive paradigms, hence avoiding their own dethronement. Interestingly for our current purpose, however, in this second book they replaced the term "disruptive technology" with a new term "disruptive innovation", suggesting the application of the theory could be broadened to include not only technological products, but also services and business models innovation, such as discount department stores, low-price, point-to-point airlines and online businesses education. Christensen (2006) admitted that he made a mistake to label the disruptive phenomenon as a disruptive technology in *The Innovator's Dilemma*. Disruptive innovations do not necessarily improve to surpass the performance of the prior technology. In other words, innovations often prove disruptive not as a result of using a different technology but because they embody a different business model.

Building on this idea, Markides (2006) classifies disruptive innovations into different types: technological, business model, and radical product innovations. All of these different types of disruptive innovations may follow a similar process to invade existing markets and may have equally disruptive effects on incumbent firms. But Markides argued that a disruptive technological innovation is a fundamentally different phenomenon from a disruptive business-model innovation as well as from disruptive product innovation: These innovations arise in different ways, have different competitive effects, and require different responses from incumbents. Two criteria can be used to distinguish disruptive innovation

from other types of innovations. First, whether they start out as inferior in terms of the performance that existing customers expect, but superior in price competitiveness. Second, whether they evolve to become "good enough" in performance while at the same time remaining superior in price. He argues that both of these characteristics are necessary for an innovation to be disruptive (Markides, 2012).

These characteristics have been distilled overwhelmingly from the analysis of innovations arising from developed market contexts. This begs the question of whether the characteristics of innovations that prove to be disruptive in the context of emerging markets might be different. Very little academic research, however, has focused on investigating the phenomenon of disruptive innovation in the context of emerging economies. This represents a potentially major omission from both the theoretical and managerial perspectives for a number of reasons.

First, emerging markets are increasingly becoming an important source of disruptive innovations, both in local markets and globally (Azevedo, et. al, 2016). China is the leading example. As McKinsey (2015) point out, however, the Chinese context differs substantially from that of developed markets in ways that might reshape the nature of disruptive innovation. Specifically: its massive and extremely dynamic domestic market; the world's largest and most diverse industrial manufacturing ecosystem, and the strong government support for innovation. It is reasonable to expect, therefore, that disruptive innovations in and from China might be different from their western counterparts in important ways.

Second, in recent years, there are increasing number of Chinese companies succeeded in disrupting global competition using what appear to be non-traditional strategies (Yip and Mckern, 2016). Examples include Huawei, Lenovo, Haier, Xiaomi and a number of other lesser-known companies in sectors as diverse as telecommunication equipment, PC, home appliance, solar panel, and wind turbines (Williamson et al., 2020). If disruptive innovations

in and from China exhibit different features and they are disrupting the global competition, it is important for theory to expand its definition of disruptive innovation and its characteristics.

Third, differences in the Chinese context for disruptive innovation might lead to differences not only in the types of disruptive innovation we observe, but also in the processes that lead to these distinctive types of disruptive innovation. Understanding the potential differences in these innovation processes is important both for the development of theory and for managers wishing to initiate or defend against disruptive innovation.

Having identified the key characteristics that theory developed almost exclusively in the context of developed markets, viz: starting out with inferior performance but superior price competitiveness; gradual performance improvement; and expansion from a niche market segment, we now turn to examine whether Chinese disruptive innovations appear to be different.

3. Distinctive disruptive innovation in and from China

Taking in turn each of the key characteristics that extant theory suggests distinguishes disruptive innovations form innovation more generally, we compare these with those characteristics identified using case studies of disruptive innovation in and from China.

3.1. Inferior performance on dimensions of performance valued by mainstream customers

As already noted, the theory developed by Christensen and his colleagues (1997, 2006, 2018), characterises disruptive innovations as underperforming the dominant incumbents along the dimensions mainstream customers in major markets have valued, but they have other features a few fringe customers value, such as "cheaper, simpler, smaller, and, frequently, more convenient to use" than those established ones (Christensen, 1997, p. xv).

By contrast, we observe many Chinese disruptive innovations that offer a fundamentally different value proposition and one which is not necessarily inferior even to mainstream customers. These innovations may not be able to reach the heights of technical performance of offerings at the top end of the market, but they match the performance of existing products in the mainstream market through a different route.

