

The top-down pattern of social innovation and social entrepreneurship. Bricolage and agility in response to COVID-19: cases from China

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Social innovation and social entrepreneurship usually follow a bottom-up pattern. Companies and entrepreneurs decide to focus their business effort on meeting critical and urgent social needs. However, what happens when institutions promote or push top-down initiatives? The outbreak of COVID-19 is redefining, for many aspects, entrepreneurial dynamics. By creating a critical shortage of resources and medical supplies, the pandemic drew central and local institutions to push companies to cover the increasing social and medical needs. This study explores how companies reacted to top-down-initiated social innovation and social entrepreneurship activities. In doing so, the study focuses on the first heavily hit country, China, and it collects data from companies involved in the production of medical masks and the provision of solutions for nucleic acid tests. Our findings reveal that companies answer to top-down pushes by implementing two main strategies in a time of crisis. First, the social bricolage by exploiting available and local resources. Second, companies react with agility by re-thinking their internal innovation, relying on past similar experiences, and making their resource fluid. Our study adds the literature regarding social innovation and entrepreneurship in a crisis time by providing implications for institutions and organizations in setting and responding to strategies for future crises.

1. Introduction

The outbreak of the coronavirus (COVID-19) has created one of the most critical crises at the global level in recent times. The spread of the virus has affected entire nations with human losses, economic

and financial crises, and health and hygiene emergencies. In this complex panorama, institutions, nonprofit organizations, entrepreneurs, and private citizens have implemented several actions to respond to the state of urgency generated by the virus. As the first country hit by the virus, China immediately

experimented with the side effects of the pandemic, such as lockdown for citizens, factories, and entire cities; a travel ban; and shortage of medical supplies. To face these severe challenges, since the beginning of the crisis, central and local institutions have started to promote top-down-initiated social innovation (SI) and social entrepreneurship (SE) activities to redirect companies' resources to address social needs emerging from the COVID-19 outbreak.

In the entrepreneurship literature, many studies have analyzed companies' strategies activated to pursue SI and SE goals (Di Domenico et al., 2009; Zahra et al., 2009; Chesbrough and Di Minin, 2014; Nicolopoulou et al., 2017; Rayna and Striukova, 2019). Companies' involvement in SI and SE makes relevant and original contributions to communities and societies, creating and adapting tools to provide creative solutions to complex and persistent social problems (Zahra et al., 2009). However, the current literature provides a limited understanding of the mechanisms and the strategies adopted by companies when pushed by public institutions to pursue social goals and respond to social needs. One of the reasons for such lack of information might lay in the fact that innovation studies mainly focus on primary actors (e.g., companies and entrepreneurs) and their dynamics in setting entrepreneurial strategies. As such, this leaves an underexplored field, the one related to the top-down-initiated social activities. The outbreak of the COVID-19 led all the actors involved in the innovation process development to act differently and rapidly without having any benchmark in their background. This study aims to answer the following question: *What strategies do companies implement to answer top-down-initiated initiatives of social-oriented innovation and entrepreneurship in a time of crisis?*

To answer this question, we conduct an inductive, explorative multiple-case analysis to explore the different strategies adopted by Chinese companies in answering the top-down-initiated social activities in two main relevant fields, the production of medical masks and the provision of solutions for nucleic acid tests. Our findings provide several contributions. First, we add to the literature in terms of SI and SE by identifying two main companies' strategies implemented. In detail, once companies are pushed to pursue social goals they tend, first to implement a social bricolage strategy by exploiting available and local resources; second, companies react with agility by re-thinking their internal innovation, relying on past similar experiences, and making their resource fluid.

The remainder of this paper is organized as follows. In Section 2, we review the social SI and SE

literature and discuss the gaps. In Section 3, we describe the research setting on which our study is grounded, as well as our applied methodology. In Section 4, we analyze and discuss our findings from the selected case studies. In Section 5, we present the concluding remarks, highlighting our study's contributions, as well as its limitations and implications for future research.

2. Theoretical development

2.1. Social innovation

Social innovation or the innovation conceived for the greater good has been widely addressed in the literature, because its essence lies in the existence of three specific elements (Bessant and Trifilova, 2017). First, social innovations typically combine or modify existing elements rather than create new items. Second, implementing social innovations encompasses developing boundary-spanning activities across organizational or industrial edges, which favor new social interactions between individuals and groups, contributing to the spread of the innovations and allowing the potential development of future ones. Third, social innovation is also considered as relying on the innate capacities of individuals and communities, which emphasizes the importance of collaborative and open innovation strategies.

During critical times driven by social, economic, political, or health and hygiene crises, SI can frequently come to light, pushed by a combination of widespread and critical needs and acute resource scarcity. In such difficult times, the pre-existing solutions may be insufficient for several reasons, such as high production costs, the lack of entrepreneurial profits, or the lack of technological suitability. As an alternative, the emergence of new paradigms can offer better-tailored solutions under extraordinary conditions. This process of increasing innovations demands out-of-the-box rethinking and recombination of skills and can represent the genesis of the creation of new innovation paths (Dees, 2012).

As prior studies have demonstrated, working with markets affected by the absence or the scarcity of supplies can represent a unique entrepreneurial experience for the implementation of radically different solutions (Christensen et al., 2005). These experiences do not automatically advance firms' technological frontiers, but often, they can represent a simplification or a fast-deliverable solution in the form of a pre-existing offer adapted to the contingencies to meet social needs.

2.2. *Social entrepreneurship*

Although the idea of SE has been used since the 1950s, scholars have not yet agreed on a single definition of this complex phenomenon (Saebi et al., 2019). Choi and Majumdar (2014, p. 372) define SE as an ‘essentially contested concept’ which clarifies ‘why it is so difficult to find a universal definition of social entrepreneurship and why it prompts different meanings among different parties’. Moreover, a unique contextual dimension of the SE concept is missing, making it difficult to ‘capture the heterogeneity of a unit of analysis in terms of its key characteristics that have relevant implications for outcomes’ (Foss and Saebi, 2017, p. 211). According to Shaw and Carter (2007), it is possible to identify as social enterprises those that operate in complex environments, including diverse stakeholders and client groups, and are directly involved in producing goods or offering services to a market in pursuit of a social aim. Thus, SE tends to be realized from those entrepreneurs that aim to generate social value, demonstrate the adequate skills to identify opportunities, and are prone to operate in high-risk-taking environments, characterized by scarce resources and market constraints (Peredo and McLean, 2006).

