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Digital Transformation Strategies and COVID-19: Findings from Bibliometric Analyses and from a European Initiative

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Abstract: Digital transformation has become a strategic priority for the enterprises, the public organizations, and the cities lately since it addresses the adoption of cutting-edge information and communication technologies (ICT) for optimizing their business processes and for generating new types of value to their end users. Although the Covid-19 pandemic is claimed to be over, it appears that organizations and cities changed their digital transformation strategies that had defined before the outbreak. The aim of this paper is to investigate the type of changes that were caused both to enterprises and cities due to the pandemic. It investigates whether and in which directions it caused business changes and how the smart city strategic objectives were affected due to pandemic, especially in cases where digital transformation strategies were defined before the outbreak. This study uses bibliometric analysis to determine the effects of Covid-19 on businesses and cities. Findings specify strategic changes and important trends, like the migration of the production supply chains to nearby territories. Moreover, this article utilizes the European Intelligent Cities Challenge initiative, in which cities had defined their priorities for their digital transformation before the outbreak. From the analysis of the strategic plans of the involved cities, it is attempted to determine whether, which cities and in which directions they changed their strategies due to the pandemic.

Keywords: digital transformation; smart cities; intelligent cities; business; strategy; emergent strategy; COVID-19

1. Introduction

The purpose of this article is to investigate the changes that organizations (enterprises, public organizations, and cities) experienced in their digital transformation processes due to the Covid-19 pandemic. More specifically, it is attempted to determine whether organizations revised their digital transformation strategies due to pandemic and in which directions. The findings of this paper show that this subject has not yet been analyzed in depth yet, and only some reports [1] attempt to capture general business and economic changes that were caused by the pandemic. More specifically, the report's data reflects the magnitude of the effort made by governments to flatten the curves and the generated economic recession. The data showed that at the end of 2020, no economy could avoid recession if they failed controlling the pandemic.

Moreover, this data shows that the organizations' behavior was affected in similar terms by the support of the governments and the size of the pandemic, both regarding their robustness and their response to their customer demands. Additionally, the economic uncertainty and the forecasts for economic growth evolved similarly in the same period. Another finding is that during the pandemic an intensive digital transformation of organizations took place, which resulted to the emergence of e-business, e-commerce, and e-government, but also to the adoption of new forms of work (remote work) and new types of digital services based on emergent technologies (e.g., artificial intelligence (AI) - based predictions etc.).

Following the above results, this article attempts to answer the following research questions (RQs):

RQ1: Did the organizations revise their digital transformation strategies, business models and value propositions in the face of the pandemic?

RQ2: Did the cities revise their digital transformation strategies due to the pandemic?

Both these questions are important to be answered since the business and city changes caused by the pandemic have not been explored in detail yet, and the findings can guide future changes due to different types of long emergencies that may appear. Moreover, the impact of the pandemic on the digital transformation strategic planning for organizations and cities is important to be clarified.

The remainder of this article is structured as follows: section 2 provides the theoretical background of this study, including definitions and concepts that deal with it. Section 3 contains the research methodology, which is multimethod and uses literature review, bibliometric analysis and the case study of the European Large-scale project entitled "Intelligent Cities Challenge" [2]. Finally, section 4 contains conclusions, limitations, and future thoughts.

2. Background

This section defines in brief the terminology that deals with this article, including pandemics, digital transformation, city, and smart city, and strategy, together with associated concepts like sustainable city, strategic management. Starting with the pandemics (or epidemics), they concern widespread diseases and they have occurred frequently over the centuries, but only in the last two decades they have become more frequent and more deadly. They influence community organizations [3], lead to the law revision or generation, reform public health systems and encourage the application of military-style surveillance and isolation methods for their control. Infectious diseases are a threat to people regardless their age, sex, lifestyle, and socioeconomic status [4]. Improvements in urban facility -including water quality and sanitation- lead to the improvement of the living conditions, which in combination with the progress in the development of new vaccines and antibiotics, support communities combating infectious microorganisms. The economic impact and health risk of epidemics are enormous and vary from short to long-term effects.

Digital transformation (DT) on the other hand has recently been defined by [5] as "a fundamental change process, enabled by the innovative use of digital technologies accompanied by the strategic leverage of key resources and capabilities, aiming to radically improve an entity and redefine its value proposition for its stakeholders (an entity could be an organization, a business network, an industry, or society)". This definition shows that the DT mainly focuses on the change that is based on the information and communication technologies (ICT) and not to the ICT themselves.

A city is considered as an urban area, which according to the United Nations [6] typically begins with a population density of 1,500 people per square mile but it varies across countries. Another indicative definition says that "city is an urban community falling under a specific administrative boundary" [7], which shows that a city requires a governance model. On the contrary, a "community is a group of people with an arrangement of responsibilities, activities, and relationships" [8]. Moreover, "a city is a system of systems with a unique history and set in a specific environmental and societal context. For it to flourish, all the key city actors need to work together, utilizing all their resources, to overcome the challenges and grasp the opportunities that the city faces" [9]. The city cannot be limited to the built environment, where the local community lives, but as an urban system, where the built environment is interconnected with several elements (i.e., the natural environment, industrial and rural areas, and other cities, etc.).

A smart city (SC) is "a new concept and a new model, which applies the new generation of information technologies, such as the internet of things, cloud computing, big data and space/geographical information integration, to facilitate the planning, construction, management and smart services of cities" [9]. Quite similarly, a smart and sustainable city (SSC) is an innovative city that uses information and communication technologies (ICT) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, and environmental aspects

[10]. Thus, a quite generic SC definition could be "the utilization of ICT and innovation by cities (new, existing or districts), as a means to sustain in economic, social and environmental terms and to address several challenges dealing with six (6) dimensions (people, economy, governance, mobility, environment and living)" [11].

According to Lysons & Farrington [12], a strategy aims to depict the future direction of an organization, while the term strategic management refers to "methods of understanding, developing capabilities and finding tools for each organization, contributing to both its advancement and the acquisition of a competitive advantage". Moreover, strategic management deals with the vision and mission of an organization, defines objectives, evaluates, and controls policies and programs, determines the long-term performance of the organization, and regularly reviews the strategy considering changing conditions, such as the technology, the political, economic, social environments etc. Strategic alignment on the other hand, can be defined as "the process of aligning all stakeholders, internal and external, so that all are focused and committed to achieving a shared organizational vision, complying with its culture" [13]. Thus, strategic alignment does not address changes or updates but concerns organizational alignment to strategic objectives. On the contrary, the term emergent strategy corresponds to "strategies that result from the emergence of opportunities and threats in the environment and from "strategies in action" (ad hoc actions across the organization)" [13]. According to its definition, emergent strategy addresses the purposes of this paper, and it is utilized under its research methodology.

3. Research Methodology

This article follows a multi-method research methodology, including literature review, several bibliometric analyses around its grounded problem and the case study of the European Intelligent Cities Challenge (ICC) [2] large scale initiative.

3.1. Literature Review

The combination of the terms "covid-19" AND "strategy" returned more than 90,000 records in ScienceDirect® alone, in late January 2023, which were classified in the following scientific subjects:

- Medicine and Dentistry (45,565)
- Social Sciences (13,902)
- Environmental Science (8,762)
- Immunology and Microbiology (8,205)
- Biochemistry, Genetics and Molecular Biology (7,404)
- Nursing and Health Professions (6,435)
- Psychology (6,405)
- Business, Management and Accounting (6,378)
- Engineering (6,203)
- Economics, Econometrics and Finance (5,073)

The inclusion of the term "strategic alignment" in the above search limited the results to 159 in ScienceDirect® and 9 in Scopus®, while "Covid-19" AND "emergent strategy" returned 30 articles in ScienceDirect and 9 from Scopus accordingly, findings which helped the primary recognition of the ground area of this study, in terms of strategic changes due to Covid-19. Most of the works emphasize the healthcare sector's behavior during the pandemic and the application of methods for threat analysis. More specifically, Tsilonis et. al. [15] applied the Strategic Alignment Maturity Model (SAMM) to several enterprises, to measure their maturity for strategic alignment before and after the pandemic. Sieber et al. [16] showed that the cultural features of the ICTs use were crucial for strategic alignment during emergencies (like Covid-19). Wang et al. [17] utilized the concept of strategic synergy to calculate the benefits, the resources, and the appropriate technology under conditions of uncertainty, for project portfolio definition by an organization to define a recovery plan from Covid-19 pandemic.