Take the example of Zhongxing Medical, that transformed the medical equipment business by focusing on direct digital radiography (DDR) in a novel way. DDR transforms an X-ray scan into a digital signal that a computer can analyse, bypassing the traditional chemical process. There are two types of DDR systems: Line-scan machines, which work best for standard procedures such as chest scans, and flat-panel imaging systems, which are ideal for sophisticated applications like heart scans.

In DDR, General Electric and Philips focused on developing flat-panel machines, which each carry a price tag of over $400,000 to appeal to the high end of the market offering the largest profit potential. In the mass market for every-day applications such as chest x-rays, they continued to sell machines based on analogue, chemical technologies. Zhongxing Medical launched a DDR machine into this mass market based on line-scanning technology licensed from the Russian Academy of Sciences which cost only around $20,000 to build. Zhongxing's offering quickly gained share in the mass market, displacing the incumbents (Zeng and Williamson, 2007: ch 2). What is particularly interesting about this disruptive innovation is the fact that despite its much lower price tag, its performance was actually *superior* to the analogue-chemical machines that dominated the mass market.

Zeng and Williamson (2007: 58) described this type of disruptive innovation as "high technology at low cost". Zhongxing subsequently continued to invest to further improve the performance of its of line-scanning devices, reducing scanning time from 10 seconds to two seconds and making the process more comfortable for patients. But it is notable that even at

launch the technology their disruptive offering embodied was at a level similar to that prevalent in the high end market. This is an example of a broader class of disruptive strategies that Zeng and Williamson (2007) labelled “cost innovation”.

Cost innovation refers to reengineering the cost structure in novel ways to offer customers more value for less cost. This superior value may be achieved bringing to the mass market higher technology that incumbents have reserved for the high-end segment or by offering similar technology combined with higher levels of variety and customization (Zeng and Williamson, 2007). A good example is the harbour machinery maker Shanghai Zhenhua Port Machinery Company (ZPMC) which founded in 1992. After establishing its leading position in Chinese market, the company disrupted the global market by providing an unmatched choice of products into what used to be considered standardized segments. The number of design engineers employed by ZPMC at relatively low cost is between 20 and 40 times the number of design staff hired by their German and Italian competitors. This massive design capability allows ZPMC to offer a high variety of products and customize its equipment to the specific requirements of any port operator's site but still at low price. For example, in 2011 the company built a main bridge tower and completed 28 customized bridge decks for San Francisco Bay Area in the USA by employing 3,000 workers.

Cost innovation is quite different from what has been widely described in the literature as “frugal innovation”. Hossain et al. (2016: 133) define frugal innovation as “a resource scarce solution (i.e., product, service, process, or business model) that is designed and implemented despite financial, technological, material or other resource constraints, whereby the final outcome is significantly cheaper than competitive offerings (if available) and is good enough to meet the basic needs of customers who would otherwise remain un(der)served.” Frugal innovation, therefore, is generally aimed at serving the poor, “bottom of the pyramid” consumers (Prahalad, 2006). Cost innovation, by contrast, is aimed at

offering distinctive value to mainstream, mass markets at lower than prevailing prices. Hence it embodies a very different kind of disruptive force from frugal innovation.

Porter (1980) argues that a company can either choose to be a quality leader or cost leader. Yet, disruptive innovations in China seem to have managed to overcome this inherent dichotomy and create the third possibility or a hybrid value proposition that combines the best from both worlds: low cost and high value through a mix of deployment of high technology to mass markets, offering greater choice of varieties, and greater customisation. Once established in the mainstream domestic market, many of these disruptive cost innovations expand globally and succeed in challenging multinational incumbents.

This analysis leads to the following proposition:

Proposition 1: *Disruptive innovations in and from China tend to embody improved value propositions at lower cost through cost innovation, rather than reduced prices achieved by deploying inferior technologies.*

3.2. Gradual performance improvement

Recall that extant theories of disruptive innovation characterise it as gradually evolving to become "good enough" in performance while at the same time remaining superior on price. By contrast, we find that the rate at which Chinese disruptive innovations are improved and extended is typically faster than in developed markets. This is underpinned by what has been labelled as “accelerated innovation” by previous work (Williamson and Yin, 2014) which we explore more fully when examining the processes behind Chinese disruptive innovation in the next section.