One of the major challenges that social entrepreneurs usually face is the constraint of financial resources to realize investments, this makes entrepreneurs relying on their capacity to obtain resources which determine the course of action of their firms (Ranucci and Lee, 2019). In regular times, SE positively impacts on the economic system because it leads to the establishment of new firms that address, with resources allocation, ignored social issues (Santos, 2012) and boosts social wealth (Zahra et al., 2009). However, little is known about how companies respond to top-down stimuli to pursue entrepreneurial activities to cover urgent needs.

2.3. *Social innovation and social entrepreneurship in normal time*

Both SI and SE, as described, differ from the canonical phenomena of entrepreneurship and innovation in managerial and technological frameworks (Oeij et al., 2019). These differences might have an impact or affect new business models (Zahra et al., 2009). A large number of organizations struggle to understand how to adapt their business models to SI and SE (Davies, 2014). However, the ambiguity and variety in the definitions make it difficult to reach a general theory that would help companies and organizations better understand the framework and the circumstances under which they operate. One of the central issues is that SI and SE activities prosper, but

many of them are not capable of becoming sustainable in their effort to address social needs (Oeij et al., 2019). The literature identifies different barriers such as limited access to finance, limited examples of scaling, insufficient skills and formation/staff, missing networks and intermediates, legal constraints and insufficient political assistance, and the lack of financial, human, scientific, and legal resources (Caulier-Grice et al., 2010; Howaldt et al., 2016). Additionally, SI and SE might also suffer from organizational and leadership abilities scarcity mixed with infrastructural inadequacy that creates unfriendly or even hostile settings for social initiatives sustainability (Dhondt et al., 2018). Such challenging conditions might bind SI and SE experiences from scaling up becoming stable and institutionalized drivers of societal changes, definitively impacting social needs.

2.4. *Exploring top-down-initiated initiatives of social innovation and entrepreneurship in a time of crisis*

The absence of short-term medical responses to the virus (either as vaccines or treatments) has necessitated the use of lockdowns and social distancing restrictions as government tools to reduce the transmission of the virus across the population. China has been the first country hit by the COVID-19 outbreak, which spread during a delicate period of the 2020 Spring Festival holiday, affecting, even more, its systems for the production and the distribution of medical supplies. The COVID-19 outbreak has led to an extreme shortage of medical supplies; factory shutdowns and poor logistics, caused by the lockdown of cities and the entire country, have exacerbated the shortage. Also, as widely recognized, China is a developing economy with a central strategy planned economy aimed at developing and transferring ‘domestic innovation’ to the global market (Yao et al., 2020; Zhang et al., 2020). Accordingly, during the COVID-19 outbreak, Chinese institutions have made great efforts to boost entrepreneurial activities to respond to the crisis’s social needs. In turn, companies faced new, unexpected, and severe challenges to meet the market’s medical needs and implement innovative solutions in terms of products (e.g., to cover the shortage of masks) and processes (e.g., new tests for the virus tracking).

Previous studies on SI and SE have still left many unexplored aspects. Considering the SI indeed, several questions remain open regarding the contextual dimension of SI, such as institutional and regulatory panorama and the innovation processes and paths of SE in developing countries (Gupta et al., 2020). On the other hand, SE’s literature has left still underexplored

Table 1. General information of the managers interviewed

Enterprise	Interviewee	Position
Haihui Pharm	Yuan jiang	Deputy general manager
Zisun	Jin-ming Yang	Vice president
Gree	Dong Mingzhu	Chairman of the Gree
BYD	Wang Chuanfu	Chairman of BYD
BYD	Li Wei	Head of BYD President Office director
KingMed Diagnostics	Liu Yong	Head of the KingMed's novel coronavirus nucleic acid detection lab in Guangzhou
KingMed Diagnostics	Li Huiyuan	General manager of KingMed's Central South branch
BGI	Wang Jian	Chairman of BGI; the first to complete the sequencing of SARS virus and develop SARS test kits in China
Caihong	Chaowan Huang	General manager

the field regarding the SE initiatives' initiation, especially during the crisis (Morris et al., 2020). The controversy mainly regards if governments can issue policies or dedicated intervention to push entrepreneurs to address urgent social needs. A growing body of SE studies agrees that governments tend to be more active in promoting SE generating social value and attention on unaddressed social needs (Moore, 2005; Shockley and Frank, 2011; Leyden, 2016). Against this background, public health crises challenge institutional and economic actors to face a challenging task providing society with essential medical supplies characterized by high-standard quality (Park et al., 2021). As demonstrated by previous studies, critical challenges are not easily realizable under ordinary circumstances, so they are even more difficult to pursue in times of crisis, lack of resources, severe medical conditions, and reduced mobility of people and goods.

3. Methodology

Due to the novelty of the topic and the presented research questions, we perform an exploratory multiple case study analysis of six firms in different industries (i.e., biomedical, pharmaceutical, filter material, electronic, and automotive) and varying in size, market share, and organizational structure. According to Yin (2009), a multiple case study analysis allows answering 'how' and 'why' questions and is particularly appropriate for cross-case comparisons; it also seems suitable for investigating emerging phenomena (Urbinati et al., 2018).

3.1. Empirical analysis and data collection

Our study focused on the COVID-19 pandemic outbreak in China for three main reasons. First, China has been identified as the 'ground zero' of the virus

spread. It has been the first country hardly hit by the virus and its responses represented, for many countries, matter of observation. Second, China successfully managed the crisis offering strong and even unpopular countermeasures as results, also, of the experience gained in the 2002 with the outbreak of the virus SARS. Third, China counts on a strongly controlled economic system and a planned economy in which the government plays an important role in terms of planning and access to the resources. For each case study, we first analyze the social need addressed and then identify the type of action implemented to rethink the organizational business, using its resources for a social purpose. We use company websites, reports, and press releases, news reports, and information from public organizations to collect some preliminary crucial data regarding our cases. Moreover, we collected primary information interviewing the top management of the six companies (see Table 1). From the secondary information collected and in the light of the theoretical framework explored, we develop a set of questions through which we collect and analyze primary data from the top management of the companies in our sample of firms. The framework of our interviews is based on the timeline followed by the companies interviewed to implement their activities during the pandemic and the results achieved. To obtain further detailed information concerning the critical events and actors involved throughout the process, we used open-ended follow-up questions, such as 'Why did you do that?', 'Who was involved in this event?', 'Did you consider alternative actions?', and 'When did this happen?' To avoid biases, the interviewees did not explicitly refer to the theoretical concepts used in this paper. This type of narrative interviewing was conducted to obtain a better understanding of actual events and to prevent personal views and theoretical perspectives from influencing the data collection. The use

of multiple informants and narrative interviewing in combination with historical documentation was crucial to reducing the problems of hindsight bias and memory decay. The aforementioned steps were used to improve the validity of retrospective reports and to ensure that we obtained accurate data regarding how the innovation projects evolved over time (Creswell and Miller, 2000).

