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Anna Visvizi
Orlando Troisi
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Research and Innovation Forum 2021

Managing Continuity, Innovation,
and Change in the Post-Covid World:
Technology, Politics and Society

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Anna Visvizi · Orlando Troisi ·
Kawther Saeedi
Editors

Research and Innovation Forum 2021

Managing Continuity, Innovation, and Change
in the Post-Covid World: Technology, Politics
and Society

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Preface

Research and Innovation Forum 2021: Managing Continuity, Innovation, and Change in the Post-Covid World: Technology, Politics, and Society

The **Research and Innovation Forum** (Rii Forum) is an annual conference that brings together researchers, academics, and practitioners in conceptually sound inter- and multi-disciplinary, empirically driven debate on key issues influencing the dynamics of social interaction today. Technology, innovation, and education define the rationale behind the Rii Forum and are at the heart of all discussions held during the conference. The COVID-19 pandemic and its social, political, and economic implications had confirmed that a more thorough debate on these issues and topics was needed. For this reason, the Rii Forum 2021 was devoted to the broadly defined question of the short- and long-term impact of the pandemic on our societies. Indeed, the Rii Forum 2021 served as a virtual arena for debate on how sophisticated information and communication technology (ICT), including artificial intelligence (AI), blockchain, big data, cloud and edge computing, 5G, Internet of Things (IoT), and social networking, could help stakeholders to manage continuity, innovation, and change in the post-Covid world.

As an inter- and multi-disciplinary conference that offers a broad view on the issues and topics related to advances in ICT, the Rii Forum 2021 sought to encourage insights from a range of research domains and academic disciplines. For this reason, the conceptual foundations of the Rii Forum 2021 were drawn from social sciences, management science, computer science, as well as education science and humanities.

Rii Forum 2021 was organized under conditions of immense uncertainty driven by the ever-changing dynamics of the COVID-19 pandemic and its implications. Indeed, COVID-19 has redefined not only the way business is conducted, but also how culture is “delivered” to entire societies. The pandemic and the quarantine that the majority of our societies were subjected to altered several social interactions, in many ways fostering a new quality of human–computer interactions. For these reasons, the Rii Forum 2021 aimed at stimulating a discussion on the multiple

facets the pandemic's impact on technology, the society, the business sector, and the art of management as well as on political systems, including democracy.

In the original open call for panels and papers, the following topics and issues were highlighted as of particular interest of the steering and the program committees: the establishment and consolidation of alliances among diverse stakeholders; the use of data and data-driven strategies to inform policy-making at local, regional, national, and global levels; COVID-19 driven new divisions between the Global North and Global South; social implications of the COVID-19 pandemic: migration, exclusion, and poverty; a weakening of democracy, transparency, and civic and human rights; the management of pandemics and their implications through the use of AI, and its value in health care, education, smart cities, economics, and foreign policy. A closer insight into the actual application of technology was also encouraged. The topics of particular interest included: blockchain and its application to the post-Covid world; social networking sites and digital space vs politics, economics, and business; information management in times of uncertainty; COVID-19 and the international economy in the AI-era: crisis, rupture, and new opportunities. In response to the initial call for panel and paper proposals, the following panels were proposed and successfully executed.

- Panel 1: Technology, education and online learning in times of the pandemic
- Panel 2: Immersive technologies as a tool for coping with COVID-19 in higher education
- Panel 3: Health and well-being in smart cities: urban design and urban planning in the COVID-19 era
- Panel 4: Smart Cities in the COVID-19 era: SDGs and resilience
- Panel 5: Smart cities, public health and infectious diseases
- Panel 6: Cultural heritage and ICT
- Panel 7: Depopulation, the global competition for talent, and the digital diaspora
- Panel 8: Democracy in the post-Covid world
- Panel 9: AI in the international and global perspective
- Panel 10: Data-driven decision making and strategy in business
- Panel 11: Human–human and human–machine interaction amid the COVID-19 pandemic

Considering that the COVID-19 pandemic persisted throughout 2020, and in early Spring 2021 only few travel restrictions were lifted, the **Rii Forum 2021** was held online, i.e., via a specialized online communication platform. Once again, the Rii Forum 2021 conference attracted delegates from nearly all continents, including North and South America, Asia, the Arab Peninsula, Europe and Sub-Saharan Africa. The conference was held on April 7–9, 2021, and consisted of sixteen panel sessions. In addition, two keynote speeches were delivered, and a roundtable discussion was held. With regard to the keynote speeches. On April 7, 2021, the Rii Forum 2021 delegates had the opportunity to listen to Professor Erkki Ormala, Senior Fellow, Innovation Management, School of Business, Aalto University. The title of his speech was “Successful innovations drive economic growth”. On April