This differentiating feature of disruptive innovation in China probably has its roots in the dynamism of Chinese markets compared with more stable developed markets. In China, the market is highly fluid partly because of lighter regulations such as weaker legal protection for intellectual property rights and poor enforcement of commercial laws (Cuervo-Cazurra and Genc, 2008). Moreover, the behaviour of western customers tends to be heavily

influenced by a large installed base of durable goods and legacy purchasing decision and established brand loyalty. Chinese customers, on the other hand, having experienced rapid economic development, are less incumbered by legacy are often less loyal to existing products and brands and are more willing to experiment with new offerings (Mooij, 2019). In this environment firms can rapidly achieve radical shifts in their competitive position (Adner, 2002; Adner et al., 2014; Adner and Zemsky, 2006). As a result, companies in China generally focus on bringing innovations rapidly to market. This emphasis is reinforced by the fact that disruptive innovation lacks extended periods of competitive advantage associated with radical technological breakthroughs. As Bower and Christensen (1995, p. 3) note: "the technological changes that damage established companies are usually not radically new or different from a technological point of view."

In consequence, Chinese disruptive innovations tend to be based on bringing cost innovations to market expeditiously (Williamson and Yin, 2013). As Mr Jun Lei, the founder and CEO of one of the most prominent smartphone companies in China, Xiaomi, famously put it: "In China, the best innovation is the one that is the fastest to the market (not necessarily the best in its value)." Following this approach Xiaomi Technology, established in 2010, soon became a leading company in consumer electronics industry. Xiaomi released its first smartphone in August 2011 and has rapidly gained market share in mainland China. According to IDC, at the start of second quarter of 2018 Xiaomi had become the fourth-largest smartphone manufacturer in the world. The success of Xiaomi smartphone is due to not only low price, but more importantly, rapid improvements in product performance and fast speed to market. To meet the needs of smartphone enthusiasts who are eager to enjoy the latest applications and potential new functionality, Xiaomi release a new version of operating system almost every week. The company achieves such a rapid cycle of innovation by establishing a social network that involves thousands of enthusiasts in the innovation process.

As a result, Xiaomi is able to offer latest technologies to customers not only at low cost but also at high speed.

Based on the above reasoning, we advance the following proposition concerning the role of speed in disruptive innovation in China:

Proposition 2: *A key characteristic of disruptive innovation in China is speed to market and rapid improvements in new value propositions at competitive prices.*

3.3. Expansion from a niche market segment

As we noted above, the theory of disruptive innovation suggests that they are initially targeted to appeal to niche segments that value non-standard performance attributes. (Christensen, 1997). Once they succeed in entering these market niches, they go on to improve those performance attributes that mainstream customers especially value. This enables the disruptive innovation to expand into established, mainstream markets. At this point, it is often too late for the established firms to respond effectively so that by leveraging their head start the disruptors come to dominate the market. The incumbents' hold on the market is, therefore, disrupted.

In China, however, disruptive innovations are often launched directly into a mass market, as we saw with Zhongxing Medical in DDR. This difference from the trajectory of disruptive innovations in developed economies can be explained by the typical segment structure of Chinese markets. While the mature economies have reached high urbanization rates (Bertinelli and Black, 2004), most emerging economies undergoing the urbanization process are facing the urban-rural divide challenge (Chen et al., 2018; Wang et al., 2016). The wide urban-rural gap is particular acute in the Chinese society since the 1950s and was further worsened by the economic reforms started in 1978 because the urban welfare state is believed to be built on the backs of the peasants (Tao and Liu, 2005; Treiman, 2012; Zhang,

2017) and the unique Household Registration (*hukou*) system which prohibits population moving from rural to urban areas (Liu, 2005; Wu, 2011). In 2013, China's urbanization rate was merely 53.73% and rural resident population was 629.61 million (Long et al., 2016). Moreover, the Chinese national statistics data shows that the urban-rural ratio of income per capita was 3.33 in 2009, 2.81 in 2013, and 2.72 in 2016[1]. The wealth gap between urban and rural areas, however, continues to widen. According to the China Household Finance Survey, the net family wealth ratio between urban and rural areas was 7.38 in 2011 and increased to 12.45 in 2015[2].