To analyze the data obtained, we reduced it through qualitative coding that converted the raw data into several low-level concepts indicating the crucial activities related to our cases (Corbin and Strauss, 2014). Finally, we developed these concepts by performing an abstraction exercise identifying internal and cross-case patterns and connections (Eisenhardt and Graebner, 2007). Finally, we rooted our findings into the theory. We referred to the literature on innovation management, R&D management, SI, and SE. Figure 1 shows the coding pattern associated with our data analysis: (i) first-order concepts summarizing information obtained; (ii) second-order categories classifying general trends and relations characterizing our cases; and (iii) comprehensive labels combining the second-order categories to identify the contributions to the theory.

By following these steps, we were able to obtain a unique level of detail regarding the evolution of the processes. Finally, for each organization, in Appendix 1 we report its short profile description, turnover, and number of employees, as well as the sector of its activity, the social need addressed, and the resources exploited.

3.2. Research setting

To select relevant case studies, we have focused on two main sectors: producers of medical masks and solution providers of nucleic acid test kits. From the beginning of the pandemic, the central and local authorities adopted containment strategies. This required two primary measures, diminishing the spread of the virus and tracking the contagious. The first one required the availability of a massive amount of medical masks, the second one, the ability to process more tests in less time.

3.3. Medical masks

A medical mask is a significant personal protective equipment (PPE) used to protect healthcare workers; especially, doctors and nurses are required to wear N95 masks when treating patients with respiratory tract infection (RTI). The precipitate outbreak of COVID-19 has led to an extreme shortage of medical

masks, especially N95, which are urgently needed by healthcare workers. The Press Conference of the Joint Prevention and Control Mechanism of the State Council of the People's Republic of China (PRC) released this statement on February 13, 2020:

On February 3, the National Development and Reform Commission (NDRC), in coordination with the Ministry of Industry and Information Technology (MIIT), supported a number of mask and other medical protective equipment enterprises to expand their production capacity with technical reconstruction. On February 8, the NDRC urgently implemented the theme of expanding the production capacity for medical masks. The theme will play an important role in alleviating the contradiction between the mask supply and demand. By February 11, the production capacity of the mask had recovered to 94%. Especially for N95 masks, the capacity utilization rate has reached 128%, with eight provinces reaching or exceeding 100%. Hubei Province's daily output rose from 45,000 on February 2 to 158,000 on February 11, Guangdong Province's daily output increased from 33,000 to 40,000, and Henan and Zhejiang Provinces now yield up to 14,000 and 100,000, respectively. The production of medical masks (especially N95) is expected to expand further.

The production of medical masks must be approved by Chinese authorities. According to the issued records, as of March 29, 2020, 149 product registration certificates for the N95 mask have been approved, involving 124 manufacturing enterprises, of which 68 are enterprises urgently transferring production (UTP) to masks. The numbers of the extant and the UTP (to N95) mask manufacturers of each province are shown in Figure 2, and the extant industry of the UTP manufacturers is shown in Figure 3.

N95 mask production needs clean workshops and automated production lines. Due to greater investment, higher operation maintenance cost, and less demand for N95 masks, most of the Chinese mask manufacturers had not made N95 masks. Pharmaceutical companies, biotechnology companies, and filter material companies have clean factories that meet the standards for producing medical masks, but they previously avoided such production because of lower profit margins. Although factories (thanks to the elevated grade of automation of the production line) could in theory, start N95 mask production in a relatively short time, it is complicated to build clean workshops in a short time. Thus, the central government has urgently encouraged factories with clean workshops to start producing N95 masks in short time.

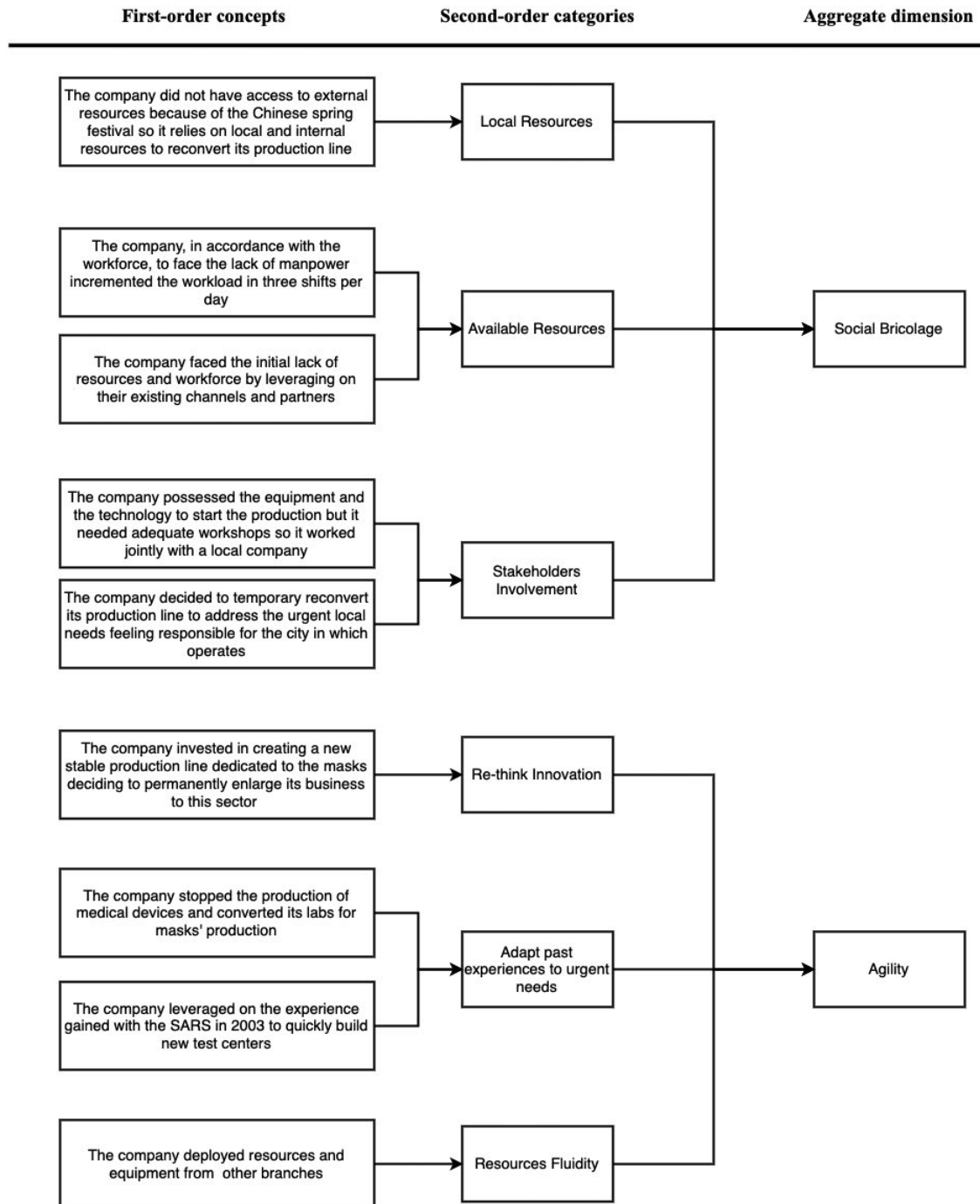


Figure 1. Data coding structure.

3.4. Nucleic acid tests

The novel coronavirus is the first marker that can be detected after the COVID-19 infection. The Press Conference of the Information Office of Hubei Province (PCIOHP) released this statement on January 28, 2020:

Before January 16, all samples of novel coronavirus should have been sent to the National Disease

Control and Prevention Center for nucleic acid tests, where it took 3–5 days to get the test results. The task to detect the novel coronavirus was transferred to the Disease Control and Prevention Center of Hubei Province on January 17. The detection capacity was 300 tests per day in Wuhan.

On January 22, 2020, the health commission of the Wuhan government approved the detection of the novel coronavirus by 10 hospital laboratories and

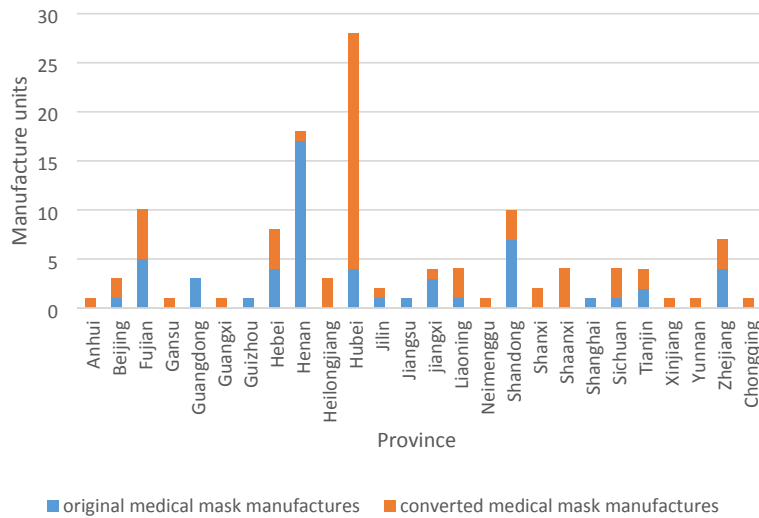


Figure 2. The number of the extant and the UTP Of N95 mask manufactures of each Province of China.

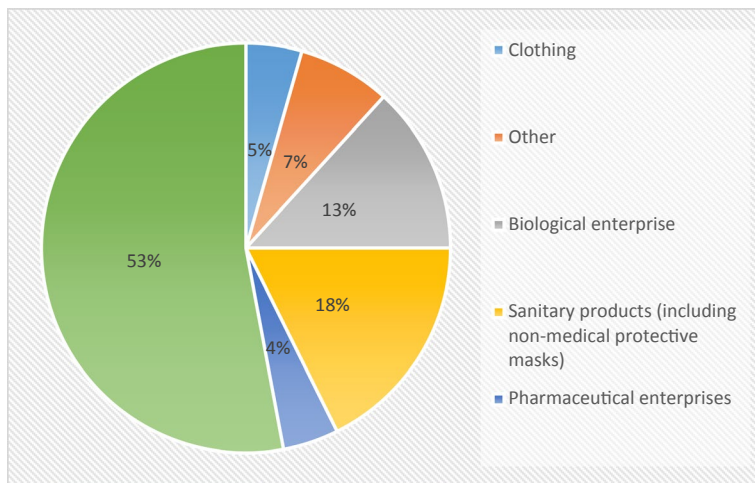


Figure 3. The extant industry of the UTP manufactures.

the disease control and prevention sub-center. The daily test capacity was expanded to 2,000 samples but could not meet the clinical diagnostic needs. The Chinese government has encouraged qualified medical institutions and independent clinical laboratories (ICLs) to conduct nucleic acid tests in order to expand the test capacity. On February 6, 2020, the PCIOHP stated, ‘35 laboratories are authorized to carry out nucleic acid detection in Wuhan. The daily detection capacity has increased from 200 to 6,000–8,000 samples’. The PCIOHP emphasized, ‘The detection capability has sharply increased since the ICLs have taken a number of steps to expand their test capabilities’. On February 21, 2020, the PCIOHP released this statement: ‘The current nucleic acid detection capability of Wuhan (daily capacity – 20,000 tests)

can match the demand, and the detection speed has also been shortened to 4–5 hr to get the results’. ‘By January 21, the daily production of COVID-19 nucleic acid test kits had reached 773,000 units,’ said Tian Yulong, chief engineer of the MIIT. The NMPA launched the urgent approval procedure after the outbreak of COVID-19. The first batch of five product registration certificates for COVID-19 nucleic acid test kits was issued on January 26, 2020, and the second batch of seven certificates was issued on February 3. On March 6, 2020, the Press Conference of the Joint Prevention and Control Mechanism of the State Council of the PRC released this statement:

On March 5, there are twelve manufacturers receiving the product registration certificate from the

NMPA, with an accumulative total supply of 15.755 million units, business inventories of 2 million units in the manufacturers' inventories, and a production capacity of 341,600 units per day. The capacity can fully meet the needs of Hubei Province and other provinces.

In light of the fierce outbreak of the virus, public bodies lacked the capacity to perform the massive number of tests needed, so the ICLs played a crucial role in improving the detection capacity of the provinces by offering a detection service for local communities and local governments.

4. Results

4.1. Strategy 1: social bricolage

With the raising of mass mask production need, China was in the middle of the Chinese spring festival. This creates enormous logistic problems in terms of workforce mobility and resource availability. So, companies such as BYD decided to leverage their internal resources and capabilities to start new production lines. BYD is a large enterprise group with 220,000 employees specialized in electronics, automobiles, new energy, and rail transit. On February 8, 2020, BYD officially announced its urgent production of masks and disinfectant gel. The mask production line needs clean rooms and equipment. With its existing mobile phone assembly and production workshops, BYD has transformed them into workshops for medical mask production by upgrading their cleanliness class. However, BYD encountered a bottleneck since both equipment production and logistics services had been stopped during the Chinese spring festival. To solve the problem, BYD decided to build its own automated production line thanks to its mechanical design and automobile assembly experience. BYD builds 90% of the mask production line machines, including 1,300 parts, such as gears, chains, and rollers.

Relying on machining and research centers about diverse automated production lines (electronics, batteries, new energy vehicles, etc.), BYD spent three days to finish the design of the production line (400 blueprints) and seven days to complete the trial production line. Five to ten automated production lines of masks are put into production every day. In the beginning, the masks had been donated; after March 15, BYD started to sell masks abroad. By April 17, BYD had completed 300 automated production lines; the daily production of medical masks reached 20 million, making BYD the world's largest mask

manufacturer. (Li Wei, head of the BYD President's Office)

Other companies, facing the shortage of resources, decided to rely on the resources available exploiting at the best the internal resources owned and their existing supply channels and business partners. One of the most severe lack companies experienced was related to manpower. Cities were in lockdown, people were not allowed to travel and others got infected. These conditions dramatically impacted on companies' production. KingMed's employees decided to help the company rising its capacity to produce tests by incrementing their workload. KingMed Diagnostics, established in Guangzhou in 2003, is the largest ICL in China. KingMed has built 37 laboratories in the Chinese mainland and in Hong Kong, covering 90% of the Chinese population. KingMed provides more than 2,700 medical testing services for over 22,000 medical institutions. On January 23, 2020, Liang Yaoming, the president, announced the company's urgent response; on the following day, the laboratory at the Guangzhou headquarters completed the first detection via the COVID-19 nucleic acid test; it took approximately 3.5 hr from receiving the samples to sending out the test report. On January 27, Wuhan KingMed was approved by Hubei Province to carry out the detection of novel coronavirus nucleic acids. KingMed promptly sent the technicians from its Central South branch and the experts from its headquarters laboratory to Wuhan to support Wuhan KingMed. The detection capacity of Wuhan KingMed rapidly increased to 1,000 tests per day. On January 31, KingMed's first novel coronavirus nucleic acid detection laboratory was set up in Guangzhou.

It can increase the screening amount to 5 times the current rate with the new test kits and testing methods. More than 10,000 tests can be done if we arrange three shifts of technicians to ensure that the instruments will not be shut down 24 hr a day. (Liu Yong, head of the laboratory – interview on Nanfang Daily)

On the other hand, in terms of exploitation of available resources, Zisun decided to use the experience gained in filtering materials and to exploit its supply channels to start the production of masks. Zisun, a medium-sized enterprise with 1,500 employees and annual revenues of 1.25 billion CNY, produces glass fiber filters, low-resistance melt blown filters, and poly tetrafluoroethylene (PTFE) membranes. A leading enterprise specializing in filter materials in the PRC, it is located in Chongqing, which is the largest city with a 31-million population in western China and no N95 mask makers before the COVID-19

outbreak. Chongqing's municipal government pushed Zisun to produce N95 masks. On January 27, 2020, Zisun decided to use its clean workshops to start an urgent production of N95 masks by organizing adequate staff training. The production line started with a daily capacity of 2,000 N95 masks, with the first batch produced on February 2.

In view of the severity of the COVID-19 outbreak, the company intends to enlarge its business scope in the research and development, production, and sales of medical protective masks and surgical masks, as required by the local government. (Company's press release – February 4)

When the local authorities in Chengdu pushed companies to find solutions for addressing the urgent need of medical masks, some companies decided to perform innovative solutions that involve other stakeholders on to work jointly with other companies. Haihui Pharm, a newly established subsidiary of the Yangzijiang pharmaceutical group in Chengdu, Sichuan Province, started to produce glimepiride tablets (the third-generation sulfonylureas anti-diabetes drug) in 2017. Haihui Pharm is located in Chengdu, which is the second largest city in western China, with a population of 16 million, and had no N95 mask maker before the COVID-19 outbreak. After the outbreak, Chengdu's municipal government urgently searched for manufacturers with a total of 10,000 clean-class workshops to rapidly produce N95 masks for the local hospitals' healthcare workers. On February 4, 2020, Haihui Pharm decided to use its clean workshop for the development and production of medical devices to produce N95 masks immediately. On February 7, the idle N95 mask automated production line of Caihong Electric was moved to Haihui Pharm, installed, and debugged. The registration certificate and the production license were issued on February 25; the first batch of 5,000 N95 masks was produced on February 26. Haihui Pharm's production capacity was expanded to 10,000 per day in early March, which can meet the daily demand of 6,000 healthcare workers in Chengdu.

4.2. Strategy 2: agility

Some companies decide to respond local needs by re-thinking their innovative capabilities. Such as the case of Gree. It is a large enterprise group (with over 90,000 employees) with annual revenues of more than 200 billion RMB. Gree focuses on two significant fields: household appliance and equipment manufacturing. To address the urgent need of producing medical masks, Gree decided to reconvert its production line offering assistance to the city in which it

is located. Thus, Gree established a subsidiary company – Zhuhai Gejian Medical Technology Co., Ltd. – on February 18, 2020. The principal business of Gejian is the production of medical protective equipment, such as masks. On March 9, medical masks were officially launched on 'Dong Mingzhu's shop' – the official Gree website. Its daily production of surgical masks increased from 20,000 to 160,000 on March 16, reaching its peak the following month.

The daily mask production of Gree is 600,000. We do not plan to enlarge the production scale since masks are not our major business; the motivation is to achieve the social value of a great enterprise.

(Dong's interview – April 29)

In this sense it is possible also to intercept in the case of Zisun an effort made to re-think its innovation. Indeed, the company reconverted its production lines to mask by leveraging on a solid network of partners involved in filtering materials, and then decided to establish permanently as new business the mask production. Zisun's production of N95 masks reached 20,000 per day on March 6.