8, 2021, the Rii Forum 2021 delegates were invited to join the keynote speech, titled “Bottom-Up Culture Creates Born Global Success Stories: The Case of Helsinki Uusimaa Region”, by Mr. Ari Huczowski, the CEO of LUMINTEL. The roundtable debate held on Friday, April 9, 2021, was organized jointly by Rii Forum and the Institute for Democracy and Electoral Assistance (IDEA). The topic of the roundtable discussion was “Global democratic trends before and during the COVID-19 pandemic” [1]. The speakers, and corresponding titles of the opening presentations, included:

- Alberto Fernandez, IDEA, “Taking stock of global democratic trends before and during the COVID-19 pandemic,”
- Lucy J. Parry, Ph.D., Centre for Deliberative Democracy and Global Governance, University of Canberra, Canberra, Australia & Webster Vienna Private University, Wien, Austria, “Democracy in flux: a systemic view on the impact of COVID-19” [2], and
- Miguel Angel Lara Otaola, Ph.D., IDEA, “Elections and COVID-19: Safeguarding health, integrity and trust.”
- The discussion was moderated by Professor Anna Visvizi.

Nearly 100 extended paper proposals were submitted in response to the initial call for papers. Of these proposals, as a result of the stringent review process, only 58 papers are included in the proceedings. This suggests that the acceptance–rejection ratio stands at 60:40. All papers were subjected to several rounds of a double-blind peer review process (at least two reviews in each round of the review process). Reflecting the inter- and multi-disciplinary focus and scope of the Rii Forum 2021, the papers included in this volume are grouped into four broad thematic sections. These include:

- Technology-enhanced teaching and learning in times of COVID-19
- Smart cities in times of COVID-19
- COVID-19 and the business sector
- COVID-19, the political system, migration, well-being

The papers included in these **Rii Forum 2021 proceedings** serve as evidence that in times of uncertainty more inter- and multi-disciplinary research is needed to inform the decision- and the policy-making process. This volume offers a unique view not only of the impact of COVID-19 on our societies but also of ways of navigating the challenges that emerged.

We are indebted to the keynote speakers, Professor Erkki Ormala and Mr Ari Huczowski for sharing their precious time and unique expertise with the **Rii Forum 2021** delegates. We remain grateful to the **Rii Forum Steering Committee** and the **Rii Forum Program Committee** for their commitment, sound judgment, and hard work in the process of organizing the **Rii Forum 2021** and then successfully moving the conference to the virtual space. We would like to say “thank you” to all contributing authors for their hard work and their patience in subsequent rounds of the “revise and resubmit” process. It would not be possible without the

reviewers who devoted countless hours to evaluate papers submitted to this volume. Finally, we would like to express our gratitude to the entire Springer team and the Editors of Complexity for their continued support and guidance.

We remain hopeful that the forthcoming Rii Forum 2022 will be held onsite and that the online mode of the conference delivery will be just an option. Please check the **Rii Forum** web site (<https://rii-forum.org>) for updates.

Sincerely,

Anna Visvizi
Orlando Troisi
Rii Forum 2021 Chairs

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The Rii Forum 2021 Chairs would like to extend their heartfelt “thank you” to the Rii Forum 2021 keynote speakers, i.e., Professor Erkki Ormala, Senior Fellow, Innovation Management, School of Business, Aalto University, and Mr Ari Huczkowski, the CEO of LUMINTEL. Insiders understand very well how a poignant distinction it is to be able to host both speakers. We are grateful for that.

We would also like to thank our dear colleagues and friends, who responded to the initial call for panels and papers, thus making the Rii Forum 2021 a truly inter- and multi-disciplinary conference. Even more so, we would like to thank all Rii Forum 2021 delegates for creating a friendly and welcoming atmosphere at the conference; an atmosphere filled with respect, self-discipline (think of the presentation time!), as well as rich in critical and constructive feedback. We cannot thank you enough.

We would also like to extend our gratitude to the Rii Forum 2021 reviewers. You did an amazing work. Thank you!

Finally, we would like to thank the Publisher, Springer Nature, and its entire team for granting us the opportunity to collaborate on this volume. We appreciate it.

Very kind regards,

Anna Visvizi
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Artificial Intelligence and Fuzzy Cognitive Map for Supporting Urban Decision-Making During the Covid-19 Pandemic



Francesca Loia and Roberto Vona

Abstract The growing complexity of urban landscapes due to the Covid-19 and the fast technology evolution make central a rethink of urban governance, in order to understand how decision-making processes are boosted by the application of smart technologies such as artificial intelligence and big data analytics. Although there is much evidence that innovative technology is crucial to fight the Covid-19, the analysis of the literature highlights the poor attention paid in the study of the urban governance framework based on emerging technologies during the pandemic. Based on these considerations, the work aims to propose a decision-making support model for the urban local governments. By following a methodological framework based on a Fuzzy Cognitive Map (FCM), a first experimentation has been conducted on a popular social network, Twitter, in reference to an Italian city. The impact analysis through the Fuzzy Cognitive Map suggests that Covid-19 emergency is highlighting the necessity to pay attention to the priorities of local governments: if, from one hand, new efforts are required regarding social welfare and health sector, on the other hand, improvements in air quality in cities during lockdown periods bring out the environmental impacts of anthropogenic activities.

Keywords Big data · Artificial intelligence · Covid-19 · Fuzzy cognitive maps · Urban decision-making

1 Introduction

From the end of 2019, Coronavirus is continuing its spread across the world. During November, Covid-19 has passed 50 million confirmed cases in 190 countries and more than 1.2 million deaths. The virus is surging in many regions and countries that had apparent success in suppressing initial outbreaks are also seeing

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infections rise again [3]. As a result, the global pandemic due to the spread of Covid-19 is still raging across the world and is further highlighting the unpredictable and emerging aspects of the contemporary situation. In this sense, the development and application of smart technologies based on artificial intelligence and big data analytics approach are definitely offering new pathways for supporting decision-making [2, 14, 28]. However, the pandemic has highlighted the need of accelerating digital city planning for improving the communication with citizens [30] and defining urban governance framework which include emerging technologies effectively in the territorial strategies.

In this sense, by hypothesizing that a governance framework based on technologies can usefully support urban governments, this work aims to propose a decision-making model for the local governments able to collect data from a social network, process them, and offer information on the multidimensional dimensions of an urban context for offering insights in the Covid-19 era.

The paper is structured as follows: Sect. 2 provides a brief overview about the role of artificial intelligence technologies and big data analytics for fighting the spread of Covid-19 by adopting a territorial perspective; Sect. 3 introduces the conceptual framework based on a Fuzzy Cognitive Map (FCM) for supporting urban governance and a first experimentation; Sect. 4 lists main theoretical and practical implications of reflections herein and it also draws the directions for future research.

2 Artificial Intelligence and Big Data Analytics for Fighting the Covid-19 in the Territorial Context

Over the past fifty years, artificial intelligence has increasingly been spoken about in a consistent and pervasive way both in terms of applications to the public sector and redefinition of organizations' processes and functions. Artificial intelligence is based on several paradigm and revolves around the use of different types of algorithms (such as Machine Learning, Deep Learning, and Fuzzy Logic) [11, 31] intended as a set of unambiguous and defined instructions that a mechanical computer can execute (Hegland 2003).

In today's era of rapid technological advancement and exponential increases in extremely large data sets—the so called big data—artificial intelligence has transitioned from mere theory to tangible application on an unprecedented scale [9, 16, 19]. The big data phenomenon has exploded in the last years representing a new era in data investigation and application [6]. The mass digitization along with Internet of Things have led to a fast and wide expansion of large amounts of data, categorized by three dimensions: volume, speed and variety, as stated by the “3Vs” model of Laney [4,32, 33]. Other dimensions like veracity and value have been attributed to this model in order to highlight respectively the quality across datasets and the capacity to produce valuable output for industry and organizational challenges and issues [25].

Table 1 Applications of artificial intelligence and big data for the management of the ongoing Covid-19 outbreak [5]

Temporal impact	Possible application	Example
Short term	Rapid identification of an ongoing outbreak	Facilitation in real-time epidemiologic data collection and analysis, risk assessment, support in the decision-making processes, and design/implementation of public health initiatives
	Diagnosis and prognosis of Covid-19 cases	Recognition of specific diagnostic and prognostic features
Medium term	Identification of a potential therapeutic option	Identification of an already existing drugs/discovering new molecules
Long term	Enhancing cities and favoring the development of healthy, smart, resilient cities	Design new standardized protocols for sharing data and information during emergencies

During the Covid-19 pandemic, artificial intelligence and big data analytics have helped in handling the huge, unprecedented amount of data derived from public health surveillance, real-time epidemic outbreaks monitoring, trend now-casting/forecasting, regular situation briefing and updating from governmental institutions and organisms, and health facility utilization information [5] (Table 1).

