The Role of Leadership and Decision-Making under Crisis: A Bibliometric Analysis and Scientific Evolution from 1962 to 2020

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Abstract
The unprecedented importance of leadership and decision-making under recent pandemic and economic crises boosts the development of this research domain. This study shed light on the published works of leadership and decision-making under crises which have had the greatest contribution and evolutionary scientific paths over the decades, which are: (1) inspect the scientific anatomy of earlier works and their main structures; (2) scrutinize the scientific trends and the evolutionary path, and (3) recognize theoretical and practical implications. This study generates its analysis based on R programming language with a package of ‘bibliometrix’ (a) multidimensional data analysis, (b) intellectual structure and network analysis, (c) conceptual structure and factorial analysis, (d) strategic diagrams and evolution maps, and (e) historical citation network and research collaboration across the world. From this bibliometric study covering 692 articles published in the academic journal from 1962 to 2020, the findings open up an opportunity of how leaders overcome plausible crises by making the right decision through organizational resources, technological capability, people management. Subsequently, the findings can explain the way decisions are made so that prevent the potential crisis in the stage of planning and lessening the harm in the stage of crisis intervention. For theoretical contributions, it appears that future research needs to explore the emerging themes of data mining, artificial intelligence, information system, and information management. In the era of the COVID-19 pandemic, healthcare and crisis management are likely to be addressed by unleashing cutting-edge digital technology such as Artificial Intelligence (AI), Machine Learning (ML), and Internet of Things (IoT).

Keywords
Leadership; decision-making; crises; financial; health; management; digital technology

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Introduction
The importance of academic leadership and decision has been widely recognized through an interdisciplinary field of research even from the beginning, whether from psychology, organization, or strategic management (Eisenhardt & Zbaracki, 1992; Papadakis et al., 1998). Given its relevance, research on leadership seems to have flourished as the field of study evolved. Understanding the state-of-the-art,
interdisciplinary approach, and implication of leadership and decision field, broadly understood as an enrichment of scientific findings, plays important role in lessening harm under recent pandemic and economic crises for scholars, practitioners, and policymakers.

Despite many literature reviews on these fields, most of them applied a qualitative analysis. Hence, the results and implications for the research are subject to several limitations, for instance, a possibility of scientific fragmentation (Skute, 2019) and subjective views (Ramos-Rodríguez & Ruíz-Navarro, 2004). In addition to that consequence, caution should be applied when generalizing the results (Blanco-Mesa et al., 2017; Bragge et al., 2010; Qaiser et al., 2017; Yu et al., 2018, Patria et al., 2019). For this reason, it is necessary to address a classical problem through an objective approach such as the quantitative computing techniques.

This study applies a computational bibliometric analysis by collecting 692 manuscripts published in academic journals over 58 years, from 1962 to 2020. This method, which has been acknowledged for over a decade, accommodates the aims to perform a systematic view of the entire picture of the state-of-the-art of published works of leadership and decision-making which have had the greatest contribution.

**Literature Review**

The bibliometric method is an important science mapping technique used in the field of bibliometrics (Cobo et al., 2011, 2012; van Eck & Waltman, 2009). When it comes to bibliometric analytics, it is commonly used to measure the influence and the similarity of citation analysis, co-citation analysis, author analysis, co-author analysis, and bibliographical coupling (Zupic & Čater, 2015). A standard workflow comprises of four stages, which are: study design, data compilation, visual analysis, and interpretation (Zupic & Čater, 2015; Aria & Cuccurullo, 2017).

Amidst the COVID-19 pandemic, leadership and technology in the field of healthcare play important role. The leaders are supposed to deal with complex and chaotic situation by re-inventing the solution through the cutting-edge technology such as Artificial Intelligence (AI), Machine Learning (ML), and Internet of Things (IoT). These digital technology are deployed from descriptive to predictive analytics to fight against the new diseases (Loey et al., 2020; Vaishya et al., 2020).