As a result, the Chinese market is largely divided into two mass market segments, the first one is the mid- or high-end urban and markets that include the tier 1 (Beijing, Shanghai, Guangzhou and Shenzhen), tier 2 cities (all the capital cities of the 30 provinces), and developed tier 3 or 4 cities. The four tier 1 cities have a population of over 20 million each, and most tier 2 cities have a population of over 8 million. Hence this mass urban market includes about 50% of the total population of the country with higher average income and educational level[3]. Customers in these markets are familiar with western brands and generally prefer to trade up.

There is also, however, a second mass market comprising rural China and less-developed tier 3 or tier 4 cities and all townships and villages. This market is also huge, including around 50% of China's population and a substantial proportion of total consumption expenditure, despite lower average incomes.

Despite the massive size of both of these two markets, they each exhibit considerable internal homogeneity in terms of consumer preferences and behaviours. The structure of most markets in China, therefore, differs from the typical pattern in developed markets comprising a large, mainstream market surrounded by a number of small niche segments. As a result,

[1] Data source: National Bureau of statistics of China, 2016
[2] Data source: China Household Finance Survey Research Report, 2012, 2016.
[3] Data source: National Bureau of statistics of China, 2016

rather than initially targeting disruptive innovations at niche segments that value its non-standard performance attributes as happens in developed economies, Chinese disruptive innovators are able to pitch their offering to appeal to the preferences of a second, mass market. Once these Chinese disruptors capture a large share of the second, mass market, while rapidly improving the performance of their product, they can begin to expand into the higher-end mass market segment in urban areas. This may then provide a platform for which to seek further growth by expanding internationally.

The leading Chinese technology company Huawei has essentially followed this disruption process. The company was established in 1987 in Shenzhen as a distributor of imported telecommunication products. It started off from the rural market in China and then dominated it by providing products tailored to its specific consumer preferences and physical demands such as lower density of users and the need for equipment that could be maintained simply with lower-skilled technicians. In a second phase Huawei rapidly improved its product performance through a mix of continuous technology and customer-driven innovations. This eventually enabled it managed to enter the high-end market in China which was dominated by western firms such as Nokia, Ericsson, and even Apple, and eventually to disrupt them.

Having solidified their market position in China, Huawei expanded globally by first focusing on first on smaller fringe markets, challenger telecom companies, and then large developing countries. Once it succeeded in these it moved up the ladder to disrupt the incumbents in developed economy markets overseas. By 2012, Huawei had overtaken Ericsson and has become the world's largest telecommunications equipment maker a global position that it has retained since[4].

These findings lead us to posit:

[4] The Economist (2012). Who's afraid of Huawei? Economist Print Edition, 4 August: 6.

Proposition 3: *Disruptive innovations in China tend to be launched directly into a mass market in contrast to the typical pattern in developed markets where disruptive innovations are initially targeted at niche segments that value their non-standard performance attributes.*

4. Processes for generating Chinese-style disruptive innovation

The differences that we have identified in the characteristics of disruptive innovation between China and the developed economies on which extant theory is based also have implications for the kinds of processes that firms use to generate disruptive innovations. In this section we explore the links between the nature of disruptive innovation in China and the innovation processes which underpin it.

4.1. Processes for developing disruptive cost innovation

Cost innovation underpinning disruption delivers three types of novel value propositions: high technology at low cost; variety and customisation at a small price premium; and products with specialised attributes at prices that appeal to a mass market (Zeng and Williamson, 2007). Many strategies and processes can be used to deliver these types of innovative value propositions, but two of the most important are materials substitution and use of additional labour in place of rigid, standardised production lines in order to provide increased flexibility.