However, several scholars have highlighted the highly heterogenous crisis from the urban point of view because Covid-19 has, at least temporarily, changed the face of cities and deeply affected the discussion of how we should manage urban life in the wake of a pandemic and also beyond. The pandemic shed light a key challenge in global health governance but also a crucial trial for the way in which we manage, plan, and live in possibly contagious cities [1]. In this direction, albeit emerging technologies based on big data and artificial intelligence [27] can help to mitigate the territorial effects of the crisis, there is the necessity to redefine and reframe urban governance framework in order to include emerging technologies effectively in the territorial strategies.

3 Methodology and Results

3.1 Fuzzy Cognitive Map for the Urban Context

This work aims to define a framework for supporting the processes of urban decision-making based on artificial intelligence and big data analytics. To meet this knowledge requirements, we propose a methodological framework based on Fuzzy Cognitive Maps which consists of decision modelling framework, able to support

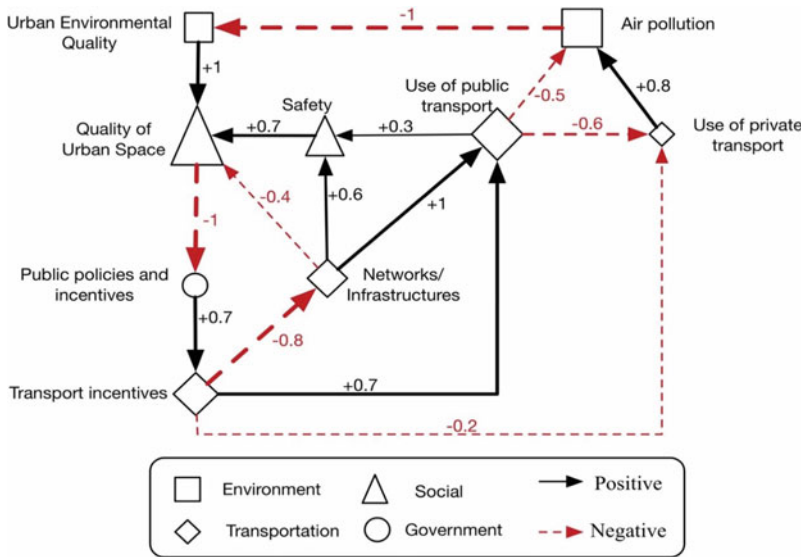


Fig. 1 Fuzzy Cognitive Map for urban context from [7]

evidence-based decision-making and impact analysis. Formally, Fuzzy Cognitive Maps (FCMs) are graphs finalized to represent a variety of relationships among concepts like events, processes or states, by allowing qualitative reasoning on the states of complex systems [13].

Indeed, many papers explored the use of FCMs as an analytical and decision-support tool in different contexts like, for instance, to support urban resilience analysis [17], green issues [18], urban planning [8].

In this work, the goal is to propose to the local governments a tool to analyse the impact of the collective perception about urban relevant questions (e.g. quality of transportation, level of safety, etc.) and to understand how such a perception may influence the other issues of the city. The FCM used in this work has been developed by integrating the maps proposed by domain experts in urban planning [17, 21]. The map includes concepts related to “perceived safety”, “environment” and “transportation” (Fig. 1).

3.2 A Scenario Analysis Based on Fuzzy Cognitive Map During the Pandemic

The urban decision-support model mentioned in Sect. 3.1 is finalized to find information related to an urban context among online sources and understand in which way is perceived by users in order to support the decision processes of the local governments.

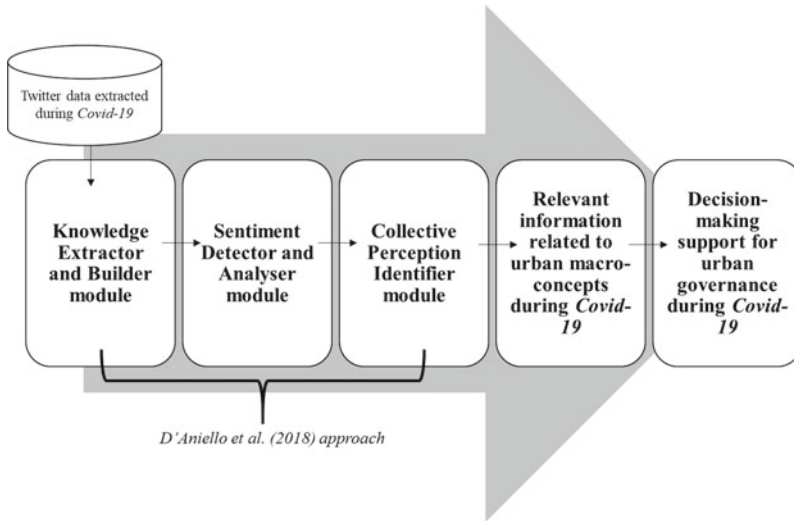


Fig. 2 The whole approach adapted from [7]