The company has enlarged its core business, and now it has taken the production of protective masks as one of its main businesses, which is expected to become a new profit growth point. (Company's report – April 30)

Some companies reacted by exploiting the experience gained in similar situations, demonstrating the ability to leverage on lessons learnt to implement innovative solutions for the current crisis. This is the case of BGI. The company was founded in 1999 and is a leading life science institution in the world, involving scientific research, technical services, diagnostic services, medical testing instruments, and test kits. Its main revenue comes from its high-throughput gene sequencer and reproductive health-related gene testing and diagnostic services. During the early stage of the outbreak, BGI organized scientific research and quickly finished the development of the COVID-19 nucleic acid detection kit (RT-PCR fluorescence probe method) on January 14, 2020. On January 26, the NMPA issued the product registration certificate for the novel coronavirus nucleic acid test kit and the high-throughput gene sequencing instrument manufactured by BGI. On February 5, the novel coronavirus emergency test laboratory, the 'Huo-yan' laboratory (with a daily detection capacity of 10,000 tests) promptly began operations. The first Huo-yan laboratory was equipped with 30 bio-safety cabinets, 12 automatic nucleic acid extractors, and 12 high-throughput PCR analyzers, as well as auxiliary facilities, such as laboratory compartments, sample rooms, test kit storage rooms, and office areas. On

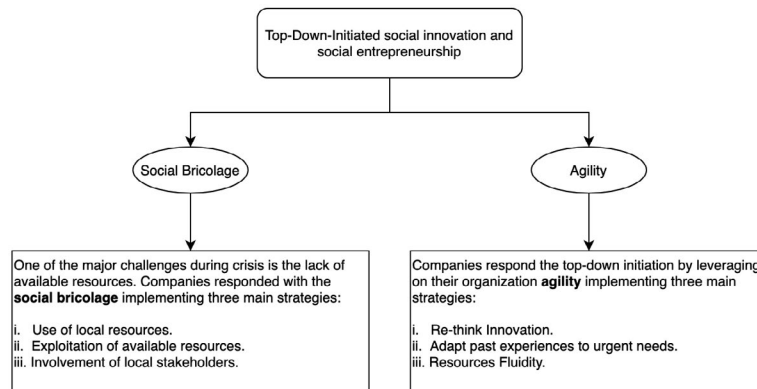


Figure 4. Response strategies to top-down-initiated social innovation and entrepreneurship initiatives.

February 7, 100,000 nucleic acid test kits were produced, and 40,000 test kits were released. At the time of this writing, 200,000 additional test kits are being produced, and the raw materials needed for 300,000 test kits are being stored. The daily production capacity for the test kits has reached 50,000 units and will further be increased rapidly, according to the need to fight the epidemic.

Through the lesson of SARS in 2003, we learn that accurate detection and diagnosis are equally important while focusing on the clinical rescue. Besides, the virus is possible to mutate to create a worse situation. Therefore, we need to quickly build a test center to further monitor the virus through gene sequencing in Wuhan. (Wang Jian – Chairman)

Companies can also leverage, in crisis situations, on available resources from other branches. The deployment of these resources requires the ability to reconfigure resources and processes to pursue the new strategy. On this regard, KingMed started to distribute the samples of Wuhan KingMed to other KingMed laboratories in South China through third-party cold chain logistics and enlarged the detection capacity of Wuhan KingMed to 4,000 tests per day. The detection capacity of Wuhan KingMed increased to 10,000 tests per day. As of March 5, Wuhan KingMed had finished 120,000 tests. As of March 25, KingMed had successively carried out nucleic tests in 27 provinces, including Hubei and Guangdong, with nearly 1,800 staff members, and its nucleic acid testing capacity reached 70,000 tests per day. As of April 24, the cumulative tests exceeded 3 million.

KingMed will further deploy resources and equipment from the other branches to support Wuhan KingMed. It is expected to have a daily detection capacity of 1,000 to 5,000. (Li Huiyuan, general manager of KingMed's Central South branch – People's Daily Interview)

Appendix 2 summarizes all the information regarding the companies, the actions implemented, and the results obtained.

5. Discussion and conclusion

According to our findings, companies may respond to top-down-initiated SI and SE initiatives by implementing two strategies: social bricolage and organizational agility. Both these strategies rely on at least three main drivers. Social bricolage's key drivers are utilizing local resources, exploiting available internal resources, and stakeholders' involvement. On the other hand, agility relies on re-think internal innovation, adapting past experiences to the present needs, and the resources fluidity (Figure 4).

First, our analysis shows that once the pandemic spread across the country and the central and local authorities pushed companies to the mass production of N95 masks and innovative solutions for tests, companies responded to this call exploiting (i) available and (ii) local resources and by (iii) getting the local stakeholders involved (Langevang and Namatovu, 2019). Here it emerges that the crisis and the national holiday challenged entrepreneurs to collect the resources needed to face such unprecedented issues. On the one hand, companies reacted by applying combinations of the resources at hand to new problems and opportunities (Baker and Nelson, 2005), integrating the pre-existing resources for new applications, and exploiting available resources. Companies that have been able to answer the government call for action demonstrated high improvising abilities, which implies the capacity to exploit existing resources, tailor standard work procedures to face constraints, and continually seize opportunities while adopting trial-and-error experimentations (Di Domenico et al., 2010). Moreover, pushed by the lockdown, companies have been able to leverage

the local community to find adequate resources, both human and material (Zahra et al., 2009), demonstrating that successful social bricolage strategies 'require intimate knowledge of both local environmental conditions and locally available resources' (Zahra et al., 2009, p. 524). Our findings are in line with two of the three implications for social bricolage that Di Domenico et al. (2010) put forward. Specifically, the first 'social value creation' implies the goal of generating social value as a crucial resource for social entrepreneurial activities, such as the creation of new employment opportunities, skills improvement, and boosting social capital and community linkages. The second 'stakeholder participation' involves stakeholders' engagement in the creation, management, and governance of social enterprises. This implies social networking and expanding firms' governance structures to create new contacts and connections with crucial players who have useful resources or skills. Regarding the third one, 'persuasion', it indicates firms' ability to persuade local authorities and policymakers. Due to the study's nature, we highlight the opposite, observing how companies responded to government influence that set their business priorities, making them social oriented.

Second, our analysis shows that companies responded with agility to government push by (i) re-thinking their innovation, (ii) adapt past experiences to the actual situation, and (iii) making their resources fluid (Sharifi and Zhang, 2001; Nejatian et al., 2019). Agility is defined as an organization's capacity to address unexpected changes and market needs by implementing quick and innovative responses (Cai et al., 2019). It allows organizations to successfully implement structural changes and promptly respond to both expected and unexpected environmental changes to improve their competitive advantage (Mathiassen and Pries-Heje, 2006; Yang and Liu, 2012). This happens when organizations can use their capabilities, which may presuppose sensing and responding to external challenges (Weber and Tarba, 2014; Park et al., 2017). Agile organizations can reduce misallocation of resources and promptly respond to environmental changes threats to outwit direct competitors (Doz and Kosonen, 2008; Gligor and Holcomb, 2012). In line with our findings, agile organizations apply previous knowledge incrementing new learning patterns from present experiences to adapt to external challenges and meet new market needs (Jyothi and Rao, 2012).

5.1. Implications

The study contributes to innovation studies by providing theoretical implications for disentangling

companies' behaviors in responding to top-down-initiated SI and SE activities. The first implication regards social bricolage. Previous studies left underexplored how bricolage can be implemented to allow organizations' innovative use of their resources and how companies can use bricolage as a long-term strategy to optimize the use and mobilization of their resources to maintain bricolage and creative use of resources. By investigating a unique research setting during an unprecedented dramatic event, our study sheds light on companies' mechanisms and strategies to respond to top-down demands in addressing severe social needs in an extremely limited period.

Second, our study contributes to the literature regarding organizations' agility by exploring the dynamics that lead companies to transform their resources and previous-gained capabilities, putting them into practice (Morton et al., 2018). If this aspect has been covered in terms of ordinary reconfigurations of internal assets and resources (Doz and Kosonen, 2010), a lot remains to explore in a time of crisis, when companies face external pressures and internal constraints (such as time and resources). Our findings show that companies can respond by leveraging their resources to re-think their innovation and previous experience. However, we observed that implemented strategies vary according to organization size. While SMEs move their resources to a new internal production line, large organizations build new subsidiaries dedicated to masks production. These different models will impact the organizational business models, influencing future business strategies. Indeed, on the one hand, after investing many resources (it is well-known that SMEs ordinarily suffer from resource shortage), SMEs will tend to improve and consolidate their new business for commercial use. On the other hand, large companies creating subsidiaries untie their core business from the new social activity might or might not be considered for future commercial development.

Third, based on different industry backgrounds, enterprises combine agility with social bricolage responding to social needs by creating new business models and new business opportunities. Our findings demonstrate how organizations, with varying sizes and industrial sectors, implement agile solutions according to their resources and expertise to foster innovative solutions. On the one hand, organizations from the medical and the filter material industries reconvert their on-hand resources related to the medical field, such as clean workshops, medical equipment, and production experience, to produce high-standard medical masks. The equipment manufacturers use their manufacturing experience, unrelated to the medical sector, to create advanced

production lines to start massive mask production. While some enterprises consider mask production a social entrepreneurial activity, others decide to exploit all their efforts and resources to transform their organizations, considering it a business opportunity.

In general terms, it is also possible to observe top-down-initiated SI and SE activities in countries with different political systems, especially during a crisis. For example, nowadays, in terms of COVID-19 vaccines, the United States and the United Kingdom massively intervened to help pharmaceutical companies develop vaccines. On the other hand, as a leading country in biotechnology, Japan struggles to keep the peace of the vaccine development also due to the lack of a solid top-down push.

Overall, the study's findings imply that the combination of strategies implemented by organizations in a time of crisis represents possible different ways to succeed in SI and SE thanks to the push received from the institutions. Indeed, the combination of having fulfilled the lack of institutional resources and the integrated approach of exploiting local and available resources adapting existing resources to the present time reveal the opportunity to realize a solid and sustainable business. Moreover, the involvement of the local stakeholder in the initiative, from the beginning, becomes part of the local environment relying on a capillary and robust network that, combined with the institutional support, definitively helps the sustainability of the initiatives.

Finally, a question that arises from our findings is whether our findings regarding the strategies implemented by organizations to cope with top-down initiated SI and SE initiatives in China could be equally predictable for different economic and political contexts. All settings, especially in matters related to the social, technological, and commercial aspects of innovation, are complex and difficult to predict due to the intricate panorama of operating actors and existing relationships. However, it can be expected that such intricate strategies might follow different patterns but similar outcomes. Nonetheless, as shown, SI and SE generally suffer from a lack of several resources that make such initiatives sustainable. The implication of having a clear vision/pattern expressed by the institutions to address specific needs fulfills some of the shortages suffered from companies that can re-organize resources and processes to create a sustainable and solid initiative.

5.2. Limitations and future research areas

As with all studies, ours has some limitations, which form the basis for developing future trends of new

studies. According to the nature of the research strategy, the findings cannot be generalized without further empirical studies (Gibbert et al., 2008). These might focus first on the institutional environment's role and national and local legislation in helping organizations pursue social activities. Second, future studies might delve deeper into the organizational dimensions' role in adopting different strategies. What dimensional drivers lead the entrepreneurs to pursue a determinate organizational structure? Finally, future research might deeply explore the relationship between knowledge and intellectual capital with social entrepreneurial strategies.

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General information of our sample of firms

Name	Brief profile	Turnover	Number of employees	Sector of activity	Social needs addressed	Resources exploited
Haihui Pharm	Haihui Pharm is a newly established subsidiary of Yangzijiang pharmaceutical group in Chengdu, Sichuan Province, started to produce the glimepiride tablets (the third-generation sulfonylureas anti-diabetes drug) in 2017	100 billion CNY for Yangzijiang pharmaceutical group	300 employees	Pharmaceutical factory	Chengdu is the second largest city in western China with a population of 16 million, and no N95 mask maker before COVID-19 outbreak	Haihui Pharm. decided to use the clean workshop for the development and production of medical devices to urgently produce N95 mask
Zisun	Zisun, a Chongqing medium-sized enterprise, producing glass fiber filter low resistance melt blown filter and PTFE Membranes, is a leading enterprise in filter materials in China	1.25 billion CNY	1,500 employees	Filter materials	Chongqing is the largest city with 31 million population in western China and no N95 mask maker before COVID-19 outbreak	Zisun produce the raw material (low resistance melt blown filter) of N95 mask. Zisun decided to use the clean workshop with fan filter unit workshop to prepare urgently production for N95 mask
Gree	Gree Electric Appliances, Inc. of Zhuhai, founded in 1991, is diversified technological global industrial group – air conditioners, home appliances, high-end equipment and communication equipment	200 billion CNY	90,000 employees	Household appliances & equipment manufacture	The pandemic of COVID-12 stimulates the huge demand of medical mask	Gree establish a subsidiary company – Zhuhai Gejian medical technology co., ltd. on February 18. The major businesses of Gejian is medical protective equipment such as mask. On March 9, medical masks were officially launched on 'Dong Mingzhu's shop' – the official Gree website. The daily mask production of Gree is 600,000
BYD	BYD is a high-tech enterprise, founded in 1995, committed to 'using technological innovation to meet people's yearning for a better life'	120 billion CNY	220,000 employees	Electronics, automobiles, new energy & rail transit	The pandemic of COVID-12 stimulates the huge demand of medical mask	BYD decides to build the mask automatic production line by themselves. With the experience of mechanical design and automobile assemble, BYD build their own medical mask automatic production line as soon as possible. Relying on the machining center and research about diverse automatic production lines (Electronics, batteries, new energy vehicles, etc), BYD spends 3 days finishing the design (400 blueprints), 7 days completing the mask production line of trial production. 5-10 automatic production lines of mask are put into production every day