Furthermore, Heitzlhofer and Lackner [18] observed the strategic alignment between the strategic objectives of an organization, with the training and development activities during the Covid-19 outbreak. Dairo et al. [19] presented the application of the Strategic Alignment Model (SAM) on several organizations during the pandemic. Hou et al. [21] studied the work changes due to the Covid-19 pandemic in Dutch enterprises and they showed that they addressed two types of risk: management and work safety. Finally, Amankwah-Amoah et al. [21] showed that the pandemic reformed of the interrelation between the market and the State, via growing the gap between the enterprises that have political connections and those that do not have.

The above findings concern scientific works that were published during the pandemic, which they mainly addressed the application of management methodologies (i.e., portfolio management, human resource management etc.) during emergencies, while in terms of strategic reform, the strategic alignment tools were investigated instead of the strategic change itself.

3.2. Bibliometric Analysis

To investigate the type of the strategic changes and the trends for business strategic changes due to the Covid-19 pandemic, the bibliometric analysis [22] was chosen as a method to collect and analyze huge amounts of articles from the scientific repositories, like the ones in the list that was presented in the previous section. The bibliometric analysis was carried out during January and February 2023 in the scientific repositories that provide their results in the appropriate format for bibliometric analysis (bibtex files), and more specifically in the Scopus® and the Web of Science® databases. Its purpose was the answer of the RQ, which requires the identification and mapping of the areas that need to be investigated (business digital transformation strategic changes due to the pandemic); the highlighting of the central concepts and their chronological evolution; their correlation in groups (clusters); and the determination of concept trends. The bibliometric analysis was based on the following 3 searches:

- *Covid-19 and strategy ("Covid-19" AND "strategy")*

This search returned more than 50,000 articles in Scopus and more than 18,000 in Web of Science. The results were limited to the scientific area "Business, Management and Accounting" to avoid analysis of irrelevant works that deal with general subjects for health and humanity changes during the pandemic (Table 1).

Table 1. Results for crawl *"Covid-19" AND "strategy"*.

Keywords	Scopus	Web of Science
"COVID-19" AND "strategy"	3,621	1,187

- *Covid-19 and Business ("Covid-19" AND "business")*

since this paper focuses on business strategic planning. This search returned more than 20,000 articles in Scopus and more than 24,000 articles in Web of Science, which were limited again to the scientific area "Business, Management and Accounting" (Table 2).

Table 2. Results for crawl for *Covid-19 and Business*.

Keywords	Scopus	Web of Science
"COVID-19" AND "business"	10,980	19,660

- *Covid-19 and City digital transformation ("Covid-19" AND "city" AND "digital transformation")*

to address city digital transformation strategic changes. This crawl returned 60 articles in Scopus and more than 50 in Web of Science, and followed the broader search for city digital transformation, to avoid the analysis of irrelevant works that do not address changes that occurred due to the pandemic (Table 3).

Table 3. Results for crawl *"Covid-19" AND "city" AND "digital transformation"*.

Keywords	Scopus	Web of Science
"city" AND "digital transformation"	1475	773
"COVID-19" AND "city" AND "digital transformation"	60	56

- *Covid-19 and City ("Covid-19" AND "city")*

to address city behaviour during the pandemic. This crawl returned more than 600 articles in Scopus and more than 300 in Web of Science. (Table 4).

Table 4. Results for crawl *"Covid-19" AND "city"*

Keywords	Scopus	Web of Science
"COVID" AND "city"	663	376

- *Covid-19 and Smart City ("Covid-19" AND "smart city")*

to address smart city utilization and response during the outbreak. This search returned more than 700 articles in Scopus and more than 200 in Web of Science. (Table 5).

Table 5. Results for crawl *"Covid-19" AND "smart city"*

Keywords	Scopus	Web of Science
"COVID" AND "smart city"	709	228

To perform the bibliometric analysis, the R-Studio© tool was used, using the bibliometrix library and the appropriate analysis code in R language. In some cases, the extraction of the results was based on the built-in biblioshiny functions.

3.2.1. Strategic Changes during the Pandemic

About the first collected pool of articles ("Covid-19" AND "strategy") that was published between 2020-2023 from 9,434 authors in 1,105 sources, the concepts that are mainly discussed in the scientific papers in Scopus, concern decision-making and the role of humans in the face of the conditions of the pandemic (Figure 1). On the contrary, data from Web of Science (that was published the same period 2020-2023 from 3,122 authors in 190 sources) is of particular interest since the evidence (Figure 2):

- focuses on organizational performance measurement models.
- Records changes in the external environment and specifically, volatility in the oil market and the digital currency [bitcoin].
- Recognizes strategies for measuring impacts (costs, competitiveness) and ensuring the sustainability of organizations.
- Detects ethnocentric attitudes, as well as new technologies (artificial intelligence (AI) and big data).

The groups of concepts (clusters) concern the effects of Covid-19 on the organizations' strategy: indicatively, issues related to risk management tools in conditions of instability and related decision making (decision making, risk, volatility), as well as tools for measuring the performance of organizations and work from a human perspective (behaviour, job-satisfaction, performance).
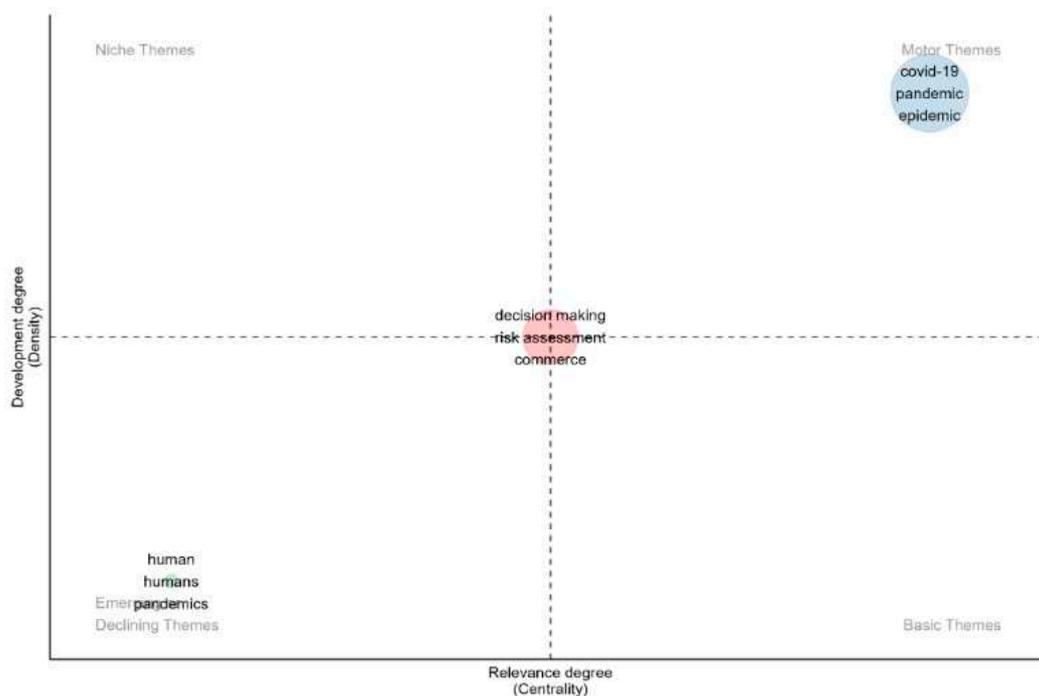
Figure 1. Concept trends extracted from Scopus ("Covid-19" AND "strategy").
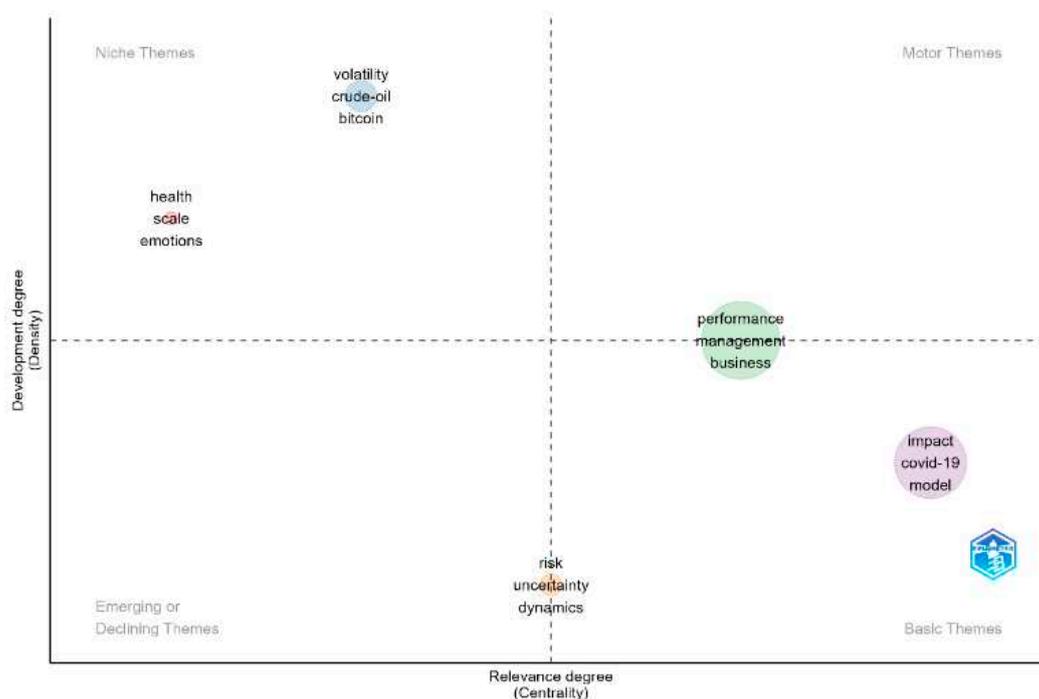

Figure 2. Concept trends extracted from Web of Science results' analysis *("Covid-19" AND "strategy").*

Moreover, the analysis of the most cited articles in this collection, shows that in terms of strategic change, companies move their production lines closer to their suppliers and to the points of high demand [23], develop corporate social responsibility, adopt flexible marketing strategies to create new markets and digitally transform themselves by identifying new digital markets and products [24]. Moreover, Donthu and Gustaffson [23] noticed a consumers' behavior change to skills' uptake about health, while they record business growth in digital and health economies. Additionally,

Wenzel et al. [25] define four strategic response tactics: retrenchment of their size and assets; persevering via risk transfer and move to local markets; innovation on digital platforms and products; and exit via shutting down. Kirk and Rifkin [26] on the other hand, analysed consumer behaviour and determined that after the outbreak they will focus on balancing work and personal life. Finally, Gössling [27] determined the following digital transformation strategies for tourist enterprises: capitalization; shutting down; immersion in digital worlds; and usurpation.

3.2.2. Business Changes during the Pandemic

About the second collected pool of articles ("Covid-19" AND "business"), the identified concepts that are mainly discussed in Scopus, concern the resilience and sustainability of businesses in the face of the conditions of the pandemic. In addition, issues related to changes in people in the workplace (i.e., new forms of work and telework) are identified, as well as business performance issues (Figure 3).
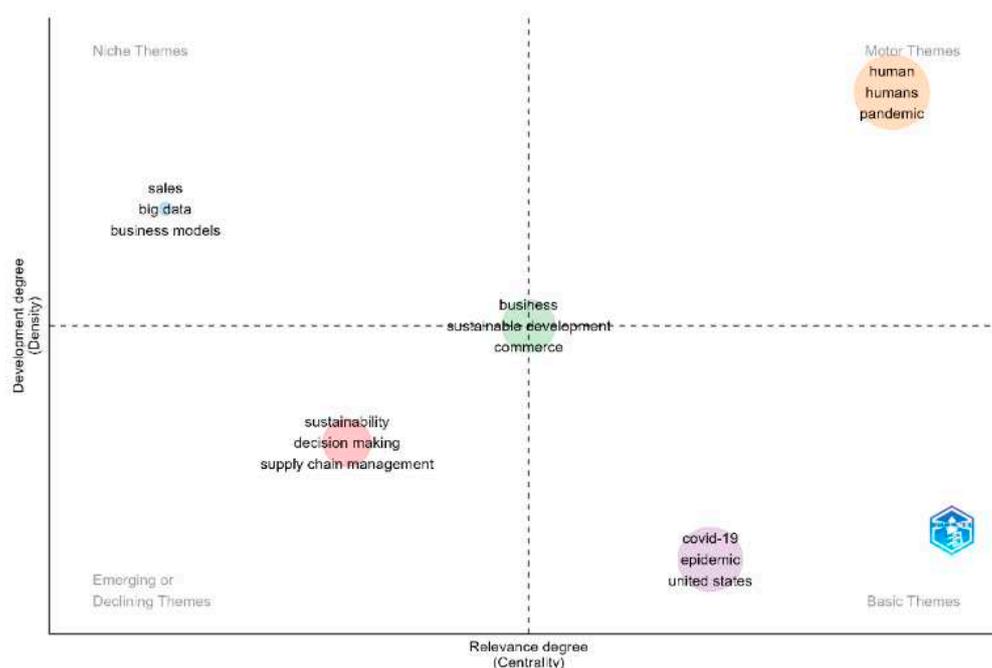

Figure 3. Concept trends extracted from Scopus results' analysis *("Covid-19" AND "business")*.

On the other hand, the main concepts that are discussed in Web of Science collected pool of articles, concern models for measuring the impact of Covid-19 on human mental health and business are explored, while the change in work and corporate social-responsibility are also highlighted. The management tools which are developed according to the same data, concern the use of time series, and forecast models for demand (e.g. for hospital beds, goods, energy, etc.) or for population movements and for changes in household savings etc. (Figure 4).
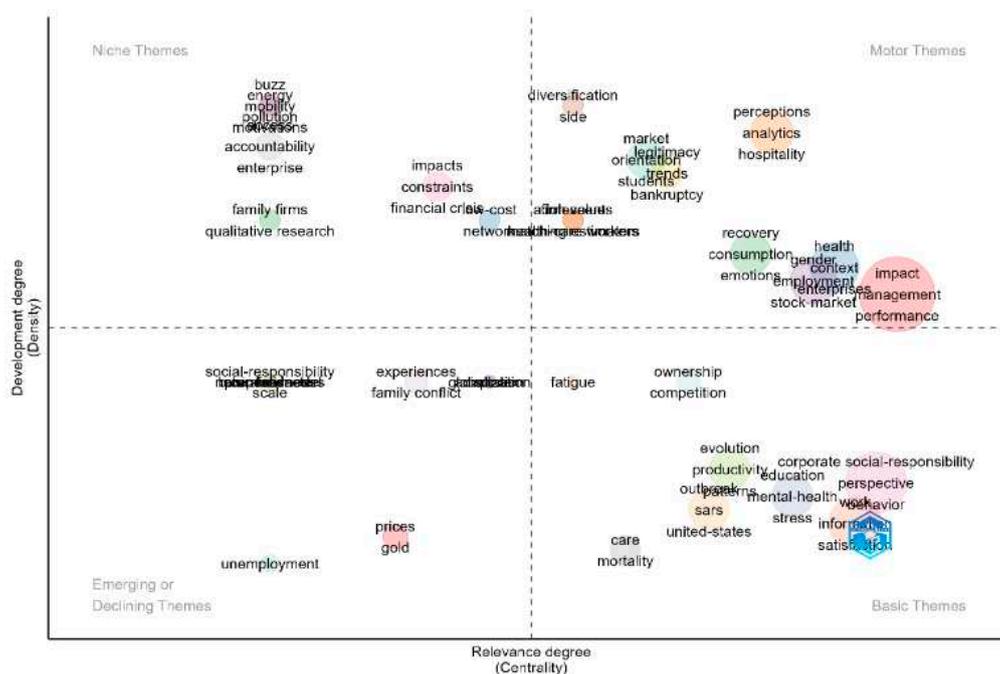
Figure 4. Concept trends extracted from Web of Science results' analysis *("Covid-19" AND "business")*.

Moreover, findings from the analysis of the most cited articles show that in terms of strategic updates, companies in the short term presented liquidity problems, so they tried to secure funding from public sources, while in the long term they review their supply chains but moving production closer to areas where there is demand [23,27]. In addition, after the "shock" from the pandemic, businesses are making structural changes and improved public health standards, greater digitization and access to open innovation and knowledge, but also more sustainable business models. Moreover, Gössling and Schweiggart [28] concluded that regardless of the shutting down of tourism during the pandemic, climate crisis remains. Zhang et al. [29] and Baker et al. [30] analysed markets' uncertainties and government financial support, and noticed variances among countries, based on policy making and on outbreak's size, while Goodell [31] recorded money savings and insurance growth. Additionally, Nicola et al. [32] determined job losses and new entrants in digital and health economies. Furthermore, Bartik et al. [33] recorded liquidity problems, which obliged businesses to ask for government assistance (i.e., the Coronavirus Aid, Relief, and Economic Security (CARES)). Finally, Wojnicka-Sycz et al. [34] determined that businesses performed extensive digitization and focused on open innovation and sustainable business models.

3.2.3. City Digital Transformation and the Pandemic

The third collected pool of articles merged two subsets: one about city digital transformation ("city" AND "digital transformation") and one focusing on the outbreak ("Covid-19" AND "city" AND "digital transformation"). The outcomes that were extracted from 1,713 documents, published by 4,932 scholars in 967 sources highlighted concepts in Scopus regarding the utilization of ICT-based innovation (i.e., AI-based sprawl predictions) to deal with the pandemic, and about digital upskilling and (Figure 5).
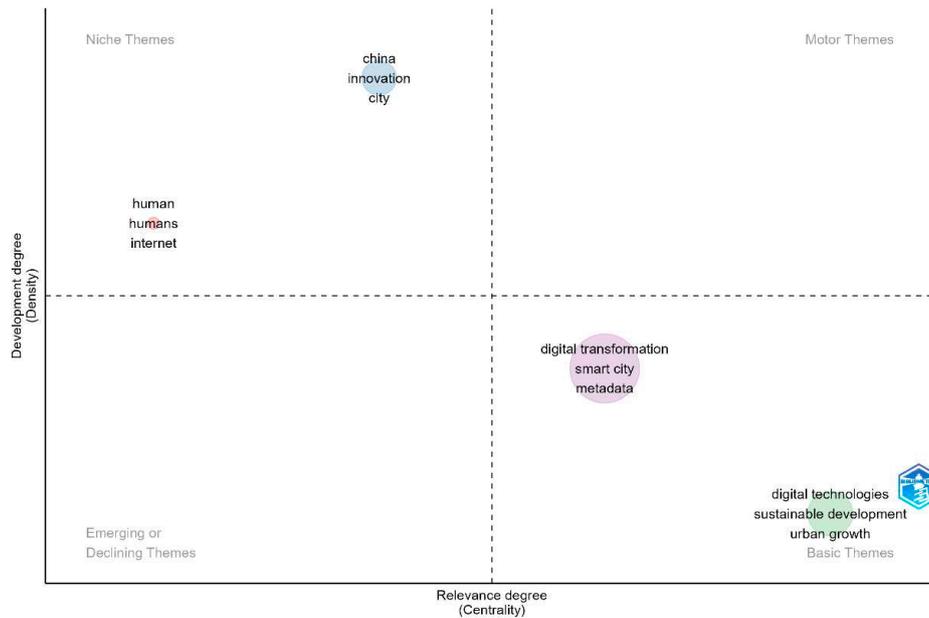
Figure 5. Concept trends in Scopus ("Covid-19" AND "city" AND "digital transformation").

On the other hand, the main concepts that were extracted from the Web of Science pool of articles, address ICT innovation for city efficiency (i.e., in terms of health and energy) and for community engagement. (Figure 6).
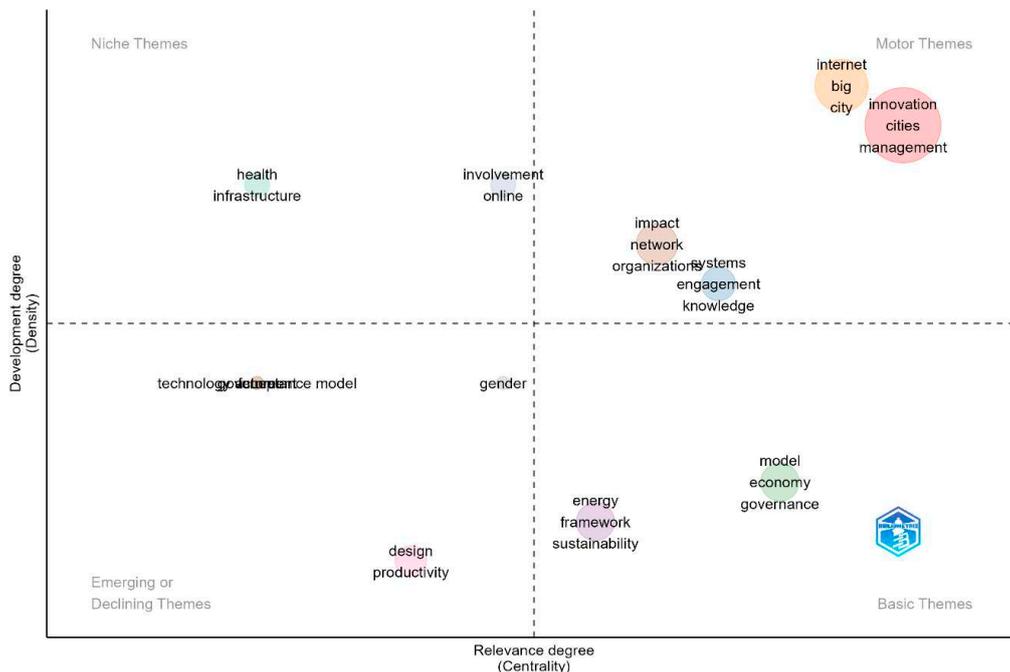

Figure 6. Concept trends extracted from Web of Science results' analysis *("Covid-19" AND "city" AND "digital transformation").*

Moreover, findings from the analysis of the most cited articles show that digital transformation in cities enhance the produced values, improve strategic responses, while the cities become a digital service provider that generates new types of value (i.e., efficient, and new digital services) [35]. Verhoef et al. [36] and Livari et al. [37] conclude that cities utilize digital platforms for data provision and for service co-creation with the community. Soto-Acosta [38] determined that the pandemic accelerated the digitization of the supply chains and cross-border service delivery, while the cities

utilized the ICT for innovation co-creation. Priyono et al. [39] showed that cities follow alternative digital transformation paths according to their digital maturity: more matured cities accelerated their transformation during the pandemic, while the less matured ones focused on the digital transformation of their supply chains. Finally, Fletcher και Griffiths [40] proved that digital transformation enhances city resilience against several types of emergencies, including the pandemics.

3.2.4. Cities and the Pandemic

The bibliometric analysis was applied to explore the impact of the pandemic on cities ("Covid-19" AND "city") according to the literature evidence, since the collected articles that were published between 2021-2023 were extensive (866 works after the removal of duplicates). These articles were published by 3,005 authors in 566 sources, and the concepts that are mainly discussed in the scientific papers in Scopus and Web of Science, concern the digital transformation importance and the application of emerging technologies (i.e., AI, big data and IoT etc.) on health (Figure 7) and (Figure 8). Moreover, issues digital transformation management (management of innovation, of Internet and of impact) and governance (e-government, city community government, decision making και involvement) issues and adoption models (absorptive capacity) were discussed, together with upskilling education methods. Subjects of lower interest concern health-related issues in cities (health infrastructure, allergic rhinitis, chronic diseases) and urban challenges (energy, sustainability, and growth).
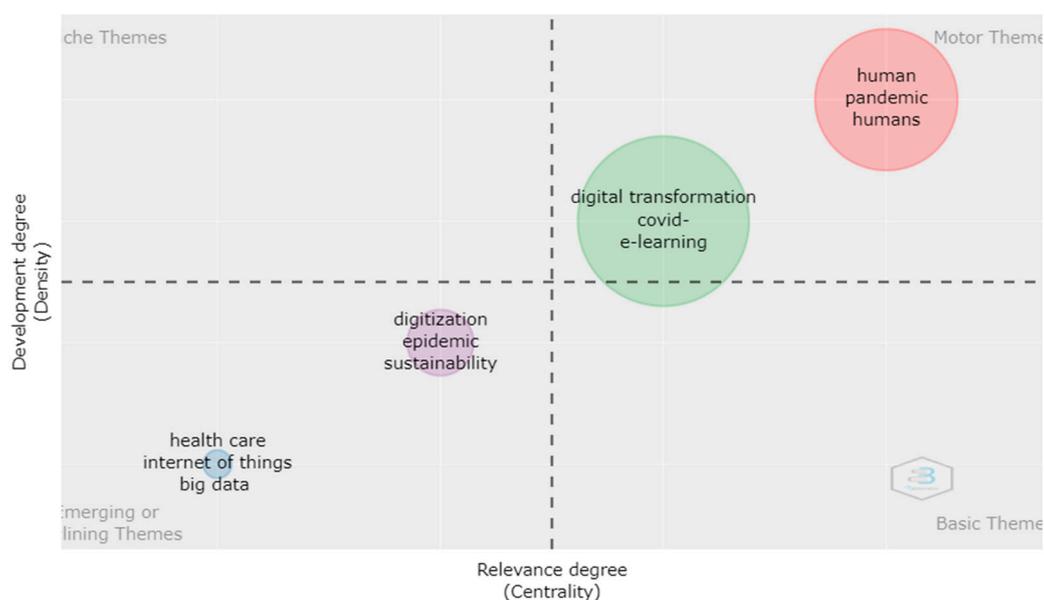

Figure 7. Concept trends extracted from Scopus results' analysis *("Covid-19" AND "city digital transformation")*.
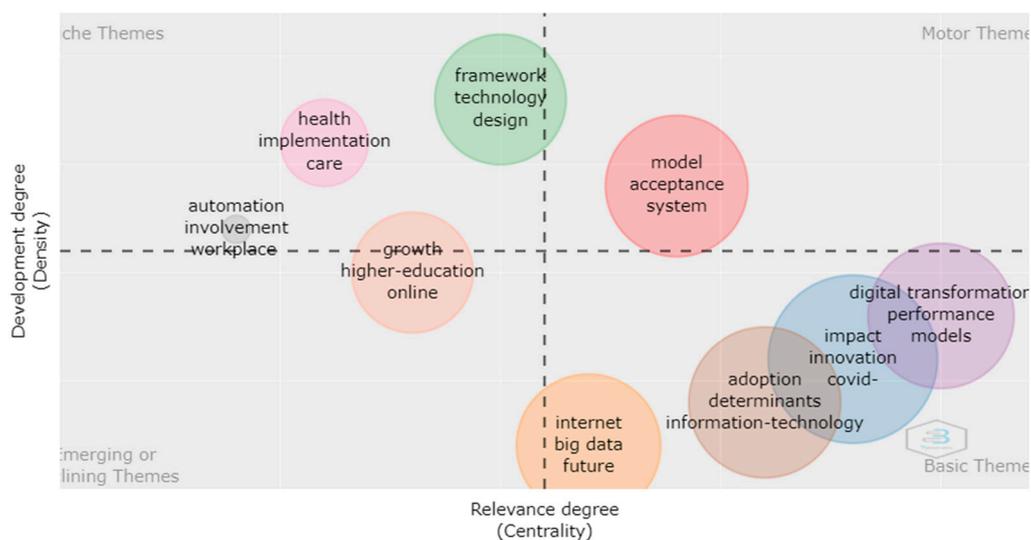
Figure 8. Concept trends extracted from Web of Science results' analysis *("Covid-19" AND "city digital transformation").*

Moreover, the analysis of the most cited articles delivers cumulative findings: innovative business models (market and product portfolio models, and multi-sided platform business model) were applied during the pandemic and contributed to new value generation in the creative economy in cities [41]. Additionally, the local governments were obliged to trust the ICT during the outbreak in their attempts to meet their economic, social, and environmental challenges [42]. In terms of waste management, AI was utilized to predict garbage collection points and enhance the utility performance [43]. Finally, a code of ethics was explored for city digital transformation (digital connectivity, algorithmization and datafication) by Calvo [44], who claimed that both the citizen engagement and privacy rights are demanded during the service co-creation.

3.2.5. Smart Cities and the Pandemic

Regarding the last pool of articles ("Covid-19" AND "smart city"), two collected sets were merged: 702 articles that were published in 384 sources during 2019-2023, by 1960 authors from Scopus; and 228 articles that were published in 136 sources during 2020-2024, by 761 authors from Web of Science. The identified concepts (Figure 9), (Figure 10) deal with digital transformation's adoption by the community (user acceptance and perceived ease), as well as issues about management of the pandemic (management Covid-19, social vulnerability, care) and of space. Some more trends -but with less importance- were also identified, regarding health and the city (urbanization and congestion), together with quality of life's issues (physical activity, CO_2 emissions).
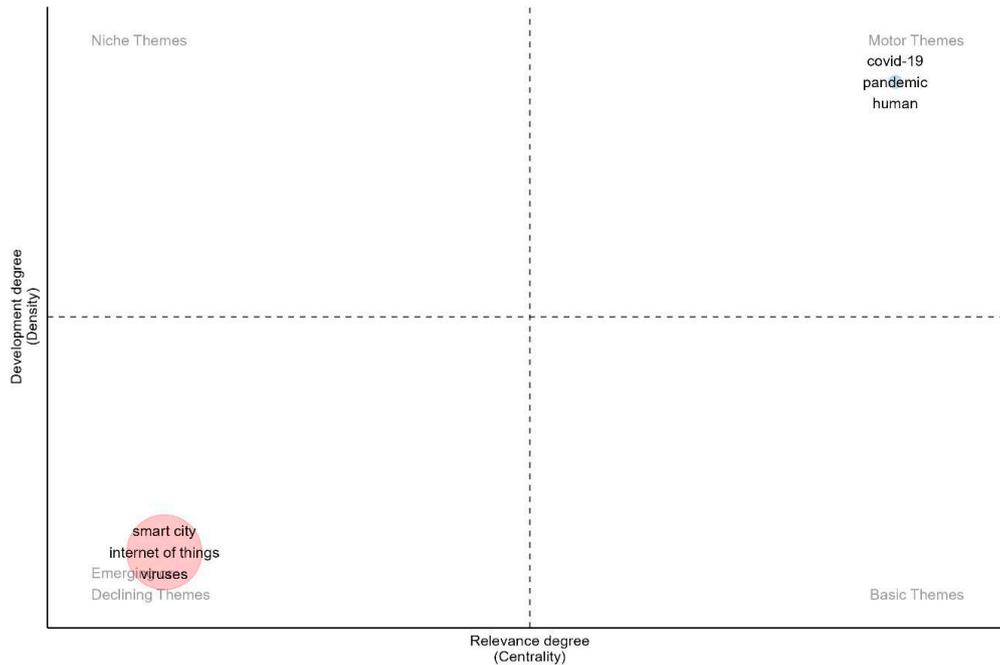
Figure 9. Concept trends extracted from Scopus results' analysis *("Covid-19" AND "city digital transformation").*
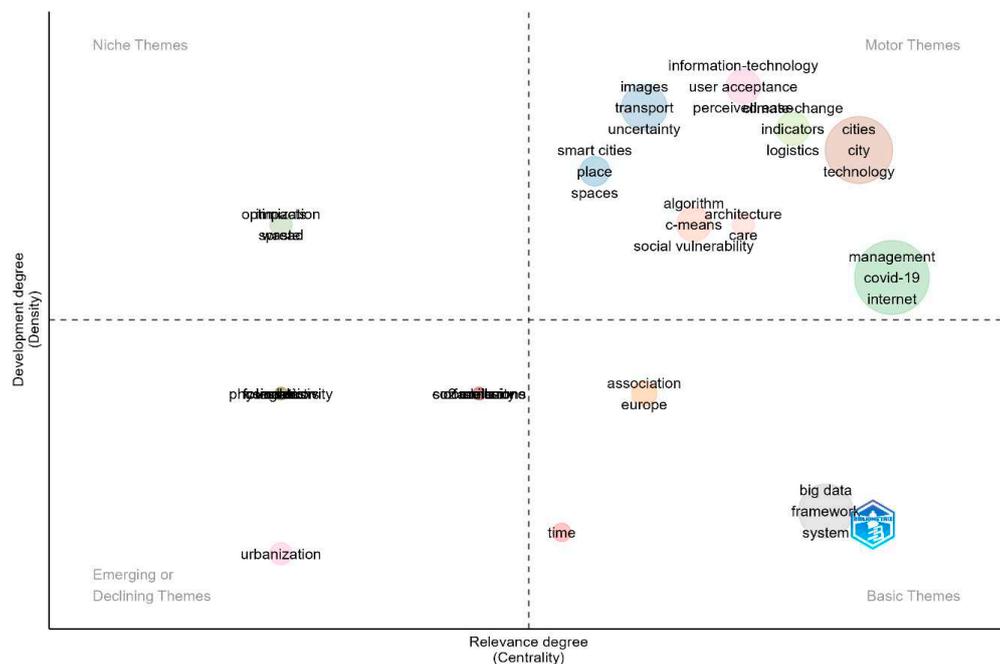

Figure 10. Concept trends extracted from Web of Science results' analysis *("Covid-19" AND "city digital transformation").*

Finally, the analysis of the most cited articles highlighted the importance for cities to perform risk prediction and raise early warnings against emergencies [45–47]. Moreover, the crucial role of the emerging ICT (online learning, digital strategy, AI, information management, social interaction, cyber security, big data, blockchain, privacy, and mobile technology) during the pandemic in cities was justified [48].

On the other hand, the impact of the pandemic on the digital transformation of local supply chains -especially the ones of high demand- was explored [49,50] and three resilient strategies

(preparedness, response, and mitigation) were extracted [51]. Local businesses also affected by the pandemic and digitally transformed, while they showed agility in terms of work forms [52].

Finally, city behavior during the pandemic was investigated by several scholars, who noticed emission reduction due to the lockdowns [53] and performance changes in mobility [50], waste management [54] and vulnerable community difficulties [55]. On the other hand, the necessity for data-driven management of the pandemic was discussed [56;57], while the city recovery was estimated with means of an increased government force and of virtual tourism [58].

3.3. The Intelligent Cities Challenge (ICC)

The ICC was a large-scale European initiative that launched by the European Committee before the pandemic in 2019 to assist 122 selected European cities defining and developing their digital transformation strategies [2]. The ICC asked the participated cities to define their priorities in compliance with the European Green Deal, the European Bauhaus and the Upskilling and Reskilling common European strategies. Due to the outbreak, the cities participated remotely in the project activities (teleconferences, virtual rooms, and remote training), while only 80 (the 65.5 percent) of them, located in 20 member States, managed to complete the project. The analysis of their initial visions shows that only 12 cases defined a vision relative to public health or the pandemic (Table 6).

Table 6. strategic visions relative to public health or the pandemic*.

	Strategic vision
1	Healthier, cleaner, safer, and more sustainable city
2	To be a region with a resilient economy that supports companies and entrepreneurs to be able to be integrated into the global economy.
3	To become a reference on sustainability, being recognized for the responsible and efficient management of our resources, and for the respect and care of our environment"
4	To become a European reference on green economy, as sustainable and resilient territory relying on unique local assets.
5	The goal is to create a resilient city that uses technology to improve the lives of its inhabitants, ensure a healthy and sustainable environment as well as promote the city's economic opportunities and attractiveness to students and educated people.
6	Proud of its unique historical heritage and identity, the city will be known as a sustainable city of choice for people to live, work, play and visit, because of its technology, business, educational and cultural opportunities.
7	To be a city that develops sustainably, inclusive in all local dimensions, culturally attractive, a bridge of knowledge and competitive in urban transformation processes through participatory, transparent, and efficient governance.
8	For a healthier, cleaner, safer, and more sustainable city. Easy to travel by sustainable modes (Ped, Bike, Transit)
9	To facilitate access to digital tools needed for studying and accessing services; to promote cohesion at neighborhood level
10	To provide tailored assistance, when needed, to elderly citizens living in care residence or nursing homes
11	Transformation City, Resilient City
12	Resilient City

* Visions are not associated with the city for project anonymity requirements.

By the completion of the project, none of the 80 participants revised its strategic vision due to the pandemic, which can be justified by the fact that ICC did not authorize emergent strategic planning and corresponding revisions. Moreover, only the cities with the corresponding vision launched initiatives that respected the outbreak (Table 7), which questions their ability to associate their digital transformation with the city's potential to deal with future emergencies.

Table 7. city initiatives that respected the pandemic*.

	Description of The Solution	Title/Label of the Solution	Link to Vision
1	Intelligent video surveillance: Deploying intelligent cameras that allow the public space to be viewed at 360°. Associate AI with the city's surveillance cameras. Automatic number plate reading (ANPR) Emergency call points to contact the Municipal Police in case of incidents. Municipal Police mobile tools. Drone unit for the Municipal to detect illegal activities.	Safe city	For a healthier, cleaner, safer, and more sustainable city
2	Promote active ageing of the elderly, through the inclusion of innovative technology and the promo-tion of activities selected and led by professionals in the care and assistance of the elderly.	Home assistance system (in consortium with Torrent's City).	To be a region with a resilient economy that supports companies and entrepreneurs to be able to be integrated into the global economy. T
3	Zero Emissions Water Management Waste Management	Sustainable City	To become a reference on sustainability, being recognized for the responsible and efficient management of our resources, and for the respect and care of our environment"
4	Creation of Local Energy Communities and increase municipal self-consumption.	Towards energy self-sufficient municipalities	To become a European reference on green economy, as sustainable and resilient territory relying on unique local assets.
5	Establish governance mechanisms, joint initiatives, and projects to connect policy making and public money with innovation, creativity and financial resources of the private sector.	Innovation District	The goal is to create a resilient city that uses technology to improve the lives of its inhabitants, ensure a healthy and sustainable environment as well as promote the city's economic opportunities and attractiveness to students and educated people.

6	Creation of a risk management information system to create a Data Driven organization and generate a virtual network for the public administration, citizens, and local businesses.	Business and citizens digital platforms	Proud of its unique historical heritage and identity, the city will be known as a sustainable city of choice for people to live, work, play and visit, because of its technology, business, educational and cultural opportunities.
7	Actions to attract more visitors to the city and to overcome the lack of them due COVID-19 restrictions. Training in digital services (i.e. digital marketing). Implementation of a smart open mall	Smart Tourism	To be a city that develops sustainably, inclusive in all local dimensions, culturally attractive, a bridge of knowledge and competitive in urban transformation processes through participatory, transparent, and efficient governance.
10	The solution provides a comprehensive home assistance system to elderly people, which delays medical intervention and reduces physical, cognitive and social fragility. It works by voice and video and allows you to interact with the user, monitor their behavior, activate reminders, and propose social, physical and mental activities.	Home assistance system	To provide tailored assistance, when needed, to elderly citizens living in care residence or nursing homes
11	Green Economy is actively utilized in City branding, turning the city image from industrial to green and attractive also to young people. Major Circular Economy events will be organized	Image of Green City	Transformation City, Resilient City
12	Analyze the resilient capacity of urban and natural areas of our cities based on big data collection, implementation of climate change adaption methods. Long-term monitorization and performance assessment of the implanted actions and methods.	Resilient Data Driven	Resilient City

[*] Initiatives are not associated with the city for project anonymity requirements.

4. Conclusion

This paper questioned the potential changes that the Covid-19 pandemic caused to the organizations' digital transformation strategies. More specifically, this article observed a rapid digital transformation of all human and business activities during the pandemic, and it grounded two research questions: the first research question (RQ1) addressed revision to the business digital transformation strategies, value propositions and business models that the pandemic caused, while

the second research question (RQ2) concerned the revision that the pandemic obliged to city digital transformation strategies.

A multi-method research methodology was followed, and literature review evidence, which mainly published during the pandemic, highlighted management methodologies that were applied during the outbreak, while in terms of strategic reform, the strategic alignment tools were investigated instead of strategic changes or emergent strategies that the pandemic caused to the organizations.

Deeper bibliometric analyses are still quite ambiguous since most articles were based on data that were collected during the pandemic, again, which concerns a limitation for this work. However, some important trends have been extracted that provide with answer the RQs. More specifically, the analysis on the impact of the pandemic on business strategies showed that the enterprises adopted agile marketing techniques for their entrance to new digital markets and for the development of new digital products. Additionally, a second bibliometric analysis on the impact of the outbreak on business showed that the enterprises prioritized their digital transformation and the definition of sustainable business models. Additionally, they adopted emerging ICT (i.e., Ai, bigdata and analytics) to measure organizational performance and predict market demands. These findings provide with answer the RQ1.

Beyond answering the RQ1, the analyses depicted some more strategic changes that the businesses performed to ensure their sustainability, since the enterprises focused on transforming their supply chains and on moving their production lines closer to their suppliers and to their consumers. Moreover, businesses prioritized human capital and of health conditions at work, and their social responsibility.

About the second research question (RQ2), bibliometric analyses showed that the cities are being transformed to smart service providers and generate new types of digital values, via digital platforms and service co-creation with their citizens. During the pandemic the cities utilized their digital assets to share knowledge with innovation producers, they focused on their communities' digital upskilling, while they adopted emerging ICT (i.e., AI, big data and IoT) to enhance their utility services. Moreover, the cities recognized the importance of their digital transformation for enhancing their resilience and they rapidly trusted the ICT and encouraged the development of ethical ecosystems. These findings were extracted regardless the cities had launched digital transformation strategies. On the contrary, the evidence from the ICC showed that only the 65.5 (80 out of the 122 cities) percent of the participated cities managed to define their transformation strategies, none revised its strategic objectives in the face of the pandemic, while only the 15 percent of them (12 out of the 80 cities) prioritized objectives relative to the pandemic or launched corresponding initiatives. The adopted initiatives indicate some ICT-based measures that the participated cities undertook to deal with the pandemic (i.e., digital surveillance, smart tourism etc.). These findings provide with answer the RQ2.

Some future thoughts concern the collection and analysis of updated literature evidence, which were generated after the pandemic, which can validate whether the above outcomes remained, or the organizations (businesses and cities) followed different strategic directions than the ones that were highlighted in this study.

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References

1. McKinsey & Company. Looking beyond the pandemic: Could the world economy gain more than it lost to COVID-19? Available online: https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/beyond-the-pandemic-eight-charts-on-covid-19-and-the-next-phase-of-global-economic-growth# (Accessed on March 20. 2022)

2. European Commission. Intelligent Cities Challenge: Guide for Applicants. Available online: https://www.intelligentcitieschallenge.eu/sites/default/files/2020-03/ICC%20Applicant%20Guidlines_17032020.pdf (Accessed on Feb. 10 2022)

3. Snowden, F. *Epidemics and Society*. Yale University Press: New Haven and London, 2019.

4. Morse, S.A. Preventing Emerging Infectious Diseases: Epidemiology and Laboratory Capacity Support. In *Preparedness Against Bioterrorism and Re-Emerging Infectious Diseases*, Kocik, Janiak and Negut, Eds.; IOS Press: Amsterdam, 2004. NATO Science Series I: Life and Behavioural Sciences - Vol. 357.

5. Gong, Y.; Yang, Y.; Shi, X. Towards a comprehensive understanding of digital transformation in government: Analysis of flexibility and enterprise architecture. *Government Information Quarterly* **2020**, 37(3), 101487.

6. United Nations. *Demographic Yearbook 2005*, 2005. Available online: http://unstats.un.org/unsd/demographic/sconcerns/densurb/Defintion_of%20Urban.pdf (Accessed on June 10 2023)

7. International Standards Organization (ISO). *ISO 37120:2014: Sustainable Development of Communities – Indicators for City Services and Quality of Life*, 2014. Available online: https://share.ansi.org/ANSI%20Network%20on%20Smart%20and%20Sustainable%20Cities/ISO%2B37120-2014_preview_final_v2.pdf (Accessed on June 10, 2023)

8. International Standards Organization (ISO). *Sustainable Development in Communities*, 2016. Available online: http://www.iso.org/iso/iso_37101_sustainable_development_in_communities.pdf (Accessed, June 10, 2023)

9. International Standards Organization (ISO). *Smart cities Preliminary Report*, 2014. Available online: http://www.iso.org/iso/smart_cities_report-jtc1.pdf (Accessed on June 10, 2023)

10. International Telecommunications Union (ITU). *Smart sustainable cities: An analysis of definitions*, 2014. Available online: www.itu.int/en/ITU-T/focusgroups/ssc/Documents/Approved_Deliverables/TR-Definitions.docx (Accessed on March 20. 2022)

11. Anthopoulos, L. *Understanding Smart Cities - A tool for Smart Government or an Industrial Trick?* Public Administration and Information Technology, Vol. 22, Springer Science+Business Media New York, 2017.

12. Lysons, K.; Farrington B. *Purchasing and Supply Chain Management*, 2006, Prentice Hall Publishing.

13. Hertz, H. So What Is Strategic Alignment? Available online: https://www.nist.gov/blogs/blogrige/so-what-strategic-alignment (Accessed on March 24, 2022).

14. Moncrief, J. Is strategy making a difference? *Long Range Planning Review* **1999**, 32(2), pp273–276.

15. Tsilonis, T.; Wautelet, Y.; Martinet, D. Evaluating the Impact of the Covid-19 Pandemic on the Strategic Alignment Competences of Organizations: A Case Study in Logistics. *In the Springer Proceedings in Complexity* **2023**, pp. 631-643.

16. Sieber, M.R.; Russ, C.; Kurz, K. Organizational Culture and Business-IT Alignment in COVID-19: A Swiss Higher Education Case Study. *International Journal of Innovation and Technology Management* **2023**, 20(3), 2242004.

17. Wang, Z.; Esangbedo, M.O.; Bai, S. Project portfolio selection based on multi-project synergy. *Journal of Industrial and Management Optimization* **2023**, 19(1), pp. 117-138

18. Heitzlhofer, U.; Lackner, K. "How the digital world turned us into narcissistic multitaskers.": Ulrich Heitzlhofer on experiences from personnel development work during the COVID-19 crisis. *Gruppe. Interaktion. Organisation. Zeitschrift fur Angewandte Organisationspsychologie* **2022**, 53(1), pp. 125-129.

19. Dairo, M.; Adekola, J.; Apostolopoulos, C.; Tsaramirsis, G. Benchmarking strategic alignment of business and IT strategies: opportunities, risks, challenges and solutions. *International Journal of Information Technology (Singapore)* **2021**, 13(6), pp. 2191-2197.

20. Hou, H.; Remøy, H.; Jylhä, T.; Vande Putte, H. A study on office workplace modification during the COVID-19 pandemic in The Netherlands. *Journal of Corporate Real Estate* **2021**, 23(3), pp. 186-202.

21. Amankwah-Amoah J.; Khan, Z.; Wood, G. COVID-19 and business failures: The paradoxes of experience, scale, and scope for theory and practice. *European Management Journal* **2021**, 39(2), pp. 179-184.

22. Donthu, N.; Kumar, S.; Debmalya, M.; Nitesh, P.; Weng Marc, L. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research* **2021**, 133, pp. 285-296, https://doi.org/10.1016/j.jbusres.2021.04.070

23. Donthu, N.; Gustafsson, A. Effects of COVID-19 on business and research. *Journal of Business Research* **2020**, 117, pp. 284-289.

24. He, H.; Harris, L. The impact of Covid-19 pandemic on corporate social responsibility and marketing philosophy. *Journal of Business Research* **2020**, 116, pp. 176–182

25. Wenzel, M.; Stanske, S.; Lieberman, M.B. Strategic responses to crisis. *Strat Mgmt J.* **2020**, 41, pp. V7-V18

26. Kirk, C.P.; Rifkin, L.S. I'll trade you diamonds for toilet paper: Consumer re-acting, coping and adapting behaviors in the COVID-19 pandemic. *Journal of Business Research* **2020**, 117, pp. 124–131

27. Gössling, S. Tourism, technology and ICT: a critical review of affordances and concessions. *Journal of Sustainable Tourism* **2021**, 29:5, pp. 733-750.

28. Gössling, S.; Schweiggart, N. Two years of COVID-19 and tourism: what we learned, and what we should have learned. *Journal of Sustainable Tourism* **2022**, 30:4, pp. 915-931, DOI: 10.1080/09669582.2022.2029872

29. Zhang, D.; Hu, M.; Ji, O. Financial markets under the global pandemic of COVID-19. *Finance Research Letters* 2020, 36, 101528.

30. Baker, S.R.; Bloom, N.; Davis, S.J.; Sammon, M.; Viratyosin, T. The Unprecedented Stock Market Reaction to COVID-19. *The Review of Asset Pricing Studies* **2020**, 10, pp. 742–758

31. Goodell, J.W. COVID-19 and finance: Agendas for future research. *Finance Research Letters* **2020**, 35, 101512.

32. Nicola, M.; Alsafi, Z.; Sohrabi, C.; Kerwan, A.; Al-Jabir, A.; Iosifidis, C.; Agha, M.; Agha, R. The socio-economic implications of the coronavirus pandemic (COVID-19): A review. *International Journal of Surgery* **2020**, 78, pp. 185-193.

33. Bartik, A.W.; Bertrand, M.; Cullen, Z.; Glaeser, E.L.; Luca, M.; Stanton, C. (2020). The impact of COVID-19 on small business outcomes and expectations. *PNAS* **2020**, 117(30), pp. 17656–17666

34. Wojnicka-Sycz, E.; Piróg, K.; Tutaj, J.; Walentynowicz, P.; Sycz, P.; TenBrink, C. From adjustment to structural changes – innovation activity of enterprises in the time of COVID-19 pandemic, Innovation. *The European Journal of Social Science Research* **2022**, DOI: 10.1080/13511610.2022.2036951

35. Vial, G. Understanding digital transformation: A review and a research Agenda. *Journal of Strategic Information Systems* **2019**, 28, pp. 118–144.

36. Verhoef, P.C.; Broekhuizen, T.; Bart, Y.; Bhattacharya, A.; Dong, J.Q.; Fabian, N.; Haenlein, H. Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research* **2021**, 122, pp. 889–901.

37. Livari, N.; Sharma, S.; Ventä-Olkkonen, L. Digital transformation of everyday life – How COVID-19 pandemic transformed the basic education of the young generation and why information management research should care? *International Journal of Information Management* **2020**, 55, 102183.

38. Soto-Acosta, P. COVID-19 Pandemic: Shifting Digital Transformation to a High-Speed Gear. *Information Systems Management* **2020**, 37:4, 260-266.

39. Priyono, A.; Moin, A.; Oktaviani Putri, V.N.A. Identifying Digital Transformation Paths in the Business Model of SMEs during the COVID-19 Pandemic. *J. Open Innov. Technol. Mark. Complex.* **2020**, 6, 104.

40. Fletcher, G.; Griffiths, M. Digital transformation during a lockdown. *International Journal of Information Management* **2020**, 55, 102185.

41. Li., F. The digital transformation of business models in the creative industries: A holistic framework and emerging trends. *Technovation* **2020**, 92–93, 102012

42. Barrutia, J.M.; Echebarria, C. Effect of the COVID-19 pandemic on public managers' attitudes toward digital transformation. *Technology in Society* **2021**, 67, 101776.

43. Maiurova, A.; Kurniawan, T.A.; Kustikova, M.; Bykovskaia, E.; Othman, M.H.D.; Singh, D.; Goh, H.H. Promoting digital transformation in waste collection service and waste recycling in Moscow (Russia): Applying a circular economy paradigm to mitigate climate change impacts on the environment. *Journal of Cleaner Production* **2022**, 354, 131604.

44. Calvo, P. The ethics of Smart City (EoSC): moral implications of hyperconnectivity, algorithmization and the datafication of urban digital society. *Ethics and Information Technology* **2020**, 22, pp. 141–149

45.   Dryhurst, S.; Schneider, C.R.; Kerr, J.; Freeman, A.L.J.; Recchia, G.; van der Bles, A.M.; Spiegelhalter, D.; Sander van der Linden. Risk perceptions of COVID-19 around the world. Journal of Risk Research **2020**, 23:7-8, pp. 994-1006.

46.   Tuli, S.; Tuli, S.; Tuli, R.; Gill, S.S. Predicting the growth and trend of COVID-19 pandemic using machine learning and cloud computing. *Internet of Things* **2020**, 11, 100222

47.   Allam, Z.; Jones, D.S. On the Coronavirus (COVID-19) Outbreak and the Smart City Network: Universal Data Sharing Standards Coupled with Artificial Intelligence (AI) to Benefit Urban Health Monitoring and Management. *Healthcare* **2020**, 8, 46.

48.   Dwivedi, Y.K.; Hughes, D.L.; Coombs, C.; Constantiou, I.; Duan, Y.; Edwards, J.S.; Gupta, B.; Lal, B.; Misra, S.; Prashant, P.; Raman, R.; Rana, N.P.; Sharma, S.K.; Upadhyay, N. Impact of COVID-19 pandemic on information management research and practice: Transforming education, work and life. *International Journal of Information Management* **2020**, 55, 102211.

49.   Belhadi, A.; Kamble, S.; Jabbour, C.J.C.; Gunasekaran, A.; Ndubisi, N.O.; Venkatesh, M. Manufacturing and service supply chain resilience to the COVID-19 outbreak: Lessons learned from the automobile and airline industries. *Technological Forecasting & Social Change* **2021**, 163, 120447

50.   Abu-Rayash, A.; Dincer, I. Analysis of mobility trends during the COVID-19 coronavirus pandemic: Exploring the impacts on global aviation and travel in selected cities. *Energy Research & Social Science* **2020**, 68, 101693.

51.   Chowdhury, P.; Paul, S.K.; Kaisar, S.; Moktadir, M.A. COVID-19 pandemic related supply chain studies: A systematic review. *Transportation Research Part E* **2021**, 148, 102271

52.   Pantano, E.; Pizzi, G.; Scarpi, D.; Dennis, C. Competing during a pandemic? Retailers' ups and downs during the COVID-19 outbreak. *Journal of Business Research* **2020**, 116, 209–213.

53.   Adam, M.G.; Tran, P.T.M.; Balasubramanian, B.. Air quality changes in cities during the COVID-19 lockdown: A critical review. *Atmospheric Research* **2021**, 264, 105823.

54.   Chauhan, A.; Jakhar, S.K.; Chauhan, C. (2021). The interplay of circular economy with in-dustry 4.0 enabled smart city drivers of healthcare waste disposal. *Journal of Cleaner Production* **2021**, 279, 123854.

55.   Pineda, V.S.; Corburn, J. Disability, Urban Health Equity, and the Coronavirus Pandemic: Promoting Cities for All. *J Urban Health* **2020**. https://doi.org/10.1007/s11524-020-00437-7

56.   Allam, Z.; Jones, D.S. Pandemic stricken cities on lockdown. Where are our planning and design professionals [now, then and into the future]? *Land Use Policy* **2020**, 97, 104805

57.   Shorfuzzaman, M.; Hossain, M.S.; Alhamid, M.F. Towards the sustainable development of smart cities through mass video surveillance: A response to the COVID-19 pandemic. *Sustainable Cities and Society* **2021**, 64, 102582.

58.   Kunzmann, K.R. Smart Cities After Covid-19: Ten Narratives. *disP - The Planning Review* **2020**, 56:2, pp. 20-31, DOI: 10.1080/02513625.2020.1794120