By adopting the methodological approach of [7], we follow the next steps (Fig. 2):

- In the Knowledge Extractor and Builder (KEB) module we acquire information about the city of Salerno and turning it into a structured taxonomy of relevant concepts. In particular, we extracted from a period of two months (March 2020 —April 2020) the users’ comments on Twitter regarding the city of Salerno (filtering through the hashtag #Salerno). The data was acquired from the Twitter application programming interface (API) which is a backend server that warehouses all tweets and enables data collection by the public.
- During the Sentiment Detector and Analyser module (SDA) a sentiment analysis of users’ tweets was carried out thanks to TwitteR package for the R programming language (Gentry 2013). TwitteR provides a well-documented and accessible means to extract data into a commonly used data mining statistical program [12].
- The Collective Perception Identifier module (CPI), lastly, makes use of domain knowledge to evaluate the collective perception of city considered. In particular, the domain knowledge is embedded in two sub-tools of CPI, namely the Fuzzy Inference System (FIS) and the Fuzzy Cognitive Map (FCM), with the aim of defuzzifying the collective perception value determined by the previous module.

Therefore, as depicted in Table 2, was performed the comparison between the base scenario with the city of Salerno, by activating the FCM with the value of collective perception defuzzified equal to 0,75,291. In the case of Salerno, the city appears to have a quality of urban space that is about 10.4% lower than the base scenario. Therefore, compared to the ideal city: it is necessary to increase the value

Table 2 Comparing base scenario with Salerno scenario during Covid-19

Concept	Base	Salerno	Difference	% change
Urban environmental quality	0,45,460	0,45,464	0,00,004	0,00,927
Air pollution	0,63,670	0,63,658	-0,00,013	-0,02,009
Quality of urban space	0,84,027	0,75,291	-0,08,736	-10,39,642
Safety	0,79,142	0,79,129	-0,00,013	-0,01,665
Use of public transport	0,86,386	0,86,413	0,00,027	0,03,144
Use of private transport	0,44,539	0,44,503	-0,00,036	-0,08,115
Public policies	0,38,908	0,41,674	0,02,766	7,10,974
Network and infrastructure	0,47,154	0,47,029	-0,00,125	-0,26,428
Transport incentives	0,73,189	0,73,659	0,00,469	0,64,140

relative to investments for public policies of about 7%, by increasing the incentives to improve public-sector efficiency especially regarding the health care system during the pandemic. On the other hand, air pollution value of the city of Salerno is settles near the value of base scenario. This probably is due to improvements in air quality in cities during lockdown periods highlight the significant environmental impacts of anthropogenic activities [20].

4 Implications and Conclusions

Digital tools and big data and AI-approaches help to achieve the viability of the social system by pointing out information that cannot be found such rapidly in other ways [22–24]. The proposed approach highlights the relevance of user-generated content which, through knowledge extraction approaches, offers a wide range of information on the city in relation to different areas, such as mobility, infrastructure, environment, etc. In this way, by encouraging citizens to use digital services in favor of greater involvement in governance processes, citizens participate directly in the development and co-production of high value-added services [15, 27] and enhance the dialogue with ICT solutions [15].

From a theoretical perspective, this work highlights how the pandemic has shed light on the necessity to accelerate the process towards digital city for effectively improving communication with citizens [30]. There is the necessity to redefine urban governance framework in order to include emerging technologies effectively in the territorial strategies. The adoption of an innovative framework of urban governance pushes to pay more attention to the prevention of negative environmental impacts and to the adoption of a sustainable approach [10, 29].

From the managerial point of view, the work, for the first time, carries out a scenario analysis based on FCM, already present in the literature, in the context of Covid-19. The graph can be particularly useful in representing the variety of

relationships among urban concepts especially in current times characterized by interdependency and complexity. This framework can be applicable for supporting the decision-making processes of local governments in order to highlight current trend of a system by calculating the influences of the factors in an iterative way or simulate the consequences of different scenarios.

Recognizing the validity of the proposed work, some possible future lines of research can be tracked. In next steps, since the data were not validated, could be useful validated the data thanks to a machine learning approach. Also, could be interesting together with urban and technological-oriented experts define a new FCM, specific developed for highly complex and intricate context characterized by the spread of dangerous viruses such as Covid-19.

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