Name	Brief profile	Turnover	Number of employees	Sector of activity	Social needs addressed	Resources exploited
KingMed	Guangzhou KingMed Diagnostics Group Co., Ltd. (KingMed Diagnostics, SSE 603882), founded in 2003, is regarded as the pioneer and leader of the Independent Clinical Laboratories (ICL) industry in China – first ICL with both CAP and ISO15189 accreditation in China	5.269 billion CNY	9,300 employees	Independent Clinical Laboratories	The pandemic of COVID-12 leads the huge demand of NAT, and the test capacity of hospital cannot match the demand	KingMed's first novel coronavirus nucleic acid detection lab was set up in Guangzhou, equipped with 17 PCR analyzers and related supporting instruments. Starting to distribute the samples of Wuhan KingMed to other KingMed lab in south China through third-party cold chain logistics and enlarge the detection capacity of Wuhan KingMed to 4,000 test per day
BGI	BGI, founded in 1999, is one of the world's leading life science and genomics organizations. The mission of BGI is to use genomics to benefit mankind and to be a leader in the era of life sciences	2.821 billion CNY	3,600 employees	Genetic engineering		Based on the knowledge of Genetic science and previous experience (Mr. Wang Jian, chairman of BGI, is the first to complete the sequencing of SARS virus and develop SARS test kits in China.), BGI build the 'Huo-yan' lab with daily detection capacity 10,000 test units. Seven 'Huo-yan' laboratories have been set up in China (Wuhan, Shenzhen, Tianjin, Changsha, Shijiazhuang, Beijing, Shanghai), the detection capacity is 50,000 test per day, and have finished 550,000 tests

APPENDIX 2

Summary of the activities and the results obtained of the medical mask and medical nucleic acid tests sectors

Case	Enterprise	Dimension	Existing businesses	COVID-related activities	Results obtained	Impact
A	Gree	90,000 employees	Household appliances & equipment manufacture	Establishing the production line of the medical mask and online store at the same time	The daily production of surgical mask increased from 20,000 to 160,000 on March 16. The daily mask production of Gree is 600,000	In 2020, The net profit of Gree decreased by 72.53% in Q1 and by 51% in half a year. The decline should be greatly narrowed
B	Haihui Pharm	300 employees	Glimpirea tablets (third-generation sulfonyleureas anti-diabetes drug)	Working with Caihong Electric; moving their idle mask production line to Haihui workshop (medical standard level) to produce medical masks	The first batch of 5,000 N95 masks was produced on February 26. The gap of N95 medical mask in Chengdu is filled up	It has no impact on the main business
C	Zisun	1,500 employees	Glass fiber filter, low resistance melt blown filter and PTFE Membranes	Quick access to raw materials and labor force through existing channel and partner. Remolding existing clean workshops to produce medical masks	Daily production capacity enlarges to 20,000 units on March 6	In the first half of year, the operating income is 856 million yuan (\$1.25 million) (up 39.04% year-on-year). The net profit attributable to shareholders of the listed company was 222 million yuan (a year-on-year increase of 125.37%), and the income per share was 0.3126 yuan
D	BYD	220,000 employees	Electronics, automobiles, new energy & rail transit	Building the parts by BYD themselves to establish the medical mask automatic production line	Until April 17, BYD has achieved 300 automatic production lines, the daily production of medical mask reach to 20 million. BYD becomes the world's biggest mask manufacture	In the first quarter, BYD netted 269 million yuan (\$40 million) from mask sales. Byd actually produced masks in February, which netted 269 million yuan in 60 days, or 4.5 million yuan per day on average!
E	KingMed Diagnostics	9,300 employees	Third-party medical examination and pathological diagnosis	Building the first novel coronavirus nucleic acid detection lab to carry out the detection of novel coronavirus nucleic acids; Increasing daily test capacity through utilizing the third-party cold chain logistics	Creation of the first novel coronavirus nucleic acid detection lab The daily detection capacity of Wuhan KingMed raised to 70,000 test units 3.5 hr from samples receiving to the test report complete	In the first half of the year, the company's revenue was 3,475 billion yuan (\$500 million) (a year-on-year increase of 36.63%); Net profit was 556 million yuan(\$70 million), up 223.71% year on year. Basic eps of ¥1.21. The total number of tests has exceeded 10 million (2020/08/17), accounting for about one-tenth of the total national nucleic acid tests during the same period, which has become a useful supplement to the existing public health and medical system

Case	Enterprise	Dimension	Existing businesses	COVID-related activities	Results obtained	Impact
F	BGI	3,600 employees	High-throughput gene sequencer and reproductive health-related gene testing & diagnosis services	<p>Building the novel coronavirus emergency test lab – ‘Huo-yan’</p> <p>Producing nucleic acid test kits</p> <p>Successfully operating ‘Huo-yan’ lab in Brunei, the United Arab Emirates, Serbia and Australia</p>	<p>Obtaining product registration certificate (coronavirus nucleic acid test kit and high-throughput gene sequencing instrument) from NMPA</p> <p>Emergency Use Authorization(COVID-19 nucleic acid test kits) from FDA</p> <p>China’s largest COVID-19 nucleic acid test kits manufacturer (daily test kit production capacity is 600,000 units, the total production over 3.14 million units)</p>	<p>The company’s overall first-half operating revenue is expected to be between 4 billion yuan (\$5.83 million) and 4.3 billion yuan (\$6 million), an increase of about 209.73% to 232.96% over the same period last year</p>