Despite some of research using technology organization environment (TOE) framework, there is still a gap on how the leadership and technology come to an end in order to tackle any substantial issues from technological readiness to organizational change. In this vein, various problems obstructing the effective use of advanced artificial intelligence (i.e., machine learning, deep learning) for leadership and decision-making research can be revealed. Further to the above implications, it seems imperative for future regional or global analysis to be performed by taking into account the context of emerging countries, instead of merely focusing on particular fields such as clinical and healthcare research. By combining the research on leadership and decision with other fields, a more holistic analysis in understanding interdisciplinary perspectives of leadership and decision research can be accomplished. From this standpoint, it may also enrich queries and keywords which can further reveal the diverse scientific themes of decision-making (Cobo et al., 2018). Last, the evolution of the research themes could be studied by using other scientific tools such as the web of science (WoS) as one approach to expanding on the articles published. It is one of the most imperative bibliographic datasets applied over the last ten years (Cobo et al., 2018).
Research Methodology

This study utilized bibliometric tools for constructing the intellectual structure and the evolution of strategic decisions. This study applied R programming language with a package of ‘bibliometrix’ (a) multidimensional data analysis using the Sankey Diagram, (b) intellectual structure and network analysis, (c) conceptual structure and factorial analysis using the Dendrogram, (d) strategic diagrams and evolution maps, and (e) historical citation network and research collaboration across the world (Aria & Cucurullo, 2017).

To determine the scope and validity of the bibliometric analysis, this study also applies the inclusion and exclusion criteria. They are conceptually defined and then applied. In line with the conceptual background and objective of this study, the inclusion criteria were collecting earlier articles indexed by Scopus. The detailed technique depicting these inclusion criteria was explained using key terms in the given Boolean logic. In contrast, the exclusion criteria were derived from the contexts of particular fields of management, which are ‘decision’, ‘decision-making’, ‘decision and making’, ‘leadership’, ‘leader’ texted in Scopus search engine. Further to the criteria, the period of publication dating from 1962 to 2020 was also added to exclude other publications that go beyond the selected period.

Data Collection

The datasets of selected articles were analyzed into key features, types of documents, contents, authors, and their collaboration. Table 1 summarizes the main features of datasets applied in this bibliometric study. The collected articles contain 692 of published articles, gathered from multiple sources of journals in the given period of 1962 to 2020.

According to key features, the selected articles were published by authors, 12 of average years from publication. The findings indicate that there might be less attention paid in this field of research.

Table 1. Asia Pacific Management and Business Application

| Key features                        | 1962:2020 |
|-------------------------------------|-----------|
| Period                              | 1962:2020 |
| Journal sources                     | 692       |
| Average years from publication      | 11.9      |
| Average citations per document      | 14.42     |
| Average citations per year per document | 1.301     |
| Average occurrences of words per document | 2.047     |
| References                          | 14887     |

Source: Author

Despite of this lack attention, the articles were relatively cited with 14.42 of average citations per document. Therefore, the results indirectly indicate that research on decisions under crises has a potential contribution in the future. According to the type of documents, the articles had dominated the publication with keywords introduced by publishers. In light of authors and their collaborations, many authors researched collaboratively with co-authors.
Preliminary Analysis

The research datasets consist of hundreds of academic publications, and bibliometric datasets which included authors, abstract, keywords, citations, year, and affiliations gathered based on key terms and the Boolean logic, namely: The principal keywords often used in the first element are: ‘decision’, ‘decision-making’, ‘decision and making’, ‘leadership’, ‘leader’. The key terms filtered the articles relied on their occurrences found either in the title, keywords, or abstracts. For collecting the datasets, it is necessary to retrieve articles from the online Scopus database which is recognized as covering a wide range of high-impact ranking journals through the peer-reviewed process.
To perform a scientific evolution in a given longitudinal analysis, a total of 542 articles were generated over 58 years, from 1962 to 2020. The finding demonstrates that the field of leadership and decision-making (LDC) has rapidly attracted practitioners and scholars. Figure 1 illustrates the scientific growth which also highlights the total number of published articles. The result also reveals that before 1990, publications were relatively intermittent. Significant growth of articles published was found between 2010 and 2019 while the peak can be seen in 2019.
Results and Discussion