The first approach involves substituting high-cost raw materials with alternatives that can deliver lowers costs with little degradation of performance. Take the example of Chinese battery maker, BYD, which was founded in 1995. The company focused their innovation efforts to reduce cost when they understood that lithium ion (Li-Ion) batteries were not able to penetrate the mass market because of the high cost - at the time costing $40 per piece. Their R&D unit tested a large variety of less expensive materials and managed to find a way to replace some of the most expensive materials used in lithium ion (Li-Ion) batteries with cheaper substitutes including iron and carbon with only minimal loss of performance. The

resulting (Li-Ion) batteries developed by BYD replaced their lower-performance nickel cadmium (NiCad) predecessors in various applications, starting with less demanding applications. Gradually BYD further improved the product quality and disrupted the global battery market taking 75 percent in cordless phones, 38 percent in toys, 30 percent in power tools, and 28 percent in mobile phones.

The second approach is to adopt semi-automated product lines instead of fully automated ones in the manufacturing process in a way that increases flexibility and enables greater product variety and customisation without substantially increasing costs. A good example is Chint, a maker of electrical equipment such as transformers and power supply units established back in 1984. Chint focused on delivering disruptive cost innovation by reengineering its production process, replacing automated product lines with semi-automated ones. Its first plant was divided into two areas. On one side were four fully automated production lines, brimming with advanced equipment and run by just two operators. Adjacent were manual lines with thousands of workstations, swarming with people. Comparing the lines in the two areas, Chint found that the maintenance costs of the complex, automated equipment alone were four times higher than the entire wage bill for the workers it had replaced! Chint also found that automated lines were actually less efficient for small batch orders, especially when customised features were required.

These insights launched Chint down a path of innovation aimed at developing processes that would enable the flexibility needed to produce high variety at low cost. Recognising the flexibility, but also the quality exposures associated with using semi-automated lines to cope with high variety, it first began to develop processes to largely eliminate human error and reliably deliver highly customized products with minimal extra cost. Chint then took the capabilities and systems it had pioneered on the manual lines and started reconfiguring its automated lines originally designed by equipment makers in the

United States and Europe. Every automated procedure was broken down and systematically analysed. Wherever engineers identified a step that could be better performed manually, they parcelled it out of the automatic process. This allowed Chint to increase flexibility while saving $600,000 in capital investment for every line. Chint first became the leader in the Chinese rural mass market. With its annual R&D spending equivalent to 5 percent of sales, Chint further improved their product quality and gradually disrupted the high-end market. Today Chint is world's fifth-largest manufacturer of electrical products. Today, Chinese companies are working to deliver similar types of cost innovations by deploying advanced robotics and artificial intelligence.

Based on these practices adopted by Chinese firms to generate disruptive cost innovations, we posit that:

Proposition 4: *Disruptive cost innovations in China are often underpinned by novel materials substitution to reduce cost with minimal loss of performance and the use of semi-automation in place of rigid, standardised production lines in order to provide increased flexibility.*

4.2. Processes for accelerating performance improvement in disruptive innovations

Another distinguishing feature of Chinese-style disruptive innovation is rapid performance improvement compared with the gradual evolution associated with disruptive innovation in developed economies. The innovation routines that underpin rapid improvements in the performance of disruptive product innovations in China include R&D industrialisation, parallel engineering, and modularisation approaches (Wan et al., 2015). First, some Chinese firms industrialise the R&D process to speed up performance improvements in disruptive innovations, analogous to creating an "assembly-line" in manufacturing. Huawei, for example, often divides its R&D project into a number of fine defined mini-tasks, and then assign a team of engineers for each mini-task. While Apple, for example, allocates 10 engineers for a R&D Project, Huawei would assign 100 or more

engineers for a similar R&D project because of the large supply of qualified engineers in China. As each engineer in Huawei is assigned a narrow defined mini-task, he/she is likely to develop expertise in this area which further improve the efficiency. This means that Huawei often is able to finish a R&D project much faster than its competitors. R&D industrialization may not work well for traditional R&D which aims for technology breakthrough, it does work for disruptive technology innovation where most technological functions are well defined.

A second approach used by some leading Chinese firms to accelerate performance improvements in disruptive innovations is parallel engineering (similar to the idea of "parallel processing" in supercomputers). When Lenovo acquired IBM's personal computer business back in 2004, for example, it learned many best practices and R&D procedures from IBM. But Lenovo also modified the R&D processes inherited from IBM so that various activities that used to be sequential steps could be conducted simultaneously. Parallel engineering may be risky for traditional R&D when the main task is to explore the unknown, but it often works well for advances of the type characterised by Chinese disruptive innovation where the well-defined overall architecture remains intact and so different modules can be worked on simultaneously.

Third, in other Chinese firms, modularisation plays an even greater role in accelerating the rate at which disruptive innovations are improved. This approach underpins the incredible speed to market achieved by the “shanzhai” phone manufacturers such as Jinli Group and Tianyu Longtong[5]. As mobile phone technology has become standardised, shanzhai phone manufacturers are able to hire design companies to redesign features and attributes and buy core modules from their suppliers. In this way shanzhai phone manufacturers can focus on managing the testing and launch of potentially disruptive

[5] Shanzhai is a term for the mountain fortress where outlaws hide, hinting at the legally dubious nature of their practices. See Wan, Williamson & Yin (2015).

innovations to speed up the process. This is possible for disruptive innovations based on high levels of variety and customisation because the core technologies and modules remain standardised and well defined.

These observations suggest some of the ways in which the rapid rate of performance improvement associated with disruptive innovations in China is achieved, leading to the following proposition:

Proposition 5: *The rapid performance improvements which characterise disruptive innovation in China is, in turn, underpinned by various process innovations including the industrialisation of R&D, parallel engineering, and modularisation.*

5. Implications and conclusions

Our study indicates that there are three important differences between the disruptive innovations observed in China compared with those in developed markets. First, while disruptive innovation in developed markets generally begins with challengers launching products with inferior performance in the face of over-specification by incumbents relative to customer requirements, disruptive innovations in China focus on offering a range of differentiated value propositions including delivering high technology at low cost, higher levels of variety and customisation at a limited price premium, and specialised product attributes into volume markets. Second, once Chinese disruptive innovations are launched, their performance improves more rapidly compared with the gradual evolution typically associated with disruptive innovation in developed economies. Third Chinese disruptive innovations often rapidly achieve large scale sales volumes because they are directly launched into a mass market rather than into niche segments as in developed economies.

These differences have important implications for the theory of disruptive innovation and shape the theoretical contributions of this paper to the existing literature on disruptive innovation. First, we extend the existing literature by identifying a new type of disruptive

innovation that has emerged in and from China. This new type of disruptive innovation has a number of distinctive characteristics that differ in important ways from disruptive innovation observed in developed markets on which existing theory is based. By characterising these differences, we have extended the definition of disruptive innovation and our theoretical understanding of the different ways in which innovations can be disruptive to incumbents. These novel characteristics include value propositions based on cost innovation, accelerated performance improvement of disruptive innovations, and rapid scale-up through the launch of disruptive innovations directly into a mass market rather than a niche segment. We have also shown that these distinctive characteristics of Chinese disruptive innovation have their roots in fact that China is an emerging market environment and therefore might be mirrored in other emerging economies.

The second theoretical contribution arises from the light our study sheds on the different trajectories that the disruption process can take. Christensen et al. (2018) suggested that exploring variations in the process of disruption and where and how rapidly disruption occurs is an important question that deserves further research. Researchers have found that the rate of product improvement varies significantly across different industries in mature markets with slower speed in traditional industries (Christensen, 1997; Christensen and Raynor, 2003; Christensen et al., 2015; Raynor, 2011). We extend this line of theorising by showing that the speed of market disruption depends not only on the characteristics of the industry, but also on the strategies adopted by potential disruptors. By developing specific processes to accelerate performance improvement in disruptive innovations including the industrialisation of R&D, parallel engineering, and modularisation, Chinese disruptors have been able to speed up the pace at which industries have been transformed. These complementary process innovations have enabled disruptive innovations to be leveraged beyond new industries such as information technology and e-business, to include traditional

industries such as industrial equipment, consumer electronics and music instruments (Zeng and Williamson, 2007; Wan et al, 2015).

Third, our study has extended our theoretic understanding of the ways in which disruptive innovations may migrate between market segments and hence the dynamics of industry disruption. The original conception of disruptive innovation envisaged a path by which the innovation was initially launched into a niche segment that valued its non-standard performance attributes, gradually moving into the mainstream market as performance improved over an extended period (Christensen, 1997; Christensen and Raynor, 2003). In China, however, we have observed a different trajectory. Because many Chinese markets tend to be bifurcated into two large segments, one centred on affluent urban areas and the other on rural regions and third- and fourth-tier cities, townships and villages, it is possible to launch disruptive innovations directly into a mass market. This insight allows us to extend the theory of disruptive innovation to incorporate the possibility of much more rapid scale-up and hence a much faster pace of far-reaching industry disruption.

Fourth, our study also contributes theories of how disruptive innovations are generated, which is an important research question in disruptive theory (Si and Chen, 2020), that remains under-investigated. Research on how to enable disruptive innovations by organizational processes is scarce (Wan et al., 2015; Yu and Hang, 2010). In this study we find that Chinese companies can systematically generate disruptive cost innovation by adopting strategies such as the substitution high cost materials with low cost ones while maintaining overall performance, or by transforming automated product lines into semi-automated ones to increase the variety and customisation of offerings while keeping costs low. Along with our identification of complementary processes that can be used to speed up the pace at which the performance of a disruptive innovation improves (including the

industrialisation of R&D, parallel engineering, and modularisation discussed above), these findings improve our understanding of antecedents of disruptive innovation.

Our study also has a number of managerial implications. First, by extending the traditional definition to include new types of disruptive innovation observed in China, we alert managers to the need to broaden their horizons in anticipating where disruption might come from. This also suggests new types of disruptive innovation which they might try to emulate. Disruptive cost innovation discussed in this paper constitutes a new type of disruptive innovation which we observed in China. Our findings flag to managers the importance of understanding the differences between the cost innovation being deployed to disrupt incumbents in China and the frugal (or jugaad) innovation observed in India. Frugal innovation aims to get more from less by taking cost out of the entire innovation process and making use of existing resources and technologies (Prabhu and Jain, 2015), and this often results in products at low cost and also with low technology that are suitable for "Bottom of the Pyramid" (Prahalad, 2006). By contrast, as we explained in this paper, although cost innovation also aims to cut cost, it simultaneously seeks to add new sources of value in the form of higher technology compared with current offerings in the mass market and higher levels of variety and customization (Zeng and Williamson, 2007). This means managers must be alert to the potential of new competition from disruptive innovations that offer high technology, variety and niche products at low cost to the mainstream mass market.

Second, our findings begin to identify some of the new capabilities that mangers will need to help their firms build (such as industrialising R&D processes), and the new strategies they might need to adopt (such as input substitution) in order either to launch disruptive innovations or respond to the threat of disruptors. MNEs may need to look to China, and possibly other emerging economies, for disruptive innovation ideas that could allow them to thrive and prosper in the next round of global competition as more and more established

market patterns are up-ended.

Third, our results alert managers to the possibility that rather than gradually expanding from a niche market with peculiar needs, some of the disruptive innovations that are potentially most dangerous to incumbents will be launched directly into a mass market in China allowing disruptors to gain scale advantages quickly and to rapidly improve performance by responding to market feedback.

Although our study makes a number of contributions to both theory development and managerial practice, it also has limitations which suggest avenues for further research. First, our findings suggest that it is worthwhile to undertake further research, using both quantitative and qualitative methodologies, to understand how the characteristics of disruptive innovation differ in emerging economy environments from those observed in developed markets on which extant theory has been based. Second, our work highlights the need to look beyond a characterisation of disruptive innovations to the processes and capabilities that generate them and the trajectories through which they penetrate a market in order to properly understand the phenomenon of disruptive innovation. Finally, despite the size and dynamism of China's markets, it is far from alone among emerging economies that are reshaping the global competitive landscape. The generalisability of our results from the Chinese context are unclear. As countries such as India, Russia, Brazil, South Africa, and Turkey rise to become an influential force in the global economy, studies that characterise the potentially different types of disruptive innovation emanating from these environments are, therefore, called for.

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