Open Innovation Initiatives to Tackle COVID-19 Crises: Imposter Open Innovation and Openness in Data

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IEEE DOI 10.1109/EMR.2020.3033991

***Abstract*—*Big data and analytics played an important role in open innovation during the pandemic. Sharing data and transferring knowledge between governments, laboratories and research centres helped us to understand the unpredictable spread of COVID-19. This article firstly explores corporate and public responses to the pandemic, presents different cases and discusses how open innovation, worldwide collaboration and data shaped this response. Having data practises in focus, this article raises concerns and underlines issues related to the applications during responses to COVID-19 at collaborative open innovation projects.*

Key words: COVID-19, open innovation, data, openness, innovation initiatives.

I. INTRODUCTION

THE ongoing outbreak of novel coronavirus disease 2019 (COVID-19) is arousing international concern. Currently, it is reported more than 42000000 cases, 1140000 deaths. The 8.5 million reported cases in the US are just the tip of the iceberg [1], [2]. The rapid spreading of the virus has tremendously influenced the daily personal and work lives of everyone. This article explores the response to the pandemic, presents different cases and discusses how open innovation, worldwide collaboration and data shaped this response.

As predictions suggest, COVID-19 will be here to stay. Several countries around the world followed their footsteps to bring all start-up companies, technology enthusiasts, government and more together to provide solution to tackle with the pandemic. By the date of the paper submission, there have been 67 hackathons confirmed and the number is growing.

Yet the characteristics of the challenge to mobilize people and resources to quickly respond to the effects of COVID-19 remains as a question.

A. Open Innovation and Open Data

The decrease in the cost of collecting, distributing, and accessing information, services, and resources provided an opportunity to have access to large amount of data. Advocates have argued that if data is gathered or created by a government institution or funded by public money, it should be “open” which means that free to access to every individual and organization to use, republish, and analyze without restrictions - patents, legal or technical hindrances [1].

The open data technologies can be described as search engines, APIs, metadata, the linkage of publications to data sets, and open data portals, and technologies for reforming, visualizing, analyzing, linking, and evaluating the quality of data sets and technologies needed to access and use open data [2].

The term “open innovation” was introduced by Chesbrough where Chesbrough [3] and defined as “a

paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as firms look to advance their technology." In 2006, Chesbrough. updated the definition to be the "use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" [4].

Open innovation can also be described as complex collaborations managing innovation communities with multiple roles across the innovation process to effectively use both internal and external knowledge in every involved organization [5]. For instance, Gassman [6] explains globalization, technology intensity, technology fusion, the emergence of new business models, and knowledge leveraging as drivers of open innovation

Public and private organizations can release their data for external parties ("inside-out"), as well as use other organizations' data for their own purpose ("outside-in"); open data and related technologies can be used as part of open innovation processes of organizations) [7].

When it comes to openness, researchers have used different definitions for "openness" (see [8], on 150 papers on open innovation). Huizingh provides two relevant dimensions: innovation output and the innovation process, leading to a 2 x 2 matrix [9]. Open innovation output involves opening the firm to external organizations or individuals for both the inflow and outflow of innovation-related knowledge and ideas [10]. Firms close the end-point of innovation due to intellectual property rights, but the output dimension mostly deals with the creation of information commons (e.g., open-source software) so the output becomes a public good "free from intellectual property constraints" [9], [11].

Providing open data is not enough to enhance openness as the process of creating public value from open data remains neither mature enough nor well understood [12].

B. Objective and Research Design In his recent article, Henry Chesbrough lists several of the developments to respond COVID-19 and states that all of the developments have "openness" as a common denominator, which is a vital aspect of open innovation [7]. According to the author, "making openness is an imperative in these times of crisis. Opening up will speed up your internal innovation process, and allow you to take advantage of the knowledge of others in your business (outside-in), even as you allow others to exploit your knowledge in their business (inside-out)" [7]. This article, similarly, lists some developments and present a critical perspective on these developments, especially in terms of openness and open data. To this end, the article aims to answer the research questions:

- Why, based on our empirical findings and observations, openness and open innovation were not utilized properly?
- What are the risks that we have been seen during responses that creates imposter of openness and open innovation (which inhibits rapid solutions, yet in reality may create new problems)?

Big data and analytics played an important role in open innovation during the pandemic. Sharing data and transferring knowledge between governments, laboratories and research centres helped us to understand the unpredictable spread of COVID-19. Furthermore, machine learning and advanced computational models illustrated great potential in tracing and predicting the future spread of the disease.

On one hand, data-driven modelling, daily statistics of the developments related to the COVID-19, mobile phone data, aviation data and social media data supported decision making of the researchers, clinicians, health-care workers, epidemiologist and decision maker. Yet, on the other hand, many questioned the privacy and data protection concerns. This article discusses some challenges related to data such as availability, accessibility, quality, volume, heterogeneity, artificial intelligence algorithms, isolationism, and privacy.

This article follows the qualitative research approach with purposeful sampling [13]. For that purpose, we collected data and examples from activities and responses across the globe. Firstly, publicly available information from health organizations (who.org, ourworldindata.org) websites, news, magazines, press releases and reports. The goal here was not to collect a large set of sample data systematically but gather illustrative examples and empirical evidence to assess how collaboration, data and open innovation is used to handle the situation in hand. Secondly, this article raises concerns and presents several example issues faced within our society during responses to COVID-19, in relation with the collaborative open innovation projects particularly from data-focused perspective.

To this end, the article continues with briefly presenting the collection of cases from corporate collaboration to open innovation in public domain. Later, in Section III, different challenges related to data, artificial intelligence, isolationism and privacy is discussed. Lastly, the article is concluded by underlining the importance of understanding the challenges around data and data analysis, ensuring the human rights and privacy of individuals, especially during government actions and public

and private organizations' collaboration.

II. Responses to COVID-19

In this section, we will give examples how corporate and public sector have responded to address COVID-19 crisis by focusing on two approaches from *Corporate Collaboration* and *Open Innovation in the Public Sector: Crowdsourcing and Hackathon*

A. Corporate Collaboration

Several organizations offered free, open access to their tools, platforms, and resources and provided collaborative environments to support to tackle with the pandemic and the crises it brought.

One example for these corporations came from the tech giant Microsoft. Given the urgency of the COVID-19, Microsoft started to accept requests in the "AI for Health" program for COVID-19 grant proposals from non-profit organizations, academia, and governments [14]. This grant program provided Azure cloud and high-performance computing (HPC) capabilities. The team of AI for Health data science experts, whose mission is to improve the health of people and communities worldwide, is also open to collaborations with COVID-19 researchers as they tackle this critical challenge. The program provides AI tools to explore new approaches to cross-organizational data access. More broadly, Microsoft's research scientists across the world, spanning computer science, biology, medicine, and public health, will also be available to provide advice and collaborate per mutual interest [14], [15].

Another example is from Ericsson AB. Ericsson has partnered with the National Institutes of Health, Georgetown University and the White House Office of Science and Technology Policy on their open research dataset challenge COVID-19 [16]. The challenge has 10 open tasks ranging from understanding COVID-19 risk factors for finding treatment protocols.

The third example is not directly sharing to the public but sharing among competitors, which is a collaboration between Google and Apple to enable the let android and iOS operating systems to share of Bluetooth technology to help governments and health agencies reduce the spread of the virus [17].

As a fourth example, in Sweden, a Chinese supplier and Karolinska Institution started to strengthen healthcare capacity in virus diagnostics which is financially supported by the Knut and Alice Wallenberg Foundation. The coordination is taking place through a collaboration with China and the Swedish national infrastructure Science for Life Laboratory [18].

Last but not least, companies all around the world from the retail sector; including Delhaize & Colruyt, Mc Donalds & Aldi, Amazon & Lyft, Carrefour & Uber Eats; started unprecedented collaborations [19]. While this period brought new, virtuous partnerships, it remains to be unseen how these changes will continue in the future.

B. Open Innovation in the Public Sector: Crowdsourcing and Hackathon

As soon as scientists found the RNA of the virus, they shared with the scientific community, which lead other researchers all over the world to start to work. Chesbrough [7] explained that one of the positive outcomes of COVID-19 was the increased ability of fast mobilization of scientists, pharmaceutical companies and government officials which led to a variety of scientific initiatives to find an effective response to the virus.

In response to the COVID-19 pandemic, the Allen Institute for AI has partnered with leading research groups to prepare and distribute the COVID-19 Open Research Dataset (CORD-19), that includes a free resource of more than 52,000 scholarly articles about COVID-19 and related viruses [20].

The Elsevier Coronavirus Research Hub [21] provides free resources for biomedical and scientific researchers working on coronavirus with access to a broad suite of tools includes access to multiple tools, from scientific and clinical content to COVID-19 specific datasets, text mining services and more.

Hack the Crisis movement started in Estonia, where the first hackathon is run between 13–15 March, in collaboration of Garage48, Accelerate Estonia, the general start-up community and Estonian government. The aim of the hackathon was to provide a collaborative environment to discuss and implement solutions on how to use tech for crisis response and to deal with the challenges of the postcrisis era [22].

III. COVID-19 Data Challenges

Even though there are several initiatives of sharing data and information regarding COVID-19, there are many challenges regarding data, information, and usage.

Technology, data, and collaboration were vital for the response to COVID-19. However, the technology-driven tools and new ways of collaboration do not come without a cost. Mello and Wang [23] used the definition as digital epidemiology - the use of data generated outside the public health system for disease surveillance. Even though it has been in use for more than a quarter-century the digital epidemiology is taken to the next level in responding to COVID-19. In general, several challenges were associated with data, such as availability, accessibility, quality,

volume and heterogeneity [24]. Some of these are still valid for the pandemic context whereas some new challenges are in raise.

We have grouped main challenge categories as stated in the Table 1 as a) data related to the spread, b) medical treatments, and c) combatting efforts. The next subsections briefly introduce the challenges within each group: censorship and information overload, data availability, data accessibility, data quality, data volume, data heterogeneity; AI algorithms; isolationism, Privacy: Tracing versus Tracking (Table 1).

A. Censorship and Information Overload Openness is tightly related to data transparency. If there is no transparent flow of information and data, it becomes challenging for the scientists to measure impact and create a model to predict development and spread of the pandemic.

There are media reports that several countries such as China, Iran, Turkey tried to avoid and control information flow in regards to COVID-19 by hiding information, silencing the whist blowers and downplaying during COVID-19 crisis [25]–[28].

On the other hand, focusing on early results to develop strategies is shown not only ineffective but also misleading. For instance, on several occasions, the president of the US compared COVID-19 with flu and stated that it would disappear like any other seasonal influenza spread [29]. Similarly, Brazil's president claimed COVID-19 is "little flu" and ignored distancing rules [30]. While researchers were busy with tackling with the virus, people in the media and politics at times shared information that did not necessarily provide by the scientist in the field. This created an information overload and did not contribute to the understanding of the public and decision-makers.

B. Data Availability The term availability here means "the extent to which data (or some portion of it) is present, obtainable and ready for use" [31]. At the beginning of the pandemic, useful data was rarely available. Later, when countries decided to collect data about the pandemic, there was no agreed data collection strategy or model. This lack of collaboration on data curation practices lead to different methods of counting patients and deaths. As a result, there has been mismatched approaches to understand the overall effect of the pandemic in different countries.

On January 19 was the first date where a US citizen is registered as infected from COVID-19. On the other hand, Cirium [32], a database and analytics company that tracks commercial air traffic, shows that there had been 3357 flights occurred between China to the US between November 17, 2019 till February 1, which is in total of 994281 seats [32]. This has raised suspicion that spread of virus in the US might have been started earlier than January 2019. Many raised concerns that all data that is presented in terms of first infection date, number of deaths, infected and recovered may be not fully correct.

C. Data Accessibility The term accessibility means "the access, authenticity and retrieval of data to obtain either the entire or some portions of the data for a particular use case" [33]. The call from the World Health Organization for immediate research actions to assess available data to learn what standard of care approaches are the most effective and to evaluate as fast as possible the effect of adjunctive and supportive therapies has been effective to initiate the open access to epidemiological data [34]. However, merging and preparing data from large multi-centre hospitals requires sophisticated data management and security, patients consent, ethics statements provided barriers to the rapid access to the clinical data [35].

D. Data Quality Different countries report coronavirus tests, the number of infected cases (case counts are highly related to the amount of testing done) and deaths in different ways, register in different time frames (record of doctor, of death certificate) and, deaths (which tend to be more easily detected) can be used to estimate the total number of cases, which makes comparing the situation between countries complicated, therefore quality of the data is another important issue that needs to be addressed [36]. The data quality is used here in the meaning of the fitness of the data "for (its) intended uses in operations, decision making and planning" [37].

According to some calculations only 14% of US COVID-19 cases have been detected [38]. Hence, integrating multiple data sources requires accessing accurate and consistent data, consolidating different data representations, and eliminating duplicate information. Therefore, the quality of data should

Table 1. COVID-19 Challenge Groups.

Groups	Challenges
Data related to the spread	Censorship and Information Overload, Data availability, Data accessibility, Data quality,
Medical treatments	Data volume, Data heterogeneity
Combatting Efforts	AI Algorithms

be considered attentively, conditions for responsible data collection and processing at a global scale must be well-thought [39], [40].

High quality, structured, accessible data that can be used further to analyze different aspects of the COVID-19 and to understand the characteristics of the spreading of the virus. This includes considering different cognitive biases.

This kind of approaches and increased awareness of cognitive biases could be the perfect opportunity to create new habits and design new health and safety processes that may be beneficial to minimise risks during and after the crisis [41].

E. Data Volume The volume of the data is one of the most misunderstood data properties, specifically in the context of big data. On one hand, having big amount of data may bring more insights, more data does not always mean better analytics results and actionable insights [42], [43]. Analyzing a large amount of data can sometimes even become unnecessarily complicated and resource-intensive. This certainly does not mean that data should not be collected. In contrary, the suggestion here is to collect only necessary data while complying with the individual's privacy and human rights. Big data enables to track the spread of the fast-moving pathogen and support planning disease prevention efforts. But this urgent need to contain the outbreak should not cloud thinking about big data's potential to do more harm than good [41].

F. Data Heterogeneity Data variety or heterogeneity is a measure of the richness of the data representation in different formats [44]. The heterogeneity or the variety of data becomes important when institutions are looking for cure or vaccination. There are propositions that suggests to creating large scale COVID-19 Real World Evidence (RWE) [45] studies that may collect data from a variety of real-world sources to accelerate the development of treatments in a more patient-centric and patient-friendly way. This approach, for instance, aims to integrate assay results to clinical status and allow epidemiologists, biostatisticians, and clinicians to explore the relative effectiveness of variations in local treatment protocols.

Such an intertwined process, surely, results with heterogeneous data silos. Like many other industries the health care domain and its processes, organizational structures, and infrastructure are dependent on legacy systems. Therefore, there should be different approaches and both long-term and short-term plans to tackle the variety of the data.

G. AI Algorithms AI is being used as a tool to combat with COVID-19. For instance, China used AI to support decisions on restricting the movement of populations, forecasting the evolution of disease outbreaks and research for the development of a vaccine or treatment.

Chun [46] mentions that the fast learning opportunity that AI brings saved time in sequencing the genome of Sars-CoV-2, designing lab tests, analyzing CAT scans and making new vaccines. The thermal scanners are another application in which authorities are using artificial intelligence and big data to combat the deadly virus, which has become common in major cities.

However, while usage of data, AI and the opportunities may support rapid response to deal with the effects of the pandemic, many AI data models are broken due to travel restrictions, purchasing patterns and unexpected behaviours of the public. The algorithms that run behind the scenes in inventory management, fraud detection, marketing, and more stopped working properly due to these changes [47].

At the same time, AI is capable to support disease forecasting. This may firstly have seen as providing low ethical concerns. However, using personally identifiable information in algorithms, such as in the case of the Alipay app, combined with algorithmic biases and errors could lead to serious consequences because of the social relationships [23].

IV. Negative Consequences of COVID-19 Responses

Not all responses resulted in positive direction to address to COVID-19. It can be noticed that COVID-19 has been used as a tool to increase isolationism and to reduce privacy of citizens.

A. Isolationism Chesbrough [7] discusses open innovation in public sector as adoption and actually flexibility of regulatory environment such as providing provisional acceptance of a ventilator if it is already approved in another country. This might be problematic because each country has different rules, regulations and protocols and do not share the same processes.

On the other hand, opposite to this direction, something we find interesting to point that during this pandemic there has been a shift to national isolationism in essential supplies and legal frameworks for handling the economic impacts of the virus. Countries did not coordinate properly on their measures towards COVID-19 collectively, rather, every country had different approach in terms of introducing travel restrictions, lockdowns or approval of devices.

B. Privacy: Tracing Versus Tracking China has been trying to use different technologies to combat COVID-19 such as

temperature detection, cameras, body detection, face detection and dual sensing via infrared cameras to identify possible patients. China and Turkey[1] are using big data that includes tracking information on people's movements through their mobile phones and rolling out mobile apps that allow users to find out if they have come in contact with a confirmed coronavirus carrier.

All these raises questions of privacy. For example, when Chinese telecom operator China Mobile sent numerous text messages to media outlets about people confirmed to have the virus, they also sent so much details about that person, including the time, seat number in the train, etc., the privacy of these people is compromised [48].

Countries like Italy, Turkey, Taiwan, Singapore, Israel, Iran, and South Korea introduced movement or whereabout apps to track exact location of its citizens [49], [50], Germany, Belgium, Austria are using anonymized data to track people's movements [49]. Sweden is also using telco operators to track public movements, for example telecom operator Telia delivers this as a "Telia Crowd Insights" service [51]. China is using thermal scanners and facial recognition technologies in public places [48]. Controversial surveillance vendors Clearview AI and Palantir are reportedly in discussion for collaboration to with the US authorities to track and trace people for COVID-19 [52]. An Israeli technology company, NSO group, has developed a new product with the ability to track people for COVID-19 [53].

These actions taken by governments raise concern in regards to privacy and human rights [54]. For example, during Hack for Crisis hackathons, privacy was not mentioned as main parameter of evaluation. Unfortunately, even though European Data Protection board has raised issues to prevent this, board also states that safeguarding public health may fall under the national and/or public security exception that gives opportunity to member states to process non-anonymous data [55]. As mentioned in earlier sections, there is a thin line between the success of the tracing and the privacy concerns where the patient's privacy and identity are compromised.

V. Conclusion

This article shows that there are several organizations all around the world that have collaborated to share data related to the COVID-19 and it was obvious that the data availability and accessibility played a big role to explain the spread and even the success of the different strategies. Similar to other data-oriented approaches in different industries, the main challenge was finding the right way to collect necessary data, structure and curate it in the right format, while protecting the privacy of the citizens, understanding the need for driving the right analysis, finding a way to collaborate towards a greater good and considering different challenges around the data for this greater good through openness. Empirical evidence shows that, there are many which may use this crisis to expand their antiprivacy operations and businesses.

Advocates have long been highlighting the importance of open data and open access in terms of open innovation. While utilizing open innovation, we also need to develop and refine methods that we use for data collection, data analysis and data sharing to both private and public organizations to tackle critic situations such as a pandemic. Improving the ways of making such big and open data readily available for analysis thus becomes an important issue for open innovation but it is key to be responsible and to respect privacy, autonomy, and human rights of the individuals.

As one method to tackle COVID-19 and provide collaborative solutions hackathons are used. However, the nature of hackathon does not provide an opportunity to address long-term challenges that this crisis was needing. For instance, there are no clear processes and strategies in place to support long term projects. Furthermore, the next steps after hackathons is not clear and how the collaboration between the teams, mentors, sponsors, public and private organizations will be developed remains unknown.

To this end, we suggest to the policy makers, public and private organizations to consider all the challenges that has been discussed in this article, such as availability, accessibility, quality, privacy, personal data protection and so on, when collaborating on projects that the public good is in the focus. Additionally, policy makers should enforce transparency in collaboration with corporates and be open about how public bodies are collecting, storing, analyzing, and utilizing data.

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