Multidimensional analysis and interconnection among bibliometric elements

The most influential authorship (left side), themes (middle side), and the cited publishers (right side) reveals the multidimensional elements of bibliometric findings. The path among bibliometric features demonstrates a bibliometric interconnection in the field of leadership and decision-making (LDC). The thicker the arrow of elements, the greater the amount of bibliometric interconnection involved. This Sankey diagram for this field of research shows that most influential themes ranging from ‘decision making’, ‘crisis management’, ‘decision support systems’, ‘leadership’, ‘disaster planning’, ‘information management’, ‘information systems’, ‘artificial intelligence’, ‘decision supports’, ‘human’, and ‘organization and management’. These words indicate that LDC works have been going through multidisciplinary perspectives (Patria, 2020).

Secondly, the Sankey diagram also found the most influential scholars (left side) which are: Baumann, Drosio, Benaben, Barthe-Delanoe, Turoff, Wang X, Matta. Last, these manuscripts can be found in the most influential publisher ranging from proceedings of the international iscram conference, journal of business continuity & emergency planning, safety science, and journal of contingencies and crisis management. The findings confirm a difference in the level of fragmentation among authors, themes, and publishers. Research works and scientific themes in the field of LDC are a relatively wide range of multidisciplinary fields and authors. On the other hand, these works are relatively fragmented.

Another Sankey diagram indicates research progress in the field of LDC across countries and affiliations. The findings reveal that the research works on this topic were fragmentally conducted by a wide range of research institutions: University of Texas, Tsinghua University, Taiwan, King’s College London, and Universiteit de Toulouse. The results also demonstrate that the keywords were studied by those affiliations in the USA, United Kingdom, Taiwan, France, China, Brazil, and Canada. The local citations reflect the cited frequencies of local cited authors (Aria & Cuccurullo, 2017). Table 2 summarizes the findings ranging from the leadership, management, psychology, and conflict management journals. The local citations are searched by reference items and DOIs. In light of the field of the authors found, most research works were performed in the field of management and psychology.
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The most productive authors can be found in Figure 4. The findings demonstrate that most of the research works on LDC have been scrutinized for decades. Despite this long period of this interdisciplinary study (e.g., JR, Baumann, Rosenthal, Pillai R.), most of the works were aggressively explored in the last 10 years. These researches were performed by several scholars Boin, Drosio, Li Hl, Hugerot, Jong, Loriette, Matta, Sediri, and Stanek.

Intellectual Structure and Network Analysis
This study applies a network analysis using VOS Viewer and R ‘bibliometrix’ for co-Word Network analysis for discovering many intellectual elements of the LDC field within scientific networks. The keywords of the selected manuscripts were then analyzed found in Figure 5. The results cover a wide range of key themes, namely: ‘decision-making’ (454.98 centralities), ‘human’ (90.29 centralities), ‘crisis management’ (40.04), ‘leadership’ (13.82 centralities), ‘disasters’ (9.25 centrality), ‘decision support systems’ (9.16 centralities).

The network has two major clusters. The first consists of decision clusters (e.g., decision-making, decision support systems, crisis management, artificial intelligence, information management). The second contains leadership cluster (e.g., leadership, human, gender male and female, crisis intervention, disaster planning). The common keywords used throughout the years were ‘decision-making’, ‘leadership’, ‘crisis management’, ‘decision support system’, and ‘human’. The preliminary findings also support the methodological selection for articles related to the role of leadership and decision-making capability addressing plausible problems under crises.

The results also reveal the exponential growth of the (LDC) field in the last decade. In light of the objective of this study, decision-making becomes a center of excellence among other thematic terms,
followed by crisis management and leadership. On the other hand, there are emerging thematic terms found in the last ten years including artificial intelligence, human dan decision support systems. The rest also reveals that academics already take into account the role of gender which is widely applied as a control variable in research settings. Hence, it can be enhanced what kind of difference in terms of the decision process and outcome in the cases of crisis management.

