Global Pandemic and Rapid New Product Development of Medical Products

MOOTHEDATH CHANDRAN KUMARI and BIRADAR SAGAR, Indian Institute of Science, Bangalore

New product development is a strenuous and long process for companies. When the COVID-19 disease turned into a global pandemic, governments announced the need for various medical products that were scarce and at the same time imposed lockdowns and trade restrictions. During this period, rapid new product development of medical products was attempted by many companies worldwide using their existing supply chains. Data of 240 companies from non-medical product-segment background launching new medical products were collected and analyzed. Two case studies of Indian companies responding to shortages of ventilators and PPE are presented. A critical reflection of a new way of new product development and cooperation across firms is discussed.

CCS Concepts: • **Social and professional topics** → *Computing / technology policy; Government technology policy; Governmental regulations;*

Additional Key Words and Phrases: COVID -19, industrial resilience, innovation, new product development, medical product design, global governance

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1 COVID 19 AND GOVERNMENT RESPONSE

Severe Acute Respiratory Syndrome-Coronavirus 2 (SARS-CoV2) or Coronavirus Disease (COVID-19), is an infectious disease outbreak first reported in November–December 2019 that later turned into a global pandemic in a few months, contracted by 17.3 million to date [1]. According to the World Health Organization (WHO), “COVID-19 spreads primarily through droplets generated when an infected person coughs, sneezes or speaks. One could also become infected by touching a contaminated surface and then touching one’s eyes, nose or mouth before washing hands” [2]. Therefore, the preventive measures from contracting the virus as advised by WHO are - to keep at least 1-m distance from others, frequently disinfect contaminated surfaces, clean hands regularly, and avoid touching the nose and mouth [2]. To date, there is no commercially available vaccine for COVID -19 that has been found effective in human trials.

Authors’ addresses: M. C. Kumari and B. Sagar, Design Innovation Centre, Centre for Product Design and Manufacturing, Indian Institute of Science, Bangalore 560012, India; emails: {kumarimc, sagarbiradar}@iisc.ac.in.

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COVID-19 spread globally across many countries in the initial months through international travelers, which influenced almost all nations and governments to curb international passenger flights by March 2020 [3]. Governments also responded to the pandemic by imposing quarantine of air travelers, cancelling visas of non-citizens to enter countries, and by announcing nationwide lockdowns. Lockdowns imposed many restrictions, including sealing of borders, transport and domestic travel restrictions, and shutdowns of schools, universities, trade, commercial establishments, marketplaces, factories, and offices. Other than essential and emergency services like hospitals, pharmacies, and supplies of essential goods, people were restricted to indoors during the government-imposed lockdowns.

Different governments imposed lockdowns at varying stringencies [4]. Geographic boundaries became significant with these restrictions and acted as barriers for the movement of people. Boundaries at different scales—from national to regional to district to streets to buildings to individual rooms—emerged as a crucial parameter for containing infected people to limit the spread of the disease. When borders became a delineating element for restrictions on movement of people and goods, supply chains were disrupted locally and globally. A supply chain disruption is defined as an unplanned and unanticipated event that disrupts the normal flow of goods and materials within a supply chain [5, 6]. The global supply chain disruptions due to COVID-19-related lockdowns affected many businesses, especially the international import/export of medical products needed for COVID-19 care itself. These include COVID-19 diagnostic testing kits, medicines, personal protective equipment (PPE) like coveralls, N95 masks, and so on, which were highly critical and urgent needs of many nations.

Hence, as the COVID-19 infectivity rate increased, governments decided to retain the COVID medical supplies they internally produced. Around 80 countries (as of April 22, 2020) introduced export prohibitions and restrictions to medical products and essentials for COVID-19 care to tackle their internal shortage. Among these products, export of face and eye protection products was prohibited by 73 countries, followed by the export of protective garments (50 countries), gloves (47 countries), sanitizers and disinfectants (28 countries), pharmaceuticals (20 countries), medical devices including ventilators (10 countries), and COVID-19 test kits (6 countries) [7]. For example, the US, UK, and India imposed restrictions on the export of PPE, COVID-19 test kits, and medicines [7].

A few months prior to the onset of the COVID-19 pandemic, medical products accounted for approximately 5% of the total world trade, including both imports and exports in 2019 [8]. Among these medical products, "medicines" represented 56% of imports, followed by "medical supplies" (17%), "medical equipment" (14%), and "personal protective equipment" (13%). The US, Germany, and China were the top three importers of medical products accounting for a third of total imports during 2017–2019 [8]. For exports, 40% of personal protective product exports were from three countries—China, Germany, and the US—with China being the top exporter of face masks (25% share) [8]. More than half the world's respirators and ventilators were exported by four countries—Singapore, US, Netherlands, and China [8]. It is evident that merely three to four countries were global leading exporters of medical products prior to the COVID-19 pandemic. But after the onset of the pandemic, and the sudden global trade restrictions due to it, the import-dependent countries for medical products were at dire shortage of essential COVID care products to meet their surging internal demands.

Nations and companies with global supply chains often have strategies and redundancies to address common supply chain disruption scenarios like natural calamities. However, a global pandemic as a supply chain disruption scenario and pandemic preparedness was new to most countries. This article will discuss the business responses to the shortage of essential COVID-19 care medical products induced by trade restrictions by different governments and how new ways of industrial collaboration scenarios can be observed during new product development amidst lockdowns.

2 RESPONSE TO PANDEMIC BY INDUSTRIES AND RAPID NEW PRODUCT DEVELOPMENT

As the supply chain disruptions and government-imposed lockdowns due to the pandemic affected companies' businesses as usual, many firms ventured to develop the medical products that are in shortage for COVID-19

care. The reasons for this new product development (NPD) by firms are many. The shortage of the medical products motivated some firms to produce them as a corporate social responsibility. For example, L'Oréal produced hand sanitizers to provide it free of cost to hospitals, pharmacies, and so on (Table A.1, row 4). Some firms entered medical products segments identifying market shortage as a business opportunity. Example, Steelbird, an Indian motorcycle helmet manufacturer, entered the medical product segment by producing face shields (Table A.1, row 231). Governments demanded that private firms and state-owned corporations produce medical products like ventilators and PPE coveralls. For example, General Motors (GM), an American automobile company, was ordered by the US government to make 30,000 ventilators (Table A.1, row 98). Some firms started producing medical products to procure the government offered benefit to open their factories during the lockdown. For example, Nomasei, a luxury shoe brand, produced masks, as doing so allowed their workers to remain employed (Table A.1, row 15). Some firms produced medical products to keep their business afloat by monetizing existing production facilities. For example, Chinese automotive company BYD Co altered their production lines to produce surgical face masks while car sales dropped (Table A.1, row 232).

Therefore, many firms from non-medical product-segment backgrounds in different countries entered into medical product design and development. Figure 1 illustrates the relationship behind the events leading to firms from diverse product segments entering NPD of medical products.

A product development process in general involves six stages—planning, concept development, system level design, detail design, testing and refinement, and production ramp-up [9]. Product development times of different products vary from 1–4.5 years depending on complexity. Very few products can be developed in less than 1 year. For example, the development time of a simple two-component product, Stanley Tools Jobmaster Screwdriver, was 1 year, whereas that of a new printer (HP Desk-Jet Printer) was 1.5 years [9]. A new product opportunity also varies in value, and the risks increase as organizations navigate from existing to new solutions, markets, and product categories [8]. The COVID-19 pandemic necessitated rapid new product development with short product development time spans of 2–3 months, and many firms from different product-segment backgrounds entered a new product category of medical product segment.

To demonstrate the diversity of the original product-segment background of the firms who newly launched medical products for COVID-19, an indicative survey of new product launches of medical products over the period from March to July 2020 was carried out. Data of 240 non-medical product firms across 26 countries were collected from digital media press articles, social media posts, promotions, company websites, and Google search. The keywords used for Google search include, “list of companies manufacturing covid face shields and ventilators,” “new covid products by automotive companies,” “new covid products by retail company,” and so on. After obtaining the company names, data were collected from each company’s official websites. COVID-19 product launches by some of the top companies in the automotive and retail sectors were searched individually in Google search. For example, the keywords were “new covid products by Mercedes Benz,” “new covid products by Nike,” and so on. The data were collected over a period of 2 months, from May to July 2020, whilst the demand of medical products were surging and COVID-19 product launches were still ongoing. Hence, this is an indicative survey illustrating the trend of product launches taking place during this period.

The data of 240 companies showed they were from 21 different product-segment backgrounds, viz. aerospace, automotive, biotechnology, brewing, business and technology solutions, the chemical industry, conglomerate, consumer appliances, consumer goods, defense research, design studios, engineering and robotics, food processing, fuel-cell manufacturers, garment manufacturers, apparel retail, home automation, industrial safety equipment, medical equipment, software firms, and sporting goods. Of these, 114 companies were from India, and 127 from 25 countries. Fifty-nine percent of companies were more than 25 years old, and 13% were start-ups of less than 5 years old.

There are seven main COVID-19 medical product categories where the most product launches have occurred: masks, ventilators, hand sanitizers, PPE coveralls, face shields, COVID diagnostic test kits, and UV-based disinfection products.

Fig. 1. Relationship between events leading to NPD in medical products by firms.

Figures 2 and 3 show the diversity of the original product-segment background of the firms that launched ventilator and PPE new products, respectively. Thirty-seven firms from 11 different product segments produced ventilators, and many of them are automotive and aerospace firms. As a ventilator is a product with mostly mechanical and electronic components, the automotive and aerospace companies would have had better access to raw material and component supply chains and manufacturing facilities for producing and assembling these components. New ventilator products were also launched by medical equipment firms, consumer appliances, consumer goods, and engineering and research organizations. Thirty-six firms from nine different product-segment backgrounds launched PPE products. While most of these firms are garment manufacturers and apparel retailers, automotive and consumer appliance firms also launched PPE products. This indicates that these firms adapted their current production systems to produce PPEs. The dataset is provided in Appendix A.1, and Appendix A.2 has bar charts for other COVID-19 medical products. We could see that the NPD of medical products were not limited to closely related product-segment firms, as many other firms from diverse product-segment backgrounds also launched COVID-19 medical products. Figure 4 illustrates this diversity of the original product-segment background of the firms versus the seven main COVID-19 medical products (masks, ventilators, hand sanitizers,

Fig. 2. Company backgrounds of 37 new ventilator producers.

Fig. 3. Company backgrounds of 36 new PPE producers.

PPE coveralls, face shields, COVID diagnostic test kits, and UV-based disinfection products) for which NPD was carried out by firms.

3 CASE STUDY OF RAPID NPD BY INDIAN INDUSTRIES AND THE ROLE OF GOVERNMENT OF INDIA

When the Government of India (GoI) imposed a nationwide lockdown for 2 months from March 23, 2020 [10], India was facing shortage of PPEs, N95 masks, ventilators, and COVID diagnostic kits. On March 29, 2020, GoI appointed an Empowered Group (EG), who were entrusted with the responsibility of ensuring the availability of essential medical products necessary in India for the COVID-19 outbreak [11]. The EG was responsible for procurement, import, production, and distribution of PPEs, masks, gloves, and ventilators [11]. The EG took measures by reaching out to firms to produce these medical products in shortage within India and permitted firms producing medical products to open facilities during lockdowns with COVID prevention protocols. The GoI also waived a regulatory law that required a license for firms producing essential medical equipment if new manufacturers partnered with a licensed firm [12]. The Indian industries from different product-segment backgrounds responded to the government by entering NPD of essential medical products such as COVID diagnostic kits, PPEs, ventilators, masks, and face shields for rapid launch amidst lockdown. NPD amidst lockdown required government support for the necessary supply chains and logistics—interstate travel permits, local commute permits for employees, raw material shipping and sourcing assistance, and so on. The next section will discuss how

Fig. 4. Company backgrounds of 240 firms and new product categories.

companies collaborated with other firms or government organizations to execute an NPD process during supply chain disruptions. Two case studies of rapid NPD through collaboration by Indian firms responding to the shortage of medical products are presented below.

3.1 Case Study 1: Company-driven Collaboration—Skanray Technologies + Mahindra & Mahindra for Ventilator Design [12]

Ventilators are necessary to treat critically ill COVID-19 patients facing breathing difficulties. India's domestic production capacity of ventilators was 2,500 units per month by seven companies in February 2020 until a month prior to the nationwide lockdown in March 2020. The Indian healthcare system was mainly relying on imported ventilators from Europe and China to meet the internal demands. In March 2020, the GoI projected an internal demand for 75,000 ventilators by June 2020 and imposed an export ban of ventilators. The EG placed orders for 60,884 ventilators to HLL Lifecare Limited (HLL), a GoI-owned corporation acting as a central procurement agency during the outbreak. HLL issued 59,884 orders to domestic manufacturers and 1,000 were to be imported.

Mahindra & Mahindra (M&M), an Indian automobile company, collaborated with Skanray Technologies (Skanray), an Indian medical equipment retail and original equipment manufacturer (OEM) company, to design and manufacture a new simplified ventilator design using easily available components and easy-to-use controls for its operation. Skanray shared the working knowledge of ventilators, and a new product design was developed that could be produced in M&M's factories using existing facilities and shared components from its other product lines. The new product development stages are as follows:

- Concept Design: Skanray shared the technology and specifications of existing ventilator designs, and Mahindra identified components from its product platforms, and a new ventilator design concept was developed.
- Detailed design: M&M's mechanical and electronics engineers developed detailed design; software engineers wrote codes; and program managers and sourcing engineers prepared Bill of Materials and identified vendors.

- Procurement and Manufacturing: Mahindra was responsible for the procurement of components from its factories.
 - Borrowed components for the new ventilator design from Mahindra's existing stock and facilities are as follows:
 - Central Control – Borrowed from Mahindra Marazzo's (MUV) compact multi-purpose vehicle platform.
 - Control knobs- Borrowed from Mahindra Marazzo's Centre console switch bank and AC switch bank
 - Displays for volume of gas, concentration of oxygen, error message - Borrowed from Mahindra Jawa's (motorcycle) round instrument cluster.
 - Power back up - Borrowed from Mahindra Treo (electric powered three-wheeler rickshaw)
 - Flow control valves - Skanray sourced from three suppliers (IMI Norgen, Parker, and Emerson) for redundancy to avoid supply delays during lockdown.
 - Other parts – These were procured from more than 20 other suppliers who were helped by M&M's taskforce to procure permission to open their facilities and to allow the necessary workforce to produce ventilator parts.
- Transportation and Logistics - Mahindra Logistics Ltd., the transport and supply chain logistics subsidiary of M&M, brought all the parts from different facilities to Mahindra Research Valley, Chennai.
- Assembly – The ventilator was assembled at Mahindra Research Valley, Chennai.
- Prototype Testing – Pre-certification tests were carried out with guidance from Skanray.

The new ventilator was priced at 7500 INR, 0.75% is correct (99.25% cheaper than the cost of an imported ventilator) [13].

3.2 Case Study 2: Government-mediated Collaboration—GoI + Garment Manufacturers for PPE Design [14]

India was import dependent for PPE kits (coveralls, N95 masks, gloves, and face and eye protection shields). In January 2020, India had only 0.275 million PPE kits in reserve, and 20 million was the projected demand in July 2020. Two of GoI's ministries, the Ministry of Textiles (MoT) and the Ministry of Health & Family Welfare (MoHFW), collaborated and invited fabric and garment manufacturers to produce PPEs on a war-time basis. Companies who responded and offered their existing facilities to manufacture PPE were guided and assisted by MoT on PPE production and certifications. MoT tested fabric samples produced by textile manufacturers in India at a government-owned testing agency, South India Textile Research Association (SITRA), in Coimbatore. The results were shared with MoHFW, and technical specifications were finalized based on WHO interim guidelines on PPEs. An Emergency Control Room of the MoT centrally monitored the supply chain—sourcing raw materials and machines, production, and supply of medical textiles coordinating with the demands from governments. A government agency was assigned as a certifying body to test and certify new PPEs made by new firms. GoI further relaxed the testing standards to meet for PPEs. The Ministry of Civil Aviation supported the transportation of samples for testing and certification through state-owned airlines (Air India) during lockdown and ban on flights.

Arvind Mills, a textile and apparel company, entered NPD of PPE coveralls along with the local government of Ranchi city in the Indian state of Jharkhand as a public-private partnership. The NPD stages of PPE production of Arvind Mills and the Ranchi City Administration are [14,15] as follows:

- Raw materials: MoT assists in sourcing SITRA-approved fabrics through the Emergency Control Room.
- Procurement: Purchased by the District Administration, Ranchi, State of Jharkhand.
- PPE Coverall Design and technical guidance: Provided by MoT to Arvind Mills.
- Production: PPEs were produced at Arvind Mills Ranchi factory.
- Testing: SITRA, GoI-owned testing agency.

The PPEs were priced at 250 INR, at subsidized rates through the firm's CSR funds [15]. Arvind Mills now has a daily capacity of producing 15,000 PPE kits per day [14].

4 CRITICAL REFLECTIONS ON THE ROLE OF GOVERNMENTS IN RAPID NPD AND COLLABORATION SCENARIOS

The data of 240 companies in Section 2 illustrated the diversity of the product-segment background of the firms entering NPD of medical products during the pandemic. The case studies in Section 3 showed how two Indian firms from non-medical product backgrounds carried out NPD through strategic collaborations while the motivations for these collaborations were different. In the first case study, M&M collaborated with an Indian medical equipment retail and OEM firm (Skanray) without a mandated government order to create ventilators. In the second case study from India, Arvind Mills was invited by the GoI and collaborated with the local government and the state-owned firms for PPE development and created a production capability. All partners in this alliance were new to medical products, except for the testing agency. In the US example of ventilator development by General Motors, GM collaborated with Ventec Life Systems, an American medical device company, to produce Ventec's ventilator design in GM's factories and was later mandated by the US government to deliver 30,000 ventilators [16, Table A.1, row 100]. These collaboration scenarios show the different motivations for firms to do NPD among those outlined in Section 2 and Figure 1. This section will discuss how the collaboration scenarios used by companies from different product-segment backgrounds for rapid NPD are different from other types of firm collaboration and co-operation alliances and the roles played by government in each of these.

Product and manufacturing firms cooperate with other firms for competitive advantage through strategic alliances. A strategic alliance is defined as an "independently initiated inter-firm link that involves exchange, sharing or co-development" [17 as in 18] or "contractual arrangements between two or more independent companies that carry out a project or operate in a specific business area by coordinating skills and resources jointly rather than either operating on their own or merging their operations" [19]. The different types of alliances from literature are as follows:

1. Exchange alliance – Resources are exchanged and utilized independently by each partner [18, 20].
2. Integration alliance – United resources shared in an organization designed by the partners to perform prescribed functions and to serve a common purpose [18, 20].
3. Symmetric alliance – The same kinds of resources are exchanged [18,19].
4. Asymmetric alliance - Different kinds of resources are exchanged [18,19].
5. Horizontal alliance - Partners belong to the same industry [19].
6. Vertical alliance - Partners are from different industries [19].

Firms cooperate through different types or combinations of these alliances, and the motivations are different for each cooperation scenarios. We can identify the COVID NPD alliances as a combination of integration, asymmetric, and vertical alliance types. Below we will discuss about the different cooperation scenarios in product and manufacturing firms.

4.1 Different Cooperation Scenarios in Product and Manufacturing Firms

Resource-sharing is a supply chain cooperative action concept. It is commonly carried out in the field of transportation logistics. For example, in maritime shipping, companies optimize the utilization of freight carriers by using shared loads, groupage systems in freights in air transportation, and so on [21]. Resource sharing as one form of cooperation is also a beneficial way to react to supply chain disruptions [21]. Cooperating companies share machines for manufacturing to meet demand fluctuations by accessing each other's machines without maintaining redundancies and expensive capacities [21]. The partnership comes into force by market-driven

and economy-driven reasons, and decisions are taken within company borders. The cooperating partners may not be competitors.

Another concept involving cooperation between firms is industrial symbiosis (IS), which engages “traditionally separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy, water, and/or by-products” (Reference [22], p. 313, as in Reference [23]). In IS, waste streams and by-products of one firm are used as inputs for other firms to generate economic benefits for the cooperating firms [23,24]. For example, a sugarcane refinery uses heat from the hot water used in combined heat and power plants to heat a glasshouse that grows tomatoes [25], which is not a primary product of the firm. Geographic proximity is often required in sharing resources for IS. The United Kingdom reports the highest number of IS cases, as the UK government launched the National Industrial Symbiosis Programme [26, 27], a voluntary program to help companies find partners that use their waste as raw material. China has highest number of IS cases in Asia, as the Chinese government has constraints on carbon dioxide emissions and plans and policies to foster circular economy practices [26, 28–30]. In Japan, IS is driven by the Japanese Eco-Town Programme, which encourages the use of waste in industrial applications to boost the economy and reduce waste disposal [26, 31, 32].

Co-opetition is another supply chain cooperation concept in which independent companies simultaneously both cooperate and compete as a business constellation. It offers the opportunity of creating additional value for the cooperating firms [21, 33]. For example, PSA group, a French automobile manufacturer, and Toyota, a Japanese automobile manufacturer, shared components for the PSA Peugeot 107, the Toyota Aygo, and the PSA Citroën C1 [34]. The companies saved on the shared production costs but remained competitive in other areas [34].

Platform-sharing is a product development method where brands share various products with the same architecture, components, technologies, and service procedures [35]. Platform product is built around pre-existing technological sub-systems [9]. An example is engine designs or steering wheel designs used across different vehicles in an automobile company. The goals of platform sharing are to reduce development and manufacturing costs and to create diverse product families to extend their brands [35–38]. Platform sharing can also be across firms to create technically identical products using different brand names. For example, the Suzuki Baleno 2015 model and its rebranded model, the Toyota Glanza, are both sold simultaneously in Indian market by Maruti Suzuki and Toyota’s Indian subsidiary, Toyota Kirloskar [22]. Here the complete product is shared by two firms, and its combined market share is higher than its individual sale by Suzuki [22].

4.2 Difference of COVID-19 NPD Alliance Co-operation Scenario

Though the above four supply chain cooperation concepts share commonalities, there are differences in its goals and outputs. In resource-sharing, the participating companies do not have a common product development goal. In IS networks, the focus is on waste streams, and there is no guaranteed production of the co-product (product made from raw materials from waste streams of other products) in required capacities. The development of a co-product is not a common goal of cooperating firms, but reduction of waste and carbon emissions are the goals, where in some cases it is driven by government laws and policies. Co-opetition involves different companies focusing on their individual products with some collaboration. Firms do not jointly carry out a new product development. Platform-sharing scenarios share designs of product sub-systems from one product to another, or entire product design from one firm to another, sharing resources and supply chains. The outcome is multiple products or the same product sold under different brand names, and both products are usually of the same product-segment.

In contrast to the above four co-operation scenarios, the COVID-19 NPD alliances shared resources to make a new product of a different domain as a shared goal. In Case Study 1 Ventilator Design of M&M and Skanray (see Figure 5), M&M shared parts from its three existing vehicles from three different product-segments, i.e., a motorcycle, a three-wheeler electric-powered rickshaw, and an MUV (minivan), which are not sharing platform

Ventilator : Mahindra & Mahindra + Skanray Technologies

Fig. 5. New ventilator product supply chain from partly shared supply chains.

products among each other. Apart from these, a new supply chain was created with 20 other manufacturers. Together, a new product with a new supply chain was developed that shared three existing products' partial supply chain network. The two firms shared a single goal of one NPD that was neither an allied/substitute product of M&M nor a by-product. Moreover, a large part of the workforce worked remotely, unlike other co-operation scenarios.

If we consider the area of supply chain resilience, according to Craighead et al. [6, 40], then it is defined as the ability of a system to return to its original state or move to a new, more desirable state after being disturbed. The focus is on returning to the original state of equilibrium of the concerned supply chain. Resilience of industrial eco-systems concerns economic benefits as well as the reduction of material, energy, and environmental impacts. Though COVID-19 NPD had a common element of material and energy reduction by adapting existing facilities for new product development, reduction of environmental impact was not its main goal. It could be said that infectious disease is an environmental health hazard, but it is not a factor usually considered in resilience measures [40].

Table 1 summarizes the above co-operation concepts and situates the cooperation phenomenon observed in COVID-19 NPD alliances. From Table 1, we can see that the COVID-19 pandemic instigated NPD and manufacturing appears as a new firm supply chain cooperation scenario. A worldwide pandemic is also a new disaster scenario for supply chain disruption perhaps comparable to World War-II, which also instigated new technology developments in weaponry, vehicle designs, medicines, and packaged food [41]. Unlike other supply chain disruptive events during a natural calamity that are region specific, like typhoons, earthquakes, and floods, where firms respond by aid through CSR funds, for the COVID pandemic disaster scenario, firms entered NPD for the different reasons stated in Figure 1 and perhaps also from social responsibility, as 150 of 240 firms launched medical products amidst lockdown in their regions. The motivations of the 240 firms who launched medical products may differ from those of the case study examples, as the motivations per se are not captured in this study. The diversity of the companies entering medical product segment demonstrates the desire to act on a common goal of

Table 1. Supply Chain Cooperation Scenarios for Multiple Products

Cooperation scenarios	Description	Shared resource	New Product Domain	Goal	Role of governments
Resource-sharing	Cooperating companies allow each other to access its resources	Technical manpower, manufacturing facilities, supply chains, Intellectual property	Same/ different domains	To deal with supply chain disruption or other disturbing events; Economic benefits of sharing; lean manufacturing	None
Industrial Symbiosis Network	By-products from waste streams are shared as raw materials to other companies	Waste as raw material	Same/ different domain	Resource efficiency and reducing wastage	Benefits provided by govt. as energy credits, carbon credits
Co-opetition	Competing companies making similar products collaborate and compete at the same time	Product components, supply chain	Same domain	Combined Value addition, lean	None
Platform sharing	Within or across companies shared resources for multiple products	Product component designs, product designs, intellectual property	Same domain	Economic and time to market benefits; resource efficiency; to capture new markets	None
COVID-19 NPD Alliance	Multiple companies shared different resources and/or build new supply chains for making a new product as a common goal	Product components, machine, facility, supply chain, intellectual property	Different domain	Socio-economic, resource efficiency, business, and community survival benefits.	NPD mandated/promoted by the govt.; NPD instigated by supply chain disruptions due to govt. policies, trade restrictions and lock-down decisions; Govt. relaxing licenses and certifications for medical product manufacturing.

addressing a global pandemic. The case studies show that industrial or supply chain resilience cannot be looked at in isolation within company or alliance boundaries in the situation of a global pandemic. There is need for research on addressing supply chain disruptions due to a global pandemic and resource-constrained production where there is restriction on human proximity at workplaces.

5 CONCLUSIONS

A global pandemic of this scale of geographic spread at a time is the first of its kind. Human-made systems of supply chains, organizations, and work environments, including the way designers work, were affected as these structures changed. This paper discussed the rapid NPD of medical products by firms of different product-segment backgrounds and new firm cooperation scenarios that emerged due to constraints imposed by the pandemic as well as by the governmental actions of lockdowns and travel and export/import restrictions. The driving factor for firms to solve design problems and enter NPD of medical products for COVID-19 were multifaceted—economic (demand for particular sets of medical products, business and supply chain disruptions), social (corporate responsibility to respond to larger needs of the society), and governmental (lockdowns, trade restrictions, mandated product development). For a globalized market to survive, a pandemic preparedness plan should not be a matter of governments alone—they need to be devised involving international trade bodies and organizations.

Further research on the COVID-19 NPD alliances and cooperation scenarios would help in understanding these scenarios as a future way of collaboration for the NPD of critical medical products on demand.

A APPENDICES

A.1 Dataset of 240 Companies That Launched COVID-19 Medical Products

No.	Company Name	Industry	COVID-19 product	Reference	Date of Reference	Country	Release Date	Year of Estb.	Is Product Released During Lockdown? Yes/No/No Data	URLs
1	LVMH	Retail company	Hand Sanitizers	Link	16-03-2020	France	Not mentioned	1987	No Data	https://www.bbc.com/news/business-51868756
2	Foxconn	Consumer appliances	Face Masks	Link	07-02-2020	Taiwan	Not mentioned	1974	No Data	https://www.bbc.com/news/business-51410700
3	Welspun	Conglomerate	Face Masks, Disinfection Wipes	Link	07-04-2020	India	Not mentioned	1985	No Data	https://economictimes.indiatimes.com/industry/cons-products/garments/-/textiles/welspun-to-start-making-disinfectant-wipes-masks/articleshow/75019409.cms?from=mdr
4	Loreal	Retail company	Hand Sanitizers	Link	28-03-2020	France	07-04-2020	1909	Yes	https://economictimes.indiatimes.com/magazines/panache/loreal-joins-fight-against-coronavirus-to-deliver-free-hand-sanitisers-to-hospitals-and-pharmacies/articleshow/74863953.cms?from=mdr
5	La-Rochey-Pose	Retail company	Hydro-alcoholic gel	Link	29-04-2020	France	29-04-2020	1976	Yes	https://fashionista.com/2020/03/fashion-beauty-companies-coronavirus-covid19-manufacturing-products-help
6	Americal Apparels	Retail company	Face Masks	Link	29-04-2020	USA	29-04-2020	1991	Yes	https://fashionista.com/2020/03/fashion-beauty-companies-coronavirus-covid19-manufacturing-products-help
7	Zara	Retail company	Hospital Gowns, Face Masks	Link	29-04-2020	Spain	29-04-2020	1974	Yes	https://fashionista.com/2020/03/fashion-beauty-companies-coronavirus-covid19-manufacturing-products-help
8	Guerlain	Retail company	Hand Sanitizers	Link	29-04-2020	France	29-04-2020	1828	Yes	https://fashionista.com/2020/03/fashion-beauty-companies-coronavirus-covid19-manufacturing-products-help

9	Big Bud Press	Retail company	Face Masks	Link	29-04-2020	USA	29-04-2020	2015	Yes	https://fashionista.com/2020/03/fashion-beauty-companies-coronavirus-covid19-manufacturing-products-help
10	Christian Siriano's sewing team	Retail company	Face Masks	Link	29-04-2020	USA	29-04-2020	2008	Yes	https://fashionista.com/2020/03/fashion-beauty-companies-coronavirus-covid19-manufacturing-products-help
11	Balenciaga and Saint Laurent	Retail company	Face Masks	Link	29-04-2020	France	29-04-2020	2001	Yes	https://fashionista.com/2020/03/fashion-beauty-companies-coronavirus-covid19-manufacturing-products-help
12	Gucci	Retail company	Surgical Masks	Link	29-04-2020	Italy	29-04-2020	1921	Yes	https://fashionista.com/2020/03/fashion-beauty-companies-coronavirus-covid19-manufacturing-products-help
13	Prada	Retail company	Face Masks, PPE Coveralls	Link	29-04-2020	Italy	29-04-2020	1913	Yes	https://fashionista.com/2020/03/fashion-beauty-companies-coronavirus-covid19-manufacturing-products-help
14	Nomasei	Retail company	Face Masks	Link	29-04-2020	Belgium	29-04-2020	2016	Yes	https://fashionista.com/2020/03/fashion-beauty-companies-coronavirus-covid19-manufacturing-products-help
15	H&M	Retail company	PPE Kit	Link	22-03-2020	Sweden	29-04-2020	1947	No Data	https://hmgroupp.com/media/news/general-news-2020/h-m-group-to-supply-protective-equipment-for-hospitals.html
16	Alabama Chanin	Retail company	Face Masks, Hospital gowns	Link	29-04-2020	USA	29-04-2020	2006	Yes	https://fashionista.com/2020/03/fashion-beauty-companies-coronavirus-covid19-manufacturing-products-help
17	ForDays	Retail company	Surgical Masks	Link	06-04-2020	Japan	01-04-2020	2016	No Data	https://www.fordays.com/5-smiley-mask-pack
18	Asimov Robotics	Engineering and Robotics	Disinfection Robots	Link	30-03-2020	India	30-05-2020	2012	Yes	https://economictimes.indiatimes.com/news/science/robots-help-combat-covid-19-in-world-and-maybe-soon-in-india-too/articleshow/74893405.cms?from=mdr
19	Nocca Robotics, IIT Kanpur	Engineering and Robotics	Ventilators	Link	08-05-2020	India	Not mentioned	2017	No Data	https://economictimes.indiatimes.com/small-biz/startups/newsbuzz/indian-startup-nocca-robotics-plans-to-ship-covid-19-ventilator-from-may-end/articleshow/75626184.cms
20	Aerobiosys Innovations, IIT Hyderabad	Engineering and Robotics	Ventilators	Link	04-04-2020	India	02-04-2020	2018	Yes	https://iith.ac.in/assets/files/pdf/Social-and-R-D-Initiatives-to-fight-against-Covid-19.pdf

21	Agva Healthcare	Medical equipment	Ventilators	Link	30-06-2020	India	02-04-2020	2017	Yes	https://www.agvahealthcare.com/
22	Indian Army's Corps of Electronics and Mechanical Engineers (EME)	Defence research	Remote controlled trolley; Surgical Masks, Hand sanitizers, Anti-aerosolization boxes, Thermal Scanners	Link	03-05-2020	India	Not mentioned	1943	No Data	https://www.indiatvnews.com/technology/news-tech-innovations-by-indian-army-drdo-to-fight-coronavirus-pandemic-covid-19-613697
23	Centre for Fire Explosive & Environment Safety (CFEES), Delhi	Defence research	Sanitiser Dispensing Unit	Link	03-05-2020	India	Not mentioned	1992	No Data	https://www.indiatvnews.com/technology/news-tech-innovations-by-indian-army-drdo-to-fight-coronavirus-pandemic-covid-19-613697
24	DIPAS, INMAS, DRDO laboratories in Delhi	Defence research	UVC Disinfection Product	Link	03-05-2020	India	Not mentioned	1961	No Data	https://www.indiatvnews.com/technology/news-tech-innovations-by-indian-army-drdo-to-fight-coronavirus-pandemic-covid-19-613697
25	Mylab Discovery	Biotechnology company	Test Kits	Link	04-06-2020	India	02-04-2020	2016	Yes	https://www.industrialautomationindia.in/startupsitm/9430/The-Innovations-Indian-Startups-are-Coming-up-with-to-Combat-Covid-19/startups
26	A water treatment company	Biotechnology company	Disinfection Tunnel	Link	04-06-2020	India	02-04-2020	2017	Yes	https://www.industrialautomationindia.in/startupsitm/9430/The-Innovations-Indian-Startups-are-Coming-up-with-to-Combat-Covid-19/startups
27	Turtle Shell Technologies	Biotechnology company	Health Monitoring Device	Link	05-03-2020	India	05-03-2020	2015	Yes	https://www.bloombergquint.com/business/startup-street-dozees-contactless-monitor-is-limiting-frontline-health-workers-exposure-to-covid-19
28	Qure.ai	Biotechnology company	PPE Kit	Link	02-04-2020	India	02-04-2020	2016	Yes	https://economictimes.indiatimes.com/startups/healthcare-startups-doze-qure-ai-log-9-mylab-speed-up-efforts-to-fight-covid-19/articleshow/74939112.cms
29	Healthians	Biotechnology company	Chatbot App	Link	28-03-2020	India	Not mentioned	2014	No Data	http://www.businessworld.in/article/Indian-HealthTech-Startups-leveraging-Tech-to-tackle-COVID-19/28-03-2020-187513/
30	InAccel	Medical equipment	Ventilator for babies	Link	08-04-2020	India	4/1/2020	2012	Yes	https://inc42.com/features/startupsvscovid19-indias-medical-devices-startups-step-up-to-the-challenge/

31	InAccel	Medical equipment	Non-Invasive Ventilator	Link	08-04-2020	India	7/21/2020	2012	No	https://inc42.com/features/startupscovid19-indias-medical-devices-startups-step-up-to-the-challenge/
32	InAccel	Medical equipment	Automated Oral Secretion Remover	Link	08-04-2020	India	Not mentioned	2012	No Data	https://inc42.com/features/startupscovid19-indias-medical-devices-startups-step-up-to-the-challenge/
33	Ashok Leyland Ltd.	Automotive	Face Masks, Face Shield	Link	31-03-2020	India	05-05-2020	1948	Yes	https://economictimes.indiatimes.com/news/company/corporate-trends/tvs-motor-company-ashok-leyland-nippon-paints-among-others-contribute-to-covid-19-relief/articleshow/74912961.cms?from=mdr
34	Ashok Leyland Ltd.	Automotive	Ventilators	Link	05-05-2020	India	05-05-2020	1948	No Data	https://www.thehindu.com/business/ashok-leyland-develops-low-cost-ventilator/article31512380.ece
35	ORBIT Gear	Engineering and Technology	Face Shield	Link	10-05-2020	Indonesia	10-05-2020	2008	No Data	https://hypebeast.com/2020/5/orbitgear-w210-a-face-shield-release
36	Reliance foundation	Consumer appliances	Face Masks, PPE Kits	Link	23-03-2020	India	23-03-2020	2010	No Data	https://www.bignewsnetwork.com/news/264398187/reliance-boosts-production-of-face-masks-to-one-lakh-per-day
37	Mahindra and Mahindra	Automotive	Face Shield	Link	29-03-2020	India	29-03-2020	1945	No Data	https://auto.economictimes.indiatimes.com/news/passenger-vehicle/cars/covid-19-fight-mahindra-mahindra-to-make-face-shield-for-health-workers-pawan-goenka-reveals-design/74869559
38	Xiaomi	Consumer appliances	N95 Masks	Link	26-03-2020	China	26-03-2020	2010	No Data	https://indianexpress.com/article/technology/tech-news-technology/vivo-huami-and-xiaomi-distributing-n95-masks-medical-supplies-to-indian-government-authorities-6331155/
39	Diageo	Brewing	Hand Sanitizers	Link	23-03-2020	England	Not mentioned	1997	No Data	https://www.diageo.com/en/news-and-media/press-releases/diageo-pledges-more-than-eight-million-bottles-of-sanitiser-for-frontline-healthcare-workers/
40	DRDO-VRDE	Defence research	Disinfection Tunnel	Link	04-05-2020	India	14-04-2020	1965	Yes	https://drdo.gov.in/counter-covid-19-technologies
41	DRDO-VRDE	Defence research	Personal Sanitization Unit	Link	04-05-2020	India	14-04-2020	1965	Yes	https://drdo.gov.in/counter-covid-19-technologies
42	DRDO-DLJ	Defence research	Hand Sanitizers	Link	03-04-2020	India	14-04-2020	1958	Yes	https://drdo.gov.in/counter-covid-19-technologies
43	DRDO-DLJ	Defence research	Mobile Area Sanitization System	Link	03-04-2020	India	14-04-2020	1958	Yes	https://drdo.gov.in/counter-covid-19-technologies

44	DRDO-DEBEL	Defence research	Single Outlet Automatic Resuscitator	Link	09-06-2020	India	14-04-2020	1958	Yes	https://drdo.gov.in/counter-covid-19-technologies
45	DRDO-DEBEL	Defence research	Medical-Oxygen-Plant, Ventilatorz	Link	09-06-2020	India	14-04-2020	1958	Yes	https://drdo.gov.in/counter-covid-19-technologies
46	DRDO-CFEES	Defence research	Backpack Sanitization Equipment	Link	03-04-2020	India	14-04-2020	1992	Yes	https://drdo.gov.in/counter-covid-19-technologies
47	DRDO-CFEES	Defence research	Area Sanitization System	Link	03-04-2020	India	14-04-2020	1992	Yes	https://drdo.gov.in/counter-covid-19-technologies
48	DRDO-CFEES	Defence research	Sanitiser Dispensing Unit	Link	03-04-2020	India	14-04-2020	1992	Yes	https://drdo.gov.in/counter-covid-19-technologies
49	DRDO-CFEES	Defence research	Personal Sanitization Unit	Link	03-04-2020	India	14-04-2020	1992	Yes	https://drdo.gov.in/counter-covid-19-technologies
50	DRDO	Defence research	UVC Disinfection Product	Link	04-05-2020	India	14-04-2020	1958	Yes	https://drdo.gov.in/counter-covid-19-technologies
51	INMAS, Delhi	Defence research	Disinfection Tunnel	Link	04-05-2020	India	14-04-2020	1961	Yes	https://drdo.gov.in/counter-covid-19-technologies
52	INMAS, Delhi	Defence research	Pen and Pocket Sanitizer	Link	03-06-2020	India	14-04-2020	1961	Yes	https://drdo.gov.in/counter-covid-19-technologies
53	INMAS, Delhi	Defence research	Sanitizing Car Mat, Sanitization Shoe Mat	Link	03-06-2020	India	14-04-2020	1961	Yes	https://drdo.gov.in/counter-covid-19-technologies
54	INMAS, Delhi	Defence research	UVC Disinfection Product	Link	03-06-2020	India	14-04-2020	1961	Yes	https://drdo.gov.in/counter-covid-19-technologies
55	INMAS, Delhi	Defence research	PPE Testing and Certification	Link	03-06-2020	India	14-04-2020	1961	Yes	https://drdo.gov.in/counter-covid-19-technologies
56	DRDO	Defence research	Mobile Diagnosis Lab	Link	23-04-2020	India	14-04-2020	1958	Yes	https://drdo.gov.in/counter-covid-19-technologies
57	CFEES	Defence research	Sanitiser Dispensing Unit	Link	17-04-2020	India	14-04-2020	1992	Yes	https://drdo.gov.in/counter-covid-19-technologies
58	DIPAS	Defence research	UVC Disinfection Product	Link	17-04-2020	India	14-04-2020	1962	Yes	https://drdo.gov.in/counter-covid-19-technologies
59	DRDO	Defence research	Mobile Diagnosis Lab	Link	23-04-2020	India	14-04-2020	1958	Yes	https://drdo.gov.in/counter-covid-19-technologies
60	LASTEC, Delhi	Defence research	UVC Disinfection Product	Link	04-05-2020	India	14-04-2020	1950	Yes	https://drdo.gov.in/counter-covid-19-technologies
61	CAIR, Bengaluru	Defence research	Robot for Medical Use	Link	28-05-2020	India	14-04-2020	1986	Yes	https://drdo.gov.in/counter-covid-19-technologies

62	TBRL- Chandigarh	Defence research	Hand Sanitizer, Face Shield	Link	22-04-2020	India	14-04-2020	1968	Yes	https://drdo.gov.in/counter-covid-19-technologies
63	DRDE	Defence research	Hand Sanitizer, Face Masks	Link	09-06-2020	India	14-04-2020	1973	Yes	https://drdo.gov.in/counter-covid-19-technologies
64	RCI Hyderabad	Defence research	Hand Sanitizer, Face Shield, Ventilators, UVC Disinfection Product	Link	09-06-2020	India	14-04-2020	1988	Yes	https://drdo.gov.in/counter-covid-19-technologies
65	NMRL, Ambernath	Defence research	PPE Seam Sealant	Link	28-05-2020	India	14-04-2020	1953	Yes	https://drdo.gov.in/counter-covid-19-technologies
66	NPOL, Kochi	Defence research	Paper Disinfectant, Chemical Disinfectant, Mobile Testing Lab, UVC Disinfection Product	Link	20-04-2020	India	14-04-2020	1952	Yes	https://drdo.gov.in/counter-covid-19-technologies
67	R&DE	Defence research	Isolation Shelter	Link	20-04-2020	India	14-04-2020	1962	Yes	https://drdo.gov.in/counter-covid-19-technologies
68	PO-I, DRDO	Defence research	Face Shield	Link	22-04-2020	India	14-04-2020	1986	Yes	https://drdo.gov.in/counter-covid-19-technologies
69	Immutouch	Engineering and Robotics	Vibrating Bracelet for Surface Contact	Link	09-05-2020	UAE	29-04-2020	2012	Yes	https://www.cbsnews.com/news/coronavirus-pandemic-innovations-hygienehook-immutouch-smart-helmet/
70	DDB Ltd	Media Agency	Hook for Surface Contact	Link	02-04-2020	England	29-04-2020	1980	Yes	https://www.cbsnews.com/news/coronavirus-pandemic-innovations-hygienehook-immutouch-smart-helmet/
71	Hanwang Technology Ltd	Engineering and Robotics	Smart Helmet to detect temperature	Link	17-05-2020	China	17-03-2020	1998	No Data	https://timesofindia.indiatimes.com/gadgets-news/watch-police-in-china-use-smart-helmet-to-detect-possible-coronavirus-patients/articleshow/74668591.cms
72	Hmcomm	Engineering and Robotics	AI - Auto response system	Link	25-03-2020	Japan	14-04-2020	2012	No Data	https://www.pluginplaytechcenter.com/resources/covid-19-japan-startups-excelling-time-crisis/
73	Mira Robotics	Engineering and Robotics	Robot to replace human workforce	Link	25-03-2020	Japan	14-04-2020	2011	No Data	https://www.pluginplaytechcenter.com/resources/covid-19-japan-startups-excelling-time-crisis/

74	Holoeyes	Engineering and Robotics	VR Remote Check-up	Link	25-03-2020	Japan	14-04-2020	2016	No Data	https://www.pluginandplaytechcenter.com/resources/covid-19-japan-startups-excelling-time-crisis/
75	Allganize	Engineering and Robotics	Chatbot App	Link	25-03-2020	Japan	14-04-2020	2017	No Data	https://www.pluginandplaytechcenter.com/resources/covid-19-japan-startups-excelling-time-crisis/
76	Unirobot	Engineering and Robotics	AI based robots for home schooling	Link	25-03-2020	Japan	14-04-2020	2014	No Data	https://www.pluginandplaytechcenter.com/resources/covid-19-japan-startups-excelling-time-crisis/
77	Xlocations	Engineering and Robotics	Location AI platform	Link	25-03-2020	Japan	14-04-2020	2010	No Data	https://www.pluginandplaytechcenter.com/resources/covid-19-japan-startups-excelling-time-crisis/
78	Asimov Robotics	Engineering and Robotics	Medicine Dispenser, Trash Collection, Disinfection	Link	06-05-2020	India	Not mentioned	2000	No Data	https://timesofindia.indiatimes.com/city/kochi/meet-keralas-robot-warriors-battling-covid-19/articleshow/75527447.cms
79	Bysh Automations	Home Automation	Hand Sanitizer robot	Link	06-05-2020	India	Not mentioned	2013	No Data	https://timesofindia.indiatimes.com/city/kochi/meet-keralas-robot-warriors-battling-covid-19/articleshow/75527447.cms
80	Dhee Yantra Research labs	Engineering and Robotics	App providing Information	Link	05-04-2020	India	05-04-2020	2017	Yes	https://www.deccanherald.com/business/technology/kerala-technologys-helping-hands-at-the-time-of-covid-19-821607.html
81	Bluesemi	Engineering and Robotics	Thermal sensor	Link	04-05-2020	India	04-05-2020	2017	Yes	https://www.financialexpress.com/industry/technology/disruption-hub-9-startups-at-hyderabad-based-startup-incubator-t-hub-debut-niche-solutions-to-combat-covid-19/1946910/
82	Byteforce	Engineering and Robotics	AI-based People Monitoring App	Link	04-05-2020	India	04-05-2020	2017	Yes	https://www.financialexpress.com/industry/technology/disruption-hub-9-startups-at-hyderabad-based-startup-incubator-t-hub-debut-niche-solutions-to-combat-covid-19/1946910/

83	Blocksapp.ai	Engineering and Robotics	AI-based drone monitoring solution	Link	04-05-2020	India	04-05-2020	2019	Yes	https://www.financialexpress.com/industry/technology/disruption-hub-9-startups-at-hyderabad-based-startup-incubator-t-hub-debut-niche-solutions-to-combat-covid-19/1946910/
84	Cogni.Care	Engineering and Robotics	Thermal sensor, Ventilators	Link	04-05-2020	India	04-05-2020	1994	Yes	https://www.financialexpress.com/industry/technology/disruption-hub-9-startups-at-hyderabad-based-startup-incubator-t-hub-debut-niche-solutions-to-combat-covid-19/1946910/
85	Dimension NXG	Engineering and Robotics	Large-scale thermal scanning glasses	Link	04-05-2020	India	04-05-2020	2014	Yes	https://www.financialexpress.com/industry/technology/disruption-hub-9-startups-at-hyderabad-based-startup-incubator-t-hub-debut-niche-solutions-to-combat-covid-19/1946910/
86	Marut	Engineering and Robotics	Drone based chemical disinfectant	Link	04-05-2020	India	04-05-2020	2019	Yes	https://www.financialexpress.com/industry/technology/disruption-hub-9-startups-at-hyderabad-based-startup-incubator-t-hub-debut-niche-solutions-to-combat-covid-19/1946910/
87	Tericsoft	Engineering and Robotics	AI-based People Monitoring App	Link	04-05-2020	India	04-05-2020	2018	Yes	https://www.financialexpress.com/industry/technology/disruption-hub-9-startups-at-hyderabad-based-startup-incubator-t-hub-debut-niche-solutions-to-combat-covid-19/1946910/
88	Eyestem Research	Biotechnology Company	Drug screening platform	Link	25-04-2020	India	Not mentioned	2015	No Data	https://timesofindia.indiatimes.com/india/covid-19-over-1000-tech-proposals-in-4-weeks-by-start-ups/articleshow/75377701.cms
89	Kerasiev	Chemical Industry	Wastewater filtration plant	Link	25-04-2020	India	Not mentioned	2017	No Data	https://timesofindia.indiatimes.com/india/covid-19-over-1000-tech-proposals-in-4-weeks-by-start-ups/articleshow/75377701.cms
90	Innaumation	Medical equipment	Convalescent plasma therapy	Link	25-04-2020	India	25-04-2020	2017	Yes	https://timesofindia.indiatimes.com/india/covid-19-over-1000-tech-proposals-in-4-weeks-by-start-ups/articleshow/75377701.cms

91	Pluss technologies	Software Company	Cold Chain for Swabs	Link	25-04-2020	India	25-04-2020	2016	Yes	https://timesofindia.indiatimes.com/india/covid-19-over-1000-tech-proposals-in-4-weeks-by-start-ups/articleshow/75377701.cms
92	DNAXperts	Biotechnology Company	Real time PCR kit	Link	25-04-2020	India	25-04-2020	2015	Yes	https://timesofindia.indiatimes.com/india/covid-19-over-1000-tech-proposals-in-4-weeks-by-start-ups/articleshow/75377701.cms
93	Docturnal	Biotechnology Company	Repurposed TB screening app	Link	17-05-2020	India	17-05-2020	2016	Yes	https://yourstory.com/2020/05/medtech-startup-docturnal-coronavirus-covid-19-screening
94	Stempeutics	Biotechnology Company	Approach in therapeutics	Link	18-04-2020	India	18-04-2020	2006	Yes	https://www.thehindubusinessline.com/news/science/c-camps-covid-19-accelerator-shortlists-7-deep-science-innovations-to-fight-virus/article31373999.ece
95	Huwel Life Sciences	Biotechnology Company	Rapid Diagnostics	Link	18-04-2020	China	18-04-2020	2015	No Data	https://www.thehindubusinessline.com/news/science/c-camps-covid-19-accelerator-shortlists-7-deep-science-innovations-to-fight-virus/article31373999.ece
96	Ubiqare Health	Biotechnology Company	Telemedicine support	Link	18-04-2020	India	18-04-2020	2017	Yes	https://www.thehindubusinessline.com/news/science/c-camps-covid-19-accelerator-shortlists-7-deep-science-innovations-to-fight-virus/article31373999.ece
97	Magna	Consumer Goods	Face Masks	Link	20-04-2020	Canada	01-04-2020	1957	No Data	https://www.magna.com/coronavirus/magna-employees-in-action
98	General Motors	Automotive	PPE, Ventilators	Link	27-04-2020	USA	27-04-2020	1908	Yes	https://www.cbsnews.com/news/ford-general-motors-coronavirus-ventilators-medical-supplies/
99	ABC Technology	Consumer Goods	Ventilators, Face Shield, Face Mask	Link	03-04-2020	Canada	03-04-2020	2013	No Data	https://abctechnologies.com/wp-content/uploads/ABCTechnologies_MedicalDevicesUnit_PressRelease_Final1-1.pdf
100	Linamar	Automotive	Ventilators	Link	02-05-2020	Canada	01-04-2020	1966	No Data	https://www.linamar.com/coronavirus/community
101	Ford	Automotive	Respirators	Link	06-05-2020	USA	01-04-2020	1903	Yes	https://corporate.ford.com/articles/products/ford-and-3m-now-shipping-powered-air-purifying-respirators.html

102	3M	Conglomerate	PPE Kits	Link	11-05-2020	USA	01-04-2020	1902	Yes	https://www.3m.com/3M/en_US/worker-health-safety-us/covid19/#general-respiratory
103	Ferrari	Automotive	Respirator valves and fittings	Link	16-04-2020	Italy	Not mentioned	1947	No Data	https://corporate.ferrari.com/en/ferrari-continues-its-efforts-fight-covid-19-pandemic
104	Lamborghini	Automotive	Surgical Masks, Face Shields	Link	31-03-2020	Italy	31-04-2020	1963	Yes	https://www.lamborghini.com/en-en/news/covid-19-lamborghini-is-producing-surgical-masks-and-medical-shields
105	Maruti Suzuki	Automotive	PPE Kits, Ventilators	Link	28-04-2020	India	28-04-2020	1982	Yes	https://www.marutisuzuki.com/corporate/media/press-releases/2020/maruti-suzuki-mobilizes-production-of-ventilators
106	Hero MotoCorp	Automotive	Hand Sanitizers	Link	18-05-2020	India	18-05-2020	1984	Yes	https://www.financialexpress.com/auto/industry/covid-19-coronavirus-relief-hero-motocorp-manufactures-over-5000-litre-sanitiser-to-fight-the-pandemic-ration-kits-food-supplies-donations/1933714/
107	Reebok	Retail Company	PPE Kits	Link	14-04-2020	USA	01-04-2020	1958	Yes	https://www.reebok.com/us/giveback
108	Nike	Retail Company	Shoes for healthcare workers; T-shirts under PPEs	Link	04-05-2020	USA	27-05-2020	1964	Yes	https://purpose.nike.com/covid-19-response-efforts
109	Honda	Automotive	Ventilator component, Face Shields	Link	05-05-2020	Japan	05-05-2020	1948	No Data	https://hondanews.com/en-US/honda-corporate/releases/release-b262241b363797081e713bf599003a5a-detroit-area-residents-will-be-transported-to-covid-19-testing-in-modified-honda-odyssey-minivans
110	Volkswagen	Automotive	Ventilators	Link	30-03-2020	Germany	Not mentioned	1937	No Data	https://www.volkswagenag.com/en/news/2020/03/cars_to_ventilators.html
111	Mercedes Benz	Automotive	Medical equipments, Face shield	Link	15-04-2020	Germany	01-04-2020	1926	Yes	https://www.daimler.com/sustainability/corporate-citizenship/the-covid-19-pandemic-daimler-is-helping.html
112	Fiat Chrysler Automobiles	Automotive	Face masks	Link	27-03-2020	England	Not mentioned	2014	No Data	https://www.manufacturingglobal.com/smart-manufacturing/flat-chrysler-automobiles-fca-response-covid-19
113	Nissan	Automotive	Face shields, Hospital gowns, Ventilators, Face masks	Link	25-05-2020	Japan	25-05-2020	1933	No Data	https://global.nissanstories.com/en/releases/release-aba6b763b790428810f6fe31a8007e34-global-social-initiatives-against-covid-19

114	Tesla	Automotive	Ventilators, Vaccines	Link	03-07-2020	USA	03-07-2020	2003	No	https://timesofindia.indiatimes.com/gadgets-news/elon-musk-tesla-to-help-pharma-company-in-development-of-covid-19-vaccine/articleshow/76762165.cms
115	Volvo	Automotive	Face Shields, Face Masks	Link	09-04-2020	Sweden	01-04-2020	1927	No Data	https://www.volvogroup.com/en-en/covid-19.html
116	Renault	Automotive	Respirators, Face Masks, Face Shield	Link	31-03-2020	France	31-03-2020	1898	Yes	https://group.renault.com/en/news-on-air/news/groupe-renaults-initiatives-to-help-tackle-the-covid-19-crisis/
117	Groupe PSA	Automotive	Respirators, Face Masks, Face Shield	Link	16-04-2020	France	01-04-2020	1976	Yes	https://www.groupe-psa.com/en/newsroom/corporate-en/covid-19-crisis-groupe-psa-is-mobilizing/
118	Lexus	Automotive	Ventilators, Face Masks	Link	20-04-2020	Japan	01-04-2020	1989	No Data	http://media.lexus.ca/releases/supporting-canadian-communities-our-covid-19-response
119	Cadillac	Automotive	PPE Kits	Link	14-04-2020	USA	14-04-2020	1902	Yes	https://www.globenewswire.com/news-release/2020/04/14/2015928/0/en/Cadillac-Products-Manufacturing-Medical-PPE-to-Help-Healthcare-Workers-Fight-COVID-19-in-Michigan.html
120	Wildcraft	Retail Company	PPE Kits, Face Masks	Link	11-06-2020	India	Not mentioned	1998	No Data	https://www.thehindu.com/business/wildcraft-unveils-covid-19-gear-ramps-up-staff/article31807291.ece
121	Mazda	Automotive	Face Shields	Link	26-05-2020	Japan	Not mentioned	1920	No Data	https://newsroom.mazda.com/assets/100187/200526_ENG_Information.pdf?_ga=2.105919747.1496763394.1594455048-975523656.1594455048
122	Skoda	Automotive	Respirators	Link	30-04-2020	Czechia	30-04-2020	1895	No	https://www.skoda-storyboard.com/en/press-releases/skoda-autos-support-in-fighting-covid-19-met-with-high-demand/
123	BHEL	Consumer appliances	Hand Sanitizers	Link	30-03-2020	India	30-03-2020	1964	Yes	http://www.bhel.com/assets/downloads/5e81a823af6dfBHEL_and_its_employees_contribute_wholeheartedly_lead_the_way_in_helping_the_nation_in_its_fight_against_Covid-19.pdf

124	Unilever	Consumer goods	Ventilator, Chemical Disinfectant	Link	25-04-2020	India	01-04-2020	1929	Yes	https://www.unilever.com/news/covid-response/
125	Bosch	Automotive	Diagnostic test tool	Link	26-03-2020	Germany	Not mentioned	1886	No Data	https://www.news18.com/news/world/bosch-develops-covid-19-test-tool-to-detect-coronavirus-in-under-3-hours-2552481.html
126	SC Johnson	Consumer goods	Hand Sanitizer	Link	22-04-2020	USA	Not mentioned	1886	No Data	https://www.3blmedia.com/News/SC-Johnson-Converts-Line-Largest-Global-Manufacturing-Plant-Prod-Hand-Sanitizer-COVID-19
127	Redbull	Brewing	Respirators	Link	14-3-2020	Austria	01-04-2020	1984	Yes	https://motorsport.tech/formula-1/red-bull-racing-keeping-busy-in-fight-against-coronavirus-pandemic
128	Nordstrom	Retail Company	Face Masks	Link	20-03-2020	USA	01-04-2020	1901	Yes	https://press.nordstrom.com/news-releases/news-release-details/working-towards-nearly-1-million-masks
129	Honeywell	Aerospace	Hand Sanitizer	Link	02-04-2020	USA	01-04-2020	1906	Yes	https://www.honeywell.com/us/en/news/2020/04/how-honeywell-plants-pivoted-to-hand-sanitizer
130	Mahindra and Mahindra	Automotive	Respirators, Face Masks, Face Shields, Ventilators, Hand Sanitisers	Link	21-04-2020	India	01-04-2020	1945	Yes	https://www.mahindra.com/news-room/knowledge-centre/impact-stories/mahindra-rising-to-support-the-nation-in-the-fight-against-covid-19
131	Brooks Brothers	Retail Company	Surgical Masks, Hospital gowns	Link	28-04-2020	USA	28-04-2020	1818	Yes	https://www.triplepundit.com/story/2020/ceos-respond-coronavirus-covid-19/87361
132	Bacardi	Brewing	Hand Sanitizer	Link	25-03-2020	Bermuda	25-03-2020	1862	No	https://www.3blmedia.com/News/USA-France-and-UK-Mexico-Bacardi-Diverts-Global-Production-Increase-Hand-Sanitizer-Supply-Local
133	Hanesbrands	Retail Company	Ventilators, Emergency gear	Link	30-03-2020	USA	30-03-2020	2006	Yes	https://www.fastcompany.com/90483109/inside-the-mad-rush-to-produce-ventilators-and-emergency-gear-to-fight-covid-19
134	H&M	Retail Company	PPE Kits	Link	22-03-2020	Sweden	22-03-2020	1947	No Data	https://www.ecotextile.com/2020032225865/fashion-retail-news/h-m-suppliers-to-make-ppe-to-tackle-covid-19.html
135	Reformation	Retail Company	Face Masks	Link	13-04-2020	USA	13-04-2020	2009	Yes	https://nrf.com/blog/retailers-lead-mask-production-combat-covid-19

136	Nestle	Food Processing	Ventilators	Link	25-05-2020	Switzerland	25-05-2020	1866	No Data	https://www.nestle.com/media/news/nestle-cote-ivoire-donates-ventilators-covid-19
137	Brown Forman	Brewing	Hand Sanitizer	Link	23-04-2020	USA	23-04-2020	1870	Yes	https://www.3blmedia.com/News/Brown-Forman-Produces-Hand-Sanitizer-Employees-Health-Care-Providers-and-First-Responders
138	IKEA	Retail Company	Face Masks	Link	31-03-2020	India	31-03-2020	1943	Yes	https://www.reuters.com/article/us-health-coronavirus-ikea-supply-idUSKBN2111EK?taid=5e836a499a7fcd0001c49c63&utm_campaign=trueAnthem%3A%20Trending%20Content&utm_medium=trueAnthem&utm_source=twitter
139	58Gin	Brewing	Hand Sanitizer	Link	13-04-2020	England	13-04-2020	2016	Yes	https://www.bbc.com/worklife/article/20200413-how-factories-change-production-to-quickly-fight-coronavirus
140	Royal Mint	Coin and Medal Production	Face Shields	Link	13-04-2020	England	13-04-2020	886	Yes	https://www.bbc.com/worklife/article/20200413-how-factories-change-production-to-quickly-fight-coronavirus
141	Sharp	Consumer Appliances	Surgical Mask	Link	02-03-2020	Japan	02-03-2020	1912	No Data	https://www.bbc.com/news/technology-51706629
142	SGMW	Automotive	Face Masks	Link	13-04-2020	China	Not mentioned	2002	No Data	https://www.bbc.com/worklife/article/20200413-how-factories-change-production-to-quickly-fight-coronavirus
143	Carbon	Digital Manufacturer	Face Shields, Test Swabs	Link	25-03-2020	USA	01-04-2020	2010	Yes	https://www.forbes.com/sites/amyfeldman/2020/03/25/inside-a-silicon-valley-unicorns-urgent-dash-to-3d-print-face-shields-and-test-swabs-to-battle-covid-19/#2b1281d14370
144	Anheuser-Busch InBev	Brewing	Hand Sanitizer	Link	01-04-2020	Belgium	01-04-2020	2008	Yes	https://www.forbes.com/sites/giacomotognini/2020/04/01/coronavirus-business-tracker-how-the-private-sector-is-fighting-the-covid-19-pandemic/?sh=60e6572a5899
145	Aria Designs	Design Studio	Surgical Masks	Link	01-04-2020	India	01-04-2020	2012	Yes	https://www.forbes.com/sites/giacomotognini/2020/04/01/coronavirus-business-tracker-how-the-private-sector-is-fighting-the-covid-19-pandemic/?sh=60e6572a5899

146	Barbour	Retail Company	Hospital Gowns	Link	01-04-2020	England	01-04-2020	1894	Yes	https://www.forbes.com/sites/giacomotognini/2020/04/01/coronavirus-business-tracker-how-the-private-sector-is-fighting-the-covid-19-pandemic/?sh=60e6572a5899
147	Bauer Hockey	Sporting Goods	Face Shields	Link	01-04-2020	England	01-04-2020	1927	Yes	https://www.forbes.com/sites/giacomotognini/2020/04/01/coronavirus-business-tracker-how-the-private-sector-is-fighting-the-covid-19-pandemic/?sh=60e6572a5899
148	Brew Dog	Brewing	Hand Sanitizer	Link	01-04-2020	Scotland	01-04-2020	2007	No Data	https://www.forbes.com/sites/giacomotognini/2020/04/01/coronavirus-business-tracker-how-the-private-sector-is-fighting-the-covid-19-pandemic/?sh=60e6572a5899
149	Airbus	Aerospace	Ventilators	Link	30-03-2020	Netherlands	30-03-2020	1970	No Data	https://www.smiths.com/news-and-media/2020/03/ventilatorchallengeuk-consortium
150	BAE Systems	Aerospace, Arms and Information security	Ventilators	Link	30-03-2020	England	30-03-2020	1999	Yes	https://www.smiths.com/news-and-media/2020/03/ventilatorchallengeuk-consortium
151	Bloom Energy	Fuel Cell manufacturers	Ventilators	Link	28-03-2020	USA	28-03-2020	2001	Yes	https://www.bloomenergy.com/newsroom/press-releases/bloom-energy-state-california-almo-partner-refurbish-ventilators-healthcare
152	BreathDirect	Medical equipment	Ventilators	Link	27-03-2020	USA	27-03-2020	1997	Yes	https://www.forbes.com/sites/amyfeldman/2020/03/27/medical-device-entrepreneur-designs-emergency-ventilator-at-10000-price-point-to-battle-coronavirus/?sh=3176f4b12611
153	Dyson	Consumer Appliances	Ventilators	Link	26-03-2020	England	Not mentioned	1991	No Data	https://www.forbes.com/sites/daviddawkins/2020/03/26/billionaire-james-dyson-confirms-initial-order-of-10000-ventilators-will-made-in-britain-at-raf-hullavington/?utm_source=followingimmediate&utm_medium=email&utm_campaign=20200326&sh=d07803616608
154	GKN Aerospace	Aerospace	Ventilators	Link	30-03-2020	England	30-03-2020	1902	Yes	https://www.smiths.com/news-and-media/2020/03/ventilatorchallengeuk-consortium
155	Inspiration Healthcare	Medical Technology	Ventilators	Link	30-03-2020	England	30-03-2020	2003	Yes	https://www.smiths.com/news-and-media/2020/03/ventilatorchallengeuk-consortium

156	Medtronic	Medical equipment	Ventilators	Link	30-03-2020	Ireland	30-03-2020	1949	Yes	https://www.smiths.com/news-and-media/2020/03/ventilatorchallengeuk-consortium
157	Meggitt	Aerospace defence	Ventilators	Link	30-03-2020	England	30-03-2020	1947	Yes	https://www.smiths.com/news-and-media/2020/03/ventilatorchallengeuk-consortium
158	Penlon	Medical equipment	Ventilators	Link	30-03-2020	England	30-03-2020	1943	Yes	https://www.smiths.com/news-and-media/2020/03/ventilatorchallengeuk-consortium
159	Philips	Consumer Appliances	Ventilators	Link	22-03-2020	Netherlands	22-03-2020	1891	No Data	https://www.nasdaq.com/articles/philips-to-ramp-up-production-of-ventilators-in-coronavirus-fight-2020-03-22
160	ResMed	Medical	Ventilators	Link	23-03-2020	USA	23-03-2020	1989	Yes	https://newsroom.resmed.com/news-releases/news-details/2020/ResMed-Statement-on-COVID-19/default.aspx
161	Rolls-Royce	Automotive	Ventilators	Link	30-03-2020	England	30-03-2020	2011	Yes	https://www.smiths.com/news-and-media/2020/03/ventilatorchallengeuk-consortium
162	Smiths Group	Engineering	Ventilators	Link	30-03-2020	England	30-03-2020	1851	Yes	https://www.smiths.com/news-and-media/2020/03/ventilatorchallengeuk-consortium
163	SpaceX	Aerospace	Ventilator component	Link	01-04-2020	USA	01-04-2020	2002	Yes	https://www.forbes.com/sites/giacomotognini/2020/04/01/coronavirus-business-tracker-how-the-private-sector-is-fighting-the-covid-19-pandemic/?sh=1479e7c65899
164	Thales Group	Aerospace, Defence, Transport, Security	Ventilators	Link	30-03-2020	France	30-03-2020	2000	Yes	https://www.smiths.com/news-and-media/2020/03/ventilatorchallengeuk-consortium
165	Ultra Electronics	Defence, security, critical detection & control	Ventilators	Link	30-03-2020	England	30-03-2020	1920	Yes	https://www.smiths.com/news-and-media/2020/03/ventilatorchallengeuk-consortium
166	Virgin Galactic	Spaceflight Company	Ventilators	Link	29-04-2020	England	29-04-2020	2004	Yes	https://www.forbes.com/sites/valeriestimac/2020/04/29/virgin-galactic-nasa-join-forces-to-fight-covid-19/?sh=1279a1937f31
167	Xerox	Buisness and Technology Solution	Ventilators	Link	06-04-2020	USA	06-04-2020	1906	Yes	https://www.forbes.com/sites/amyfeldman/2020/04/06/xerox-will-mass-produce-disposable-ventilators-in-partnership-with-vortran-to-fight-coronavirus/?sh=2219cca8205a

168	Koniku	Neurotechnology	Odorant Receptors	Link	04-05-2020	Nigeria	04-05-2020	2015	No	https://www.airbus.com/newsroom/press-releases/en/2020/05/airbus-and-koniku-inc-embark-on-disruptive-biotechnology-solutions-for-aviation-security-operations.html
169	Globe Keeper	Tactical and strategic operations platform	Monitoring App	Link	01-04-2020	Israel	01-04-2020	2014	No	https://www.reuters.com/article/us-health-coronavirus-israel-apps/1-5-million-israelis-using-voluntary-coronavirus-monitoring-app-idUSKBN21J5L5
170	Boston Dynamics	Engineering and Robotics	Robotic Dogs	Link	01-04-2020	USA	01-04-2020	1992	Yes	https://www.reuters.com/article/us-health-coronavirus-israel-apps/1-5-million-israelis-using-voluntary-coronavirus-monitoring-app-idUSKBN21J5L5
171	NeuroFlow	Software Company	Online Tool for screening	Link	23-03-2020	USA	23-03-2020	2016	Yes	https://www.neuroflow.com/neuroflow-launches-coronavirus-risk-assessment/
172	Palantir	Software Company	Tracking Software	Link	28-03-2020	USA	28-03-2020	2003	Yes	https://healthtech.blog.gov.uk/2020/03/28/the-power-of-data-in-a-pandemic/
173	UiPath	Software Company	Robotic process automation software	Link	07-04-2020	USA	07-04-2020	2005	Yes	https://www.uipath.com/newsroom/global-organizations-turning-to-rpa-to-respond-to-covid-19-pandemic
174	UnitedHealth	Biotechnology Company	Screening app	Link	15-03-2020	USA	15-03-2020	1977	Yes	https://news.microsoft.com/2020/05/15/unitedhealth-group-and-microsoft-collaborate-to-launch-protectwell-protocol-and-app-to-support-return-to-workplace-planning-and-covid-19-symptom-screening/
175	Ava	Biotechnology Company	Bracelete for Tracking	Link	15-04-2020	USA	15-04-2020	2007	Yes	https://www.avawomen.com/press/liechtenstein-study-aims-to-help-combat-coronavirus-pandemic/
176	Credo Diagnostics	Biotechnology Company	Test Kits	Link	17-03-2020	Singapore	Not mentioned	2011	No Data	https://www.credodxbiomed.com/en/news/100-credo-diagnostics-biomedical-vitapcr-sars-cov-2-assay-garners-ce-mark
177	DiaSorin	Biotechnology Company	Test Kits	Link	20-03-2020	USA	Not mentioned	2000	No Data	https://www.diasorin.com/en/news/diasorin-covid-19-test-has-received-fda-emergency-use-authorization
178	Ipsium Diagnostics	Biotechnology Company	Test Kits	Link	01-04-2020	USA	01-04-2020	2018	Yes	https://www.fda.gov/media/136618/download

179	Mammoth Biosciences	Biotechnology Company	Strip Tool for Detection	Link	15-02-2020	USA	15-02-2020	2017	Yes	https://mammoth.bio/2020/02/15/white-paper-a-protocol-for-rapid-detection-of-sars-cov-2-using-crispr-sars-cov-2-detectr/
180	Siemens Healthineers	Biotechnology Company	Blood Gas Analyser	Link	31-03-2020	Germany	31-03-2020	2015	Yes	https://www.siemens-healthineers.com/press-room/press-releases/rapid-point500ebloodgasanalyzer.html
181	Fanatics	Consumer Appliances	Face Masks, Hospital Gowns	Link	27-03-2020	USA	27-03-2020	1995	Yes	https://twitter.com/MichaelGRubin/status/1243258525066891264?s=20
182	ExxonMobil	Consumer Appliances	Face Shields, Face Masks	Link	02-04-2020	USA	Not mentioned	1999	No Data	https://corporate.exxonmobil.com/News/Newsroom/News-releases/2020/0402_ExxonMobil-joins-Global-Center-to-expedite-medical-innovation-for-PPE
183	Dickies	Consumer Appliances	Hospital Gowns	Link	16-04-2020	USA	16-04-2020	1922	Yes	https://www.vfc.com/news/press-release/1719/dickies-vf-corporation-to-produce-3-4-million-isolation
184	GVS	Consumer Appliances	Face Masks, Ventilator component	Link	16-03-2020	Italy	16-03-2020	1984	Yes	https://www.forbes.com/sites/giacomotognini/2020/03/16/this-italian-companys-masks-and-filters-are-helping-doctors-fight-back-against-the-coronavirus-in-china-the-us-italy-and-beyond/?sh=97ddb4a7b6c3
185	Charoen Popkhand Group	Consumer Appliances	Surgical Masks	Link	01-04-2020	Thailand	Not mentioned	1921	No Data	https://www.forbes.com/sites/gracechung/2020/04/13/forbes-asia-tracker-how-the-regions-tycoons-entrepreneurs-and-businesses-are-combating-the-coronavirus/?sh=62be646b2b64
186	Cantabria Lab	Consumer Appliances	Hand Sanitizer	Link	19-03-2020	Spain	Not mentioned	1989	No Data	https://www.cantabrialabs.com/en/communication/cantabria-labs-starts-making-hand-sanitiser-for-health-personnel/
187	Canada Goose	Consumer Appliances	Medical Scrubs, Hospital Gowns	Link	25-03-2020	Canada	25-03-2020	1957	No Data	https://www.canadagoose.com/on/demandware.static/-/Library-Sites-CG-Global/default/dw40fd0561/press/Canada-Goose-Dedicates-Manufacturing-Resources-in-Fight-Against-COVID-19.pdf
188	Calzedonia Group	Consumer Appliances	Face Masks, Hospital Gowns	Link	29-05-2020	Italy	29-05-2020	1986	No	https://www.calzedoniagroup.com/en/news-archive/news-6
189	Bulgari	Consumer Appliances	Hand Sanitizer	Link	02-04-2020	Italy	Not mentioned	1884	No Data	https://www.bulgari.com/en-us/stories/bulgari-donate-hand-sanitizer-against-coronavirus.html

190	Fippi	Consumer Appliances	Face Masks	Link	29-03-2020	Italy	29-03-2020	1970	Yes	https://twitter.com/RegLombardia/status/1244284212976459778
191	GelPro	Consumer Appliances	Face Shields	Link	01-04-2020	USA	01-04-2020	2002	Yes	https://www.statesman.com/business/20200401/austinsquos-gelpro-making-face-shields-to-aid-in-coronavirus-fight
192	HP	Consumer Appliances	Face Masks, Face Shields, Ventilator component	Link	24-03-2020	Spain	24-03-2020	1939	Yes	https://press.hp.com/us/en/press-releases/2020/hp-inc-and-partners-mobilize-3d-printing-solutions-to-battle-c.html
193	INEOS	Consumer Appliances	Hand Sanitizer	Link	24-03-2020	Scotland	24-03-2020	1998	No Data	https://press.hp.com/us/en/press-releases/2020/hp-inc-and-partners-mobilize-3d-printing-solutions-to-battle-c.html
194	Jenco Productions	Consumer Appliances	Face Shields	Link	01-04-2020	USA	01-04-2020	1995	Yes	https://www.jencoproductions.com/
195	Jockey	Retail Company	Face Masks, Hospital Gowns	Link	01-04-2020	USA	01-04-2020	1876	Yes	https://www.forbes.com/sites/giacomotognini/2020/04/01/coronavirus-business-tracker-how-the-private-sector-is-fighting-the-covid-19-pandemic/?sh=3f6067ff5899
196	Decathlon	Retail Company	Respirators	Link	14-04-2020	France	Not mentioned	1976	No Data	https://www.decathlon.com/blogs/inside-decathlon/decathlon-easybreath-mask-covid-19-update
197	Orient Electric	Consumer Appliances	UVC Disinfection Product	Link	18-07-2020	India	18-07-2020	1954	No	https://www.moneycontrol.com/news/business/orient-electric-enters-health-appliances-space-launches-uv-sanitiser-device-5559621.html
198	Borosil	Consumer Appliances	UVC Disinfection Product	Link	22-07-2020	India	22-07-2020	1962	No	https://gadgets.ndtv.com/others/news/borosil-suraksha-uv-disinfection-price-in-india-rs-11990-launch-specifications-features-2267039
199	Finolex	Consumer Appliances	Hand Sanitizer	Storefront	23-07-2020	India	Not mentioned	1958	No Data	Storefront
200	Vystar	Consumer Appliances	UVC Disinfection Product	Link	22-07-2020	USA	22-07-2020	1952	No	https://www.globenewswire.com/news-release/2020/07/22/2065910/0/en/Vystar-Introduces-RxAir400-UV-C-Light-Germicidal-Air-Purifier-Extended-Life-UV-Bulb-Wall-Mount-Option.html
201	Samsung	Consumer Appliances	UVC Disinfection Product	Link	23-07-2020	India	23-07-2020	1938	No	https://indianexpress.com/article/technology/gadgets/uv-lights-are-becoming-the-weapon-of-choice-to-kill-the-virus-6520319/

202	Godrej	Consumer Appliances	UVC Disinfection Product	Link	23-07-2020	India	23-07-2020	1897	No	https://indianexpress.com/article/technology/gadgets/uv-lights-are-becoming-the-weapon-of-choice-to-kill-the-virus-6520319/
203	CuraSigna	Consumer Appliances	Ventilators	Link	23-07-2020	India	23-07-2020	2014	No	https://indianexpress.com/article/technology/gadgets/uv-lights-are-becoming-the-weapon-of-choice-to-kill-the-virus-6520319/
204	Philips	Consumer Appliances	UVC Disinfection Product	Link	24-07-2020	India	24-07-2020	1891	No	https://www.news18.com/news/tech/philips-uv-c-system-review-this-will-disinfect-everything-you-can-fit-inside-it-2731485.html
205	Muse Wearables	Consumer Appliances	Wrist based tracker	Link	25-07-2020	India	25-07-2020	2012	No	https://www.thehindu.com/news/national/iit-madras-startup-generates-22-cr-funding-for-launching-wrist-band-for-detecting-covid-symptoms/article32189460.ece
206	Cartoni	Consumer Appliances	UVC Disinfection Product	Link	27-07-2020	Italy	27-07-2020	1935	No	https://www.newsshooter.com/2020/07/27/cartoni-uv-c-boxer-uv-disinfection-device-for-video-motion-picture-equipment/
207	Bharat Electronics Ltd	Consumer Appliances	Ventilators	Link	30-03-2020	India	30-03-2020	1954	Yes	https://www.thehindu.com/news/national/automobile-makers-asked-to-built-ventilators-health-ministry/article31204808.ece
208	The Trident Group	Conglomerate	Face Masks, PPE Kits	Link	01-05-2020	India	01-05-2020	1990	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf
209	The Aditya Birla Group	Conglomerate	Face Masks, Hospital Gowns	Link	01-05-2020	India	01-05-2020	1857	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf
210	Sure Safety	Industrial safety equipment	PPE Kits	Link	01-05-2020	India	01-05-2020	1974	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf
211	Matrix Clothing	Garment manufacturers	PPE Kits	Link	01-05-2020	India	01-05-2020	1980	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf
212	Shahi Exports	Garment manufacturers	PPE Kits	Link	01-05-2020	India	01-05-2020	1974	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf
213	Welspun	Conglomerate	Hand Sanitizer	Link	01-05-2020	India	01-05-2020	1985	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf

214	Alok Industries	Garment manufacturers	PPE Kits	Link	01-05-2020	India	01-05-2020	1986	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf
215	JCT Mills	Garment manufacturers	PPE Kits	Link	01-05-2020	India	01-05-2020	1971	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf
216	Arvind Mills	Conglomerate	PPE Kits	Link	01-05-2020	India	01-05-2020	1931	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf
217	SCG Enterprises	Chemical Industry	PPE Kits	Link	01-05-2020	India	01-05-2020	1999	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf
218	Amaryllis	Medical Healthcare	PPE Kits	Link	01-05-2020	India	01-05-2020	1952	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf
219	Shree Healthcare	Medical Healthcare	PPE Kits	Link	01-05-2020	India	01-05-2020	1988	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf
220	Shiva Texyarn	Garment manufacturers	PPE Kits	Link	01-05-2020	India	01-05-2020	1980	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf
221	Frontier Protective wear	Industrial safety equipment	PPE Kits	Link	01-05-2020	India	01-05-2020	1993	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf
222	Sai Synergy	Industrial safety equipment	PPE Kits	Link	01-05-2020	India	01-05-2020	2009	Yes	https://static.investindia.gov.in/2020-07/PPE%20Report_Invest%20India.pdf
223	Swell Knit	Garment manufacturers	PPE Kits	Link	14-04-2020	India	14-04-2020	2001	Yes	https://theprint.in/india/tirupur-moves-from-hm-tommy-hilfiger-marks-spencer-to-making-masks-and-ppe-kits/400898/
224	Melange Polymers	Garment manufacturers	Face Masks, PPE Kits	Link	14-04-2020	India	14-04-2020	2012	Yes	https://theprint.in/india/tirupur-moves-from-hm-tommy-hilfiger-marks-spencer-to-making-masks-and-ppe-kits/400898/

225	Mobitizer	Consumer Goods	UVC Disinfection Product	Link	25-02-2020	India	04-06-2020	2000	No	https://www.amazon.in/Mobitizer-sterilizer-sanitizer-Aromatherapy-BLACK/dp/B08BJQPRBX/ref=sr_1_1_sspa?crd=1H3XY74GYR471&dchild=1&keywords=uv%box&qid=1596105687&sprefix=uv%b%2Caps%2C337&sr=8-1-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmYWVvPUEuMUFWNTI0M1pXRFO2JmVuY3J5cHRlZElkPUEwMDcxNDg1MzNPT0pZVTU5N0FJOSZlbnNyeXB0ZWRRBZEIkPUeWODewNTY5MUdPMkFBMkNONFhUUSZ3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU=
226	Homera-y-the Souvenir	Consumer Goods	UVC Disinfection Product	Link	13-03-2020	India	14-06-2020	2012	No	https://www.amazon.in/Homray-Sterilizer-Disinfectant-Jewellery-Earphones/dp/B0893JJHGW/ref=sr_1_2_sspa?crd=1H3XY74GYR471&dchild=1&keywords=uv%box&qid=1596105687&sprefix=uv%b%2Caps%2C337&sr=8-2-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmYWVvPUEuMUFWNTI0M1pXRFO2JmVuY3J5cHRlZElkPUEwMDcxNDg1MzNPT0pZVTU5N0FJOSZlbnNyeXB0ZWRRBZEIkPUeWNTM2ODYwMkNFQVBaUjVlVlV81VSZ3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU=
227	Pyrotech	Consumer Appliances	UVC Disinfection Product	Link	02-04-2020	India	17-06-2020	1976	No	https://www.amazon.in/Pyrotech-Sanitizer-Box-Make-Disinfectant/dp/B08BC38CC8/ref=sr_1_3_sspa?crd=1H3XY74GYR471&dchild=1&keywords=uv%box&qid=1596105687&sprefix=uv%b%2Caps%2C337&sr=8-3-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmYWVvPUEuMUFWNTI0M1pXRFO2JmVuY3J5cHRlZElkPUEwMDcxNDg1MzNPT0pZVTU5N0FJOSZlbnNyeXB0ZWRRBZEIkPUeWMTUxMjc0OUFRVIEQjI2U1WJndpZGldE5hbWU9c3BfYXRmJmFjdGlvb1JlbnGlja1JlZGlyZWNoJmRvTm90TG9nQ2xpY2s9dHJ1ZQ==

228	IFITech	Consumer Appliances	UVC Disinfection Product	Link	05-07-2020	India	16-05-2020	2012	Yes	https://www.amazon.in/IFITech-Portable-sterilizer-Disinfection-Scissors/dp/B089RLP1MF/ref=sr_1_5?crd=1H3XY74GYR471&dchild=1&keywords=uv±box&qid=1596105687&sprefix=uv±b%2Caps%2C337&sr=8-5
229	Eco UV	Consumer Appliances	UVC Disinfection Product	Link	14-04-2020	USA	02-06-2020	1995	No	https://www.amazon.in/eco-UV-sanitizer-stainless-sterilizer/dp/B08BY1J1RD/ref=sr_1_6?crd=1H3XY74GYR471&dchild=1&keywords=uv±box&qid=1596105687&sprefix=uv±b%2Caps%2C337&sr=8-6
230	Smartcam	Consumer Appliances	UVC Disinfection Product	Link	04-06-2020	India	21-05-2020	2003	Yes	https://www.amazon.in/SmartCam-Portable-Disinfection-Ultraviolet-Sterilization/dp/B089N6RCH2/ref=sr_1_7?crd=1H3XY74GYR471&dchild=1&keywords=uv±box&qid=1596105687&sprefix=uv±b%2Caps%2C337&sr=8-7
231	Steelbird	Consumer Appliances	Face Shield	Link	13-08-2020	India	Not mentioned	1964	No Data	https://indianbizreview.in/2020/08/13/steelbird-launches-first-ever-hands-free-face-shield-in-india/
232	BYD Co.	Consumer Appliances	Face Masks	Link	13-03-2020	USA	Not mentioned	1981	No Data	https://www.bloomberg.com/news/articles/2020-03-13/buffett-backed-byd-says-it-s-now-the-biggest-maker-of-face-masks
233	Godrej	Consumer Appliances	UVC Disinfection Product	Link	10-08-2020	India	Not mentioned	1897	No Data	https://www.financialexpress.com/industry/technology/godrej-uv-case-hand-device-for-sanitising-and-keeping-pathogens-at-bay/2049845/#:~:text=The%20UV%20Case%20by%20Godrej,bags%20and%20many%20other%20articles
234	Orient Electric	Consumer Appliances	UVC Disinfection Product	Link	7/17/2020	India	Not mentioned	1954	No Data	https://economictimes.indiatimes.com/industry/cons-products/fmcg/orient-electric-enters-hygiene-products-segment/articleshow/77013802.cms?from=mdr
235	Lifebuoy	Consumer Goods	Hand Sanitizer	Link	14-09-2020	India	Not mentioned	1895	No Data	https://www.lifebuoy.in/products/sanitizer.html
236	Bubble Byte	Engineering and Technology	Hand Sanitizer	Link	5/1/2020	India	Not mentioned	1895	No	https://www.startupindia.gov.in/content/dam/invest-india/Templates/public/covid_resource_section/COVIDResource&Programs_Listicle%20of%20Covid%20Startup%20Solutions_29.04.20_86%20shortlist.pdf

237	IIT, Madras	Engineering and Technology	Hand Sanitizer	Link	01-05-2020	India	04-09-2020	2012	No	https://www.startupindia.gov.in/content/dam/invest-india/Templates/public/covid_resource_section/COVIDResource&Programs_Listicle%20of%20Covid%20Startup%20Solutions_29.04.20_86%20shortlist.pdf
238	Shapeysquare	Consumer goods	Nasal Drop	Link	01-05-2020	India	10-10-2020	1959	Yes	https://www.startupindia.gov.in/content/dam/invest-india/Templates/public/covid_resource_section/COVIDResource&Programs_Listicle%20of%20Covid%20Startup%20Solutions_29.04.20_86%20shortlist.pdf
239	Sunfox Technology	Research and Development lab	Face Shield	Link	01-05-2020	India	16-04-2020	2018	Yes	https://www.startupindia.gov.in/content/dam/invest-india/Templates/public/covid_resource_section/COVIDResource&Programs_Listicle%20of%20Covid%20Startup%20Solutions_29.04.20_86%20shortlist.pdf
240	Swasti Agro and Biproducts	Consumer goods	Face Shield	Link	01-05-2020	India	31-03-2020	2016	No	https://www.startupindia.gov.in/content/dam/invest-india/Templates/public/covid_resource_section/COVIDResource&Programs_Listicle%20of%20Covid%20Startup%20Solutions_29.04.20_86%20shortlist.pdf

A.2 Charts Showing the Original Product-segment Background and COVID-19 Medical Products Launched by the 240 Companies

Company backgrounds of 45 new mask producers

Company backgrounds of 21 new sanitizer producers

New Face Shield Manufacturers and Company Background

Company backgrounds of 16 new face shield producers

New Test Kits Manufacturers and Company Background

Company backgrounds of 22 new COVID-19 test kit producers

New UV Products Manufacturers and Company Background

Company backgrounds of 18 new UV disinfection product manufacturers

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