A Causality Analysis Framework for Analyzing the Retail Consumer Behavior Change in Covid-19 Pandemic

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Abstract

The pandemic of COVID-19 has leveraged many aspects in social life around the world. The number of infected people in Indonesia has passed 1.000.000 cases and still getting increased. The Government enforces regulations to minimize the transmission rate of the virus, namely, health protocol. One of the three pillars of health protocol is applying physical distancing and avoiding crowds. The policies have caused the community to significantly reduce activities outside due to their fear of being infected. This condition encourages the change in people's shopping behavior, especially for daily necessities. This study aims to model shopping behavior change for daily needs or retail products before and after the pandemic. The whole research will focus on modeling the retail consumer behavior change leveraged by the pandemic using Agent-Based Simulation. In this study, the conceptual model for the observed system was mainly built as an essential input for the Agent-Based Simulation in future research. Some relevant and significant variables within the system were identified and being analyzed for constructing the conceptual model. The final results of this study are expected to present a causality analysis framework as the conceptual model that explains the causality of consumer behavior change.

Keywords
COVID-19, Consumer Behavior Change, Causality Analysis Framework, Retail Products, Agent-Based Simulation

1. Introduction
The rapid and massive spread of SARS-COV-2 as the cause of the Coronavirus Disease (COVID-19) in numerous countries has been declared as a global pandemic (WHO, 2020). This global pandemic has impacted the world and societies. In respond of the declaration as well as the increasing number of positive testing results of the virus, Indonesian government has generated actions to decelerate the virus transmission as well as recovery efforts to treat the infected. One of the most prominent appeal is to apply health protocol. One of the three pillars of health protocol is applying physical distancing and avoiding crowds, which is the action to maintain safe physical distance between individuals while conducting daily activities (Qureshi et al., 2020; Ahmed et al., 2020). In the Government regulation, daily activities are strictly limited, especially those involving large masses and public transportations. The regulation affected numerous daily activities in all aspects, causing a significant decrease in public activity and personal mobility alongside a perception of fear in the society. As physical distancing remains the primary way to minimize the pandemic's spread, economic activities involving human interactions have been switched by online activities, such as shopping, attending schools and universities, and working from home (Araya, 2020). This restriction is not only influences the social behavior changes, but it seems that various areas of life are affected, including consumer behavior, and this time, across the world (Anastasiadou, 2020). The new consumer behaviors span all areas of life, from how society work, shop, and entertain themselves. These rapid shifts have important implications for retailers and 'consumer-packaged-goods companies (McKinsey, 2020). One of the changes includes the increase of online technology utilization to fulfill their necessities. Data recorded by Bank of Indonesia (2020) shows that during COVID-19 pandemic, there was a significant increase in digital transactions by 38.3% in Indonesia. On behalf of the seller, the focus shifted in ready-to-deliver products such as frozen food and takeaways for the Food and Beverages sector. Digital platforms such as instant messengers, social media, and e-commerce are used to promote their product which would later be delivered directly to the consumer through third party logistic firms (e.g. courier). The phenomenon has become the new standard for an era dubbed the "new normal" which is high in possibility to continue even after the pandemic is declared over (McKinsey, 2020). The whole research will focus on modeling the retail

consumer behavior change leveraged by the pandemic using Agent-Based Simulation. In this study, the conceptual model for the observed system was mainly built as an essential input for the Agent-Based Simulation in future research. Some relevant and significant variables within the system were identified and being analyzed for constructing the conceptual model. The final results of this study are expected to present a causality analysis framework as the conceptual model that explains the causality of consumer behavior change.

2. Theoritical Development

Consumption is an activity that is closely related to location and time (Sheth, 2020). Over time, consumers will develop a shopping habit according to their surrounding environment. Consumer behavior is something that can be predicted. Things related to the consumer's live as well as their surrounding environment will eventually influence their shopping habits (Singh and Rosengren, 2020). The COVID-19 pandemic is an event that caused a major shift in our lifestyle; the way we socialize, the way we conduct activities, and even the way we shop. History wise, a pandemic could cause fear that leads to irrational actions. These actions, dubbed "social mirrors", are actions of how the people correspond to a crisis situation (Doka, 1997).

At the beginning of the pandemic, the public understanding and knowledge of the coronavirus was limited. The information conveyed by various media also raise a significant amount of fear in the society. This triggers panic buying caused by uncertainties about the situation in the future which triggers an excessive-shopping behavior as a precaution in case of a commodity shortages (Baker et al., 2020; Beard-Knowland, 2020). Consumers purchase daily necessities (retail products) as well as personal hygiene needs in massive quantities, causing product scarcity and a significant increase in commodity prices at the start of the pandemic. The behavior is also well known as hoarding. Hoarding is a common reaction carried out by people in various countries during an economic crisis or political instability as well as extraordinary events such as the hyperinflation in Venezuela (Sheth, 2020). The behavior is also possible to be caused by a disruption in the supply chains due to the lockdown of several countries which causes a limited amount of streamed raw material (Nielsen, 2020).

The hoarding behavior does not occur for every type of commodity. In general, the commodities that is most affected by the shift in consumer shopping behavior are daily necessities (retail products) including personal hygiene products (Grashuis et al., 2020; Singh and Rakshit, 2020). In Spain, the demand for fruits containing Vitamin C has increased significantly due to the local consumer's desire to find an alternative nutrient to increase their immunity. The phenomenon itself is caused by the scarcity of Vitamin C supplements as well as various other vitamins on the market (Gain, 2020). In Italy, there is also a highly significant increase in the consumption of raw materials and products with a long shelf life, such as frozen food, rice, pasta, flour, mineral water, and others (Aull et al., 2020). The phenomenon also occurs in various other countries such as the UK, Australia, and the USA where the society's demand has increased significantly for daily necessities and decreased quite significantly for other products, such as fashion products (Criteo, 2020; Anastasiadou et al., 2020).

Over time, the society's knowledge and understanding regarding the coronavirus has increased, causing a decrease in the level of fear of shopping for retail products offline. However, there is a significant change in the consumer shopping behavior while new shopping habits are formed. Consumers have a tendency to improvise when there are certain constraints (Radjou et al., 2012). A study conducted by Nielsen (2020) signifies that there are 6 categories of changes in the consumer behavior caused by the COVID-19 pandemic: 1) Pro-active Health-minded Buying: An increase of interest in healthcare products. 2) Reactive Health Management: Prioritizing products that can aid in the avoidance of virus such as medical masks, etc. 3) Pantry Preparation: Increased consumption for products with a long shelf life, decreased frequency of offline shopping, and significant increase in volume and sending per offline purchases. 4) Quarantined Living Preparation: Increase in online shopping, decrease in offline store visits, and increased number of out-of-stocks products. 5) Restricted Living: Limited shopping trips with an increasing concern on fluctuating prices caused by the scarcity of commodities. 6) Living a New Normal: People are returning to their normal activities while applying a strict health protocol and an increased level of caution regarding hygiene during said activities. Research conducted by Grashuis et al., (2020) also showcased consumer's tendency to choose online shopping methods, reduce the frequency of offline shopping, and choose a shopping time with low crowd levels while shopping offline during the pandemic. In addition, there has also been an increase in the customer preferences regarding products that are well-known (trusted brands) as well as shopping offline at stores closest to their home with the aim of reducing time outdoors (McKinsey, 2020).

3. Methods

To conduct the research, several methods and tools are utilized. The stages involved in this research are depicted in Figure 1 below.
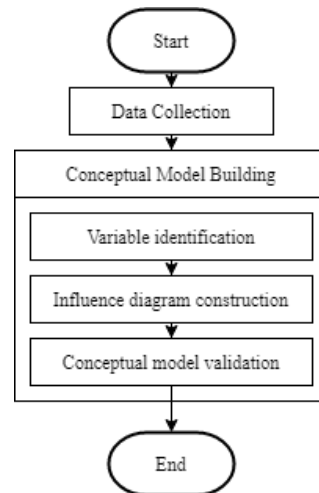
Figure 1. Research Methodology

Details regarding the research stages is elaborated in the following sub-chapters.

3.1 Data collection
In this stage, primary and secondary data is collected. The primary data includes consumer behavior towards retail goods before and after COVID-19 pandemic by using a questionnaire. Meanwhile, secondary data includes literature studies regarding the characteristic of COVID-19 spread as well as factors that affects consumer behavior shifts.

3.2 Conceptual Model Building
Conceptual model of consumer behavior in retail goods consumption before the pandemic in a form of influence diagram between agents is described in this stage. The model is constructed to observe the correlation between the effects of agents on retail goods consumption system and the results of their interactions. The conceptual model building consists of three steps: a) Variable identification, b) Influenced Diagram Construction, dan c) Conceptual Model Validation.

a. Variable Identification
Variables identified through literature reviews and direct observation. The variables observed represented in the questionnaire.

b. Causality Framework Construction
This stage aims to identify the entity, roles tasks, activities, and interactions between involved elements. A macro (overall) and micro (individual) system modelling is conducted towards the retail industry commerce system. In this stage, agents in the retail industry commerce system is identified in regard of their behavior, objective, interaction, and individual attributes. In addition, the identification of input variables was conducted alongside the determination of the ABM model output.

c. Conceptual Model Validation
The conceptual model validated, continuation of the modeling stage, this stage depicts the conceptual model in detail with a programming approach. The stage involves determining initialization values or data which would affect the entirety of the model to ease the implementation stage.

4. Data Collection
Questionnaire as research instrument captured 8 aspects, which are 1) Purchasing Method/Order Channel, 2) Time Window/Purchasing Frequency, 3) Average Spending, 4) Types of Product Purchased, 5) Preferred Offline Shopping Location and Time, 6) Self-awareness, 7) Reasons of Offline Purchase, and 8) Willingness to use Online Channel after pandemic. The questionnaire was distributed and filled by 101 respondents from all provinces in Indonesia. The demographic information about respondents is explained in Table 1 and Table 2.

Table 1. Respondents Profile

Age Group	Frequency	Percentage
< 20	4	3.96%
20-25	18	17.82%
26-40	55	54.46%
>40	24	23.76%
Total	**101**	**100%**

From Table 1. above, it was known that most of Respondents who filled the questionnaire are from 26-40 age range, and least Respondents are from <20 age range.

Table 2. Respondents Occupation

Occupation	Frequency	Percentage
Lecturer / Teacher	3	2,97%
Housewife	13	12,87%
Private / State-Owned Enterprise Employee	33	32,67%
Civil Worker	20	19,80%
Student	16	15,84%
Entrepreneur	16	15,84%
Total	**101**	**100%**

Data collected and recapitulated from questionnaires which already filled by respondents described in Table 3 below.

Table 3. Questionnaire Results

No	Item	Respond	Value
Purchasing Method / Order Channel			
1	Shop online before pandemic	Yes	26.73%
		No	73.27%
2	Percentage of monthly retail products bought online	< 10%	60.26%
		10 – 50%	37.18%
		>75%	2.56%
3	Shopped online during the pandemic (No previous online shopping before the pandemic)	Yes	80.20%
		No	19.80%
4	Online shopping percentage during the pandemic	< 10%	32.05%
		10 – 50%	58.97%
		>75%	12.82%
5	Do you still shop offline?	Yes	94.06%
		No	5.94%
Time Window / Purchase Frequency			
1	Monthly retail shopping frequency before the pandemic	1-2 Times	55.45%
		3-4 Times	30.69%
		> 4 Times	13.86%
2	Monthly shopping frequency after and during the pandemic	Yes. Less frequent	32.67%
		Yes. More frequent	42.57%
		No changes	24.75%
Average Spending			
1	Average shopping expenses before the pandemic	< IDR 200.000	40.59%
		IDR 200.000 – IDR 499.000	44.55%
		IDR 500.000 – IDR 1.000.000	13.86%
		> IDR 1.000.000	0.99%
2	Average shopping expenses after the pandemic	< IDR 200.000	37.62%
		IDR 200.000 – IDR 499.000	45.54%
		IDR 500.000 – IDR 1.000.000	12.87%
		> IDR 1.000.000	3.96%
Types of Product Purchased			
1	Largest type of retail product purchased before the pandemic	Staple food products	33.66%
		Snacks	16.83%
		Hygiene and sanitation	13.86%

No	Item	Respond	Value
		Beauty products	23.76%
		Fashion	4.95%
		Electronics	2.97%
		Children necessities	0.99%
		Office Stationeries	0.99%
		Miscellaneous	1.98%
Preferred Offline Shopping Location & Time			
1	Chose to shop offline near the customer's residence	Mean= 3.69	Category: Very High
2	Offline shopping location preference for retail products	Traditional Market	12.63%
		Grocery store	15.79%
		Minimarket/Supermarket	71.58%
3	Offline shopping day preference for retail products	Weekend	23.16%
		Weekdays	18.95%
		No preference	57.89%
4	Offline shopping time preference for retail products	Morning / Afternoon	35.79%
		Evening	13.68%
		No preference	50.53%
Self-awareness			
1	Chose to shop offline in a place with strict health protocols	3.69	Very High
2	Chose to wait or leave if the shopping location is crowded	3.34	Very High
3	Chose to shop elsewhere if the visited shopping location does not apply a strict health protocol	3.45	Very High
4	Chose to buy a product with a brand/brands that the customer have known / used before compared to cheaper options	3.11	High
5	Chose to shop offline at a location offering the lowest price or a discount	3.2	High
Reasons of Offline Purchase Preference			
1	Prefer to buy daily necessities offline due to the ability to directly observe the products	3.47	Very High
2	Prefer to buy daily necessities offline due to the ability to shop spontaneously while at the shopping location	3.21	High
Willingness to use Online Channel after pandemic			
1	Keep shopping online after the pandemic is over	Yes	84.16%
		No	15.84%

5. Results and Discussion

5.1 Variables Identification

The variable identification stage is crucial in building the conceptual model and in the simulations. In this case, the final model to be developed is an Agent-based model. Hence, a conceptual must be made beforehand as the input for the simulation model. The variables used in the model is differentiated based on the source of variable influence, both internal and external. Internal factors are seen from indicators which appear in the customer's internal environment (endogenous) such as their preference and background. On the other hand, external factors are indicators that appeared from external environment (exogenous) such as health protocol implementation by the government as well as shop location and promotions offered by retail stores. Variables and attributes used in this study are described in Table 4.

Table 4. Variables used in Conceptual Model

Variables	Attributes	Definition	Units
Customer's background	Gender	Customer background that influences product selection and shopping behavior during the pandemic in the form of a demographic data	-
	Age		Year
	Location		City

Variables	Attributes	Definition	Units
	Revenue		IDR (Indonesian Rupiah)
Consumer goods purchased	Personal hygiene & health products	Classification of purchased consumer goods	Unit
	Staple food & perishable products		
	Beauty products (cosmetics)		
	Fashion products		
Shopping store type	Traditional market	Type of store / shopping place chosen by the customer	-
	Grocery store		
	Supermarket or minimarket		
Payment type	Cashless payment	Payment method selected by the customer	-
	Cash payment		
Purchasing method	Offline shopping	Product purchasing method selected by the customer	-
	Online shopping		
COVID-19 spreading risk	-	Risk of spreading COVID-19	-
Customer Review	Star 1: Very Bad	Previous buyer's review on the desired products	-
	Star 2: Bad		
	Star 3: Fair		
	Star 4: Good		
	Star 5: Very Good		
Delivery cost	-	Additional cost charged to the customer for the purchased product delivery	IDR (Indonesian Rupiah)
Technology usage	-	Intensity of technology usage (e.g. social media)	Percentage
Health protocol applied	-	Health protocol application according to the Government's suggestions	-
Store distance/location	-	Store distance / location from customer's residence	Kilometer (Km)
Total expenses	-	Customer's total purchasing expenses	IDR (Indonesian Rupiah)
Total product purchased	-	Customer's total purchased item	Kilogram (Kg)
Product brand	-	Product brand chosen by the customer	-
Product promotion	-	Product promotion offered to the customer	-
Purchasing Frequency	-	Frequency or intensity of customer purchase	Times
Shopping time preference	-	Time preferred by the customer to conduct a purchase	Time (day/week/month)

Variables	Attributes	Definition	Units
Hoarding behavior	-	Customer's tendency to hoard items	-
Excessive purchase	-	Excessive purchase caused by several factors	IDR (Indonesian Rupiah)

5.2 Causality Analysis Framework

In this stage, the conceptual framework for this study is based on the data collected (including literature reviews and direct observation) and identified variables that are significant and relevant to the objectives. This framework is developed through the logic of systems thinking by looking at the causal relationship between the variables. It is defined as the causality framework, which aims to propose as the conceptual model for the Agent-based model. The conceptual model is used as the author's line of thought in describing the conditions of the system and as a reference when creating a simulation model. The conceptual model design consists of agent identification, interaction diagrams between agents and an overview of the conceptual model. Thus, once the framework of causality analysis is created, the relationship between significant variables will be depicted and easy to understand how much the impact of variables interdependencies on system behavior is (Sterman, 2000).

In developing an Agent-based model, it is necessary to analyze the agent beforehand to find out how the agents are connected to each other and their behavior. By depicting a conceptual model based on the depiction of fix attributes, variable attributes and behavior of the identified agents, the next step is to elaborate interactions between agents, either directly or indirectly. The interactions that occur between agents are based on direct observation (using surveys) and the results of a review of literature studies as well.
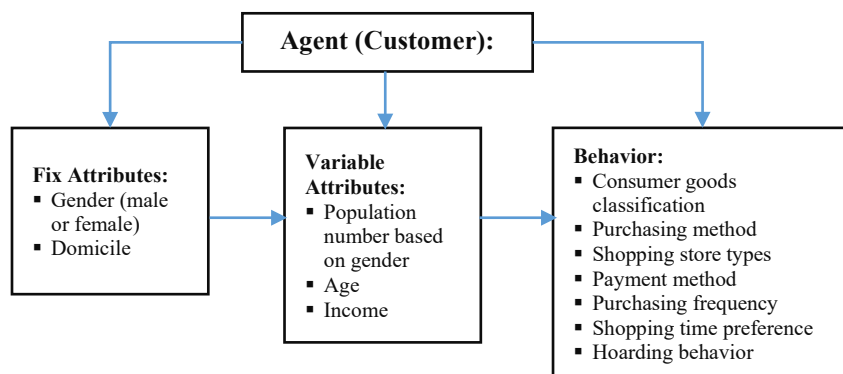

Figure 2. Attributes and Agent's Behavior (Customer)

Based on Figure 2, the agent identified for the current study are the customer agent who acts as a retail consumer for online and/or offline shopping. These customers certainly have different background that can leverage the shopping preference and behavior. Fix and variable attributes represent agent's background, while behavior represents as a response of the background. In this study, gender and domicile are determined as fix attributes, which have no changeable characteristics. Otherwise, the variable attributes that have changeable characteristics are indicated by population, age, and income. Afterwards, these attributes can be of help to detect what kind of impacts on retail consumer behavior, especially during Covid-19 pandemic.

After designing the agent's interaction based on Figure 2, the detail interdependencies between variables within system, such as agent interaction, behavior, and other identified variables are constructed in the form of the causal loop diagram (CLD). According to Maftuhah (2019), there are some elements within CLD which are indicated by a set of significant variables, arrows/link, feedback, and feedback loops. The variables in CLD represents the relationship of cause and effect, as well as arrows represent the connection between affecting and affected variables, which can show the decision and response variables. Moreover, the feedbacks represent positive/negative polarity of the influential relationships. While positive feedback shows a directly proportional relationship, the negative one indicates an inversely proportional relationship. Likewise, the feedback loops represent loop types, reinforcing loop (R) and balancing loop (B), which both have a clockwise direction. The reinforcing loops (R) can be defined as a positive loop, while balancing loop is as a negative loop (B).

In Figure 3, the conceptual framework for analyzing changes in retail consumer behavior after the COVID-19 pandemic is shown based on the causal relationship between variables (CLD). In this causality diagram, several decision and response variables can be seen in the observation system. The decision variables in this case include the rules for implementing health protocols, offering benefits of online shopping (product promotions, bonus delivery costs), as well as limiting the number of customers on offline shopping. Meanwhile, the response variable, where this variable can be referred to as the output variable, is shown, including hoarding behavior (hoarding), selection of purchasing methods (offline or online), use of technology for shopping, and types of products to be purchased by customers, and still many more behaviors can be seen.

5.3 Conceptual Model Validation

After developing conceptual model which represents the causality analysis framework for retail consumer behavior, a validation testing for this model is required to conduct. Validation is concerned with determining whether the created model is an accurate representation of real system for study objectives (Law, 2013). In the validation stage, referring to Barlas (1996), tests of model structure, such as structure-verification test and boundary-adequacy test were carried out. In structure-verification test, structure of the conceptual model was directly compared with structure of the real system that the model represents. This included review of model assumptions by experts (policy makers) who are highly knowledgeable about corresponding parts of the real system and by the literature reviews. In addition, boundary-adequacy test was performed by considering structural relationships necessary to satisfy the research objectives, which is to get the understanding of retail consumer behavior during Covid-19 pandemic. Conducting the validation test supports this causality analysis framework to be validated as the input for the Agent-based model.
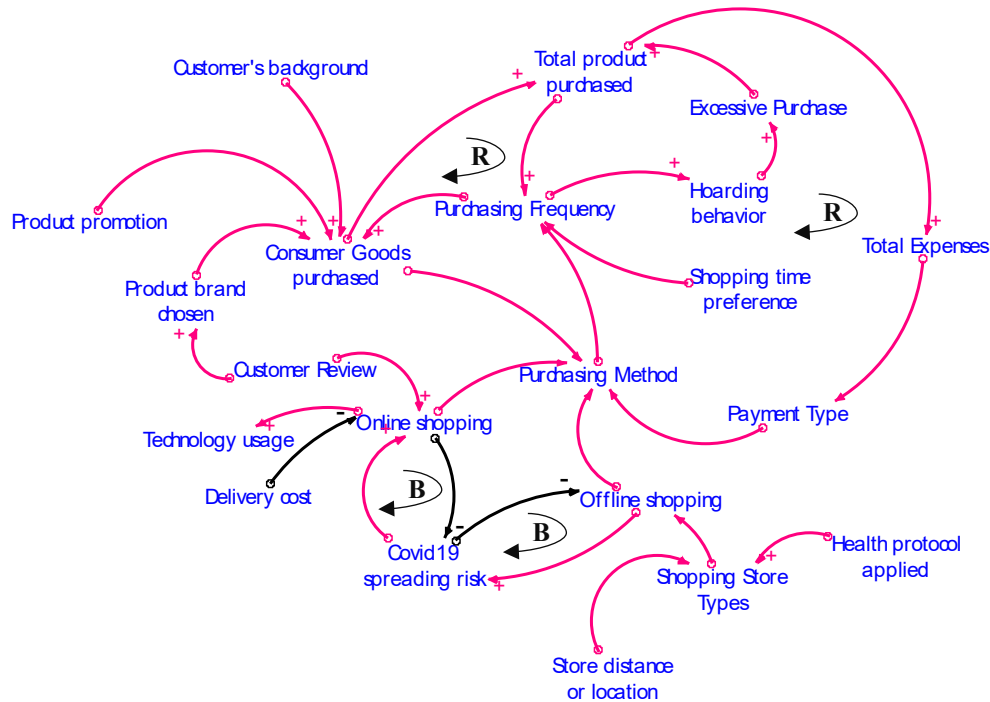

Figure 3. Causality Analysis Framework for Retail Consumer Behavior during Covid-19 Pandemic

6. Conclusion

Overall, the purposes of this study have been accomplished in order to develop the causality analysis framework for retail consumer behavior during Covid-19 pandemic. In understanding the change of retail consumer behavior caused by the pandemic, direct observation using surveys and the literature reviews have been performed to collect the data, especially significant variables, such as customer's background, shopping preferences, its impacts, and other factors. These steps yielded eight important aspects that leverage the consumer behavior during pandemic, namely Purchasing Method/Order Channel, Time Window/Purchasing Frequency, Average Spending, Types of Product Purchased, Preferred Offline Shopping Location and Time, Self-awareness, Reasons of Offline Purchase, and Willingness to use Online Channel after pandemic. Then, the aspects were taken into account to elaborate the conceptual framework as the objective of this research.

Furthermore, the causality framework as the conceptual model of this study had been developed as well. This framework was expanded from the results of agent's interaction and their behavior into causal loop diagram (CLD). As the results of CLD, the decision and response variables can be analyzed through their interdependencies. In this case, the rules for implementing health protocols, offering benefits of online shopping (product promotions, bonus delivery costs), as well as limiting the number of customers on offline shopping indicates decision variables. Otherwise, the response variable includes hoarding behavior (hoarding), selection of purchasing methods (offline or online), use of technology for shopping, and types of products to be purchased by customers. Lastly, this framework of CLD can provide better understanding and insight of retail consumer behavior change due to Covid-19 pandemic. In conclusion, this conceptual model will become the key input for developing the Agent-based model. Regarding the next research, the developed causality framework will be extended for the Agent-based model in order to run the simulation and to do further analysis. Once the simulation of Agent-based has been established, the best policy scenarios for this system will be determined.

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Biography

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