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Figure 6 demonstrates a network analysis and scientific trends throughout the period of time. Most of the scientific themes found in the first cluster of decision-making were performed in the last 5 years. While most of the scientific words found in the second cluster of leadership were conducted in the last 10 years. Moreover, a number of networks between clusters and among scientific themes indicate the importance of an interdisciplinary field between leadership and decision-making. These interconnections demonstrate works on how a leader as a subject of decision-making can address the crisis in the organization (Patria, 2020).

The interdisciplinary works between leadership and decision-making were widely developed by scrutinizing a number of new scientific themes. These key words varied throughout the period of time, for instance, behavioral research, qualitative research, disaster prevention, risk assessment, artificial intelligence, public health, policymaking, health care policy.
during 2010-2020. Besides, these words covered some psychological aspects, crisis intervention, problem-solving, and emergency before 2000. The findings reveal a scientific evolution of leadership and decision-making from traditional themes of psychological and crisis aspects to revolutionary technological transformation such as artificial intelligence, information management, information systems.

Figure 6. Scientific Evolution of Leadership and Decision under Crises
**Conceptual Structure and Factorial Analysis**

To further the trend of the published articles, this study analyzed the conceptual structure and factorial analysis based on the bibliographic coupling results. The method refers to the Multiple Correspondence Analysis (MCA) method that performs factor analysis. The technique aims to summarize and visualize a data table that contains more than two categorical variables.

In general, MCA is widely used to scrutinize a cluster of scientific elements that similar profile and their associations among others (Aria & Cuccurullo, 2017). Figure 7 depicts two major structures by examining the most frequent words found in the publication’s abstracts. The result reveals two clusters relied on dissimilarity of the terms (dim), namely (i) decision and information cluster; and (ii) clinical decision and crisis intervention cluster.

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**Cluster 1: the anatomy of decision and information**

According to Figures 7, the first cluster focus on decision and information development applied to improve decision outcomes under crisis. The research in this cluster shed some light on investigating the way decisions made and the necessary antecedents to prevent or lessen the harm of environmental, health, economic, and financial crises. The result comprises of sub-clusters which are classified into people, organization, process, and technology, system or infrastructure.
The first sub-cluster is relatively associated with several keywords on the left side of a red cluster, which are: ‘decision-making’, ‘decision-making process’, ‘decision-makers’, ‘crisis’, ‘disasters’, ‘decision support systems’, ‘emergency response’, ‘risk management’, ‘disaster management’, ‘disaster prevention’, ‘information system’, ‘information management’, ‘crisis management’, ‘emergency response’, ‘decision support systems’, ‘information management’, ‘disaster management’, ‘disaster prevention’, ‘computer simulation’, ‘decision trees’, ‘artificial intelligence’, ‘forecasting’, ‘data mining’, ‘financial crisis’. While the right side of this cluster consists of several words related to healthcare management such as ‘healthcare personnel’, ‘patient care team’, ‘decision support techniques’, ‘emergency health service’, ‘healthcare policy’, ‘organization’. With these findings, it can be concluded that the first cluster reveals how the leader and organization make the right decision facing environmental, health, and financial crises by managing organizational resources, organizational assets, technological capabilities, systems, and procedures. Hence, to successfully enhance decision outcomes under crises, one must realize that the main thematic areas in these sub-clusters are relatively dynamic in a given multistage process, from disaster planning to crisis management. A further implication is necessary to take into account a different approach, knowledge, perspectives, and organizational resources both an organizational asset (people, data, and technology) and processing capability by modernizing computing technology at the edge of artificial intelligence, data mining, and information management.

Cluster 2: the emergence of decision under the clinical context
The second cluster consists of clinical decision-making, namely people sub-cluster (‘adult’, ‘male’, ‘female’, ‘human’), process sub-cluster (‘clinical decision making’, ‘crises intervention’, ‘major clinical study’), and technology systems (‘procedures’) in the interdisciplinary field of leadership and decision. The second indicated sub-theme shed some light on the roles of decision elements such as gender and age as control variables, risk assessment in the stage of planning, and crisis intervention when lessening the harm caused by the clinical crisis.

Compared to the first cluster discussed above, there are a few conceptual terms found in the second cluster. This cluster focuses on risk planning and crisis intervention of decisions under clinical cases. Hereafter, it could be noticeably revealed that there is room for further research on risk assessment and crisis intervention in the field of the clinical study. This study also applied Dendrogram for depicting hierarchical elements of those two clusters. This analysis estimated a dissimilarity of merged conceptual terms with others through the Ward algorithm approach. The findings reveal that sub-clusters of main decision cluster, namely: people (e.g., managers, crisis management, decision-makers, interoperability, data mining), research domain (e.g., research, disasters, crisis, uncertainty analysis, financial analysis), decision systems, and process (e.g., information systems, information management, disaster prevention, decision supports, decision-making process), healthcare and crisis context (e.g., health care policy, emergencies, health policy, government, psychological aspect, leadership, communication).
Figure 8. Factorial Analysis using Topic Dendrogram

Figure 9. Factorial Analysis using Topic Dendrogram
Scientific Production and Collaborative Development

This study also covered a knowledge diffusion of the interdisciplinary field of leadership and decision-making (LDC) across countries that were related to the scientific articles. The results discover a global collaboration among regions such as the United States, UK, Australia, and China. Despite the collaboration, the scientific works are exclusively concentrated on developed countries such as the United States and the UK. Concerning academic institutions, it is found that both countries have the largest number of universities that reflect the intellectual capital and academic supports in the field of decision under crises.

According to scientific production depicted in Figure 9, the center of research development in this field is distributed across countries excluding African, South American, and the former Soviet Union. The United States and the UK are the key anchors where the researchers actively performed extant research works and scientific publications. In general, scientific production is associated with developed countries that have larger and more reputable research institutions. Without a doubt, these two developed regions are the scientific leader in this research field with the best indicator indicated by productivity in all the dimensions we had evaluated.

Another high interest that relates to the published works and development is a collaboration among researchers and institutions across countries. Among the noted activities, the study focusing on decisions under crises was investigated collaboratively on a regional. These results also show a series of directions depicting research activities published and knowledge spillovers at a national level. According to the size of the direction, the highest collaboration is found between academics or scientists performed research and published works in two major countries, the United States and the United Kingdom.

Discussion and Contribution

In this study, the findings have stressed the importance of addressing some forthcoming works that could provide implications and directions for practical implications and future research recommendations. Over the years of studies conducted, academics and scholars have observed that very few studies have focused on an interdisciplinary study of leadership and decision-making. Based on this lack, it is imperative to know the relationship between these themes of how leaders overcome plausible crises by making the right decision. For instance, how capability, people, and technology interplay so that prevent or at least lessen the harm of crises?

In line with the latest findings, there has been a sort of studies that encourage the role of system and technology modeling a crisis (Fertier et al., 2020; Maalel et al., 2019; Slam et al., 2015), team and leadership (Alkharabsheh et al., 2014, Sommer et al., 2007). Secondly, it is necessary to figure out integration and reconfiguration among these complementary organizational assets, decision-making, and leadership capability (Maalel et al., 2019; Slam et al., 2015; Saraswati & Patria, 2021). Subsequently, the findings can explain the way decisions are made so that prevent the potential crisis in the stage of planning and lessening the harm in the stage of crisis intervention. For instance, Slam et al. (2015) introduced a decision-support framework for mitigating the crisis through integrating learning mechanisms, knowledge base, and reasoning mechanisms.

Next, it appears that future research needs to explore the emerging themes of data mining, artificial intelligence, information system, and information management. In the era of the COVID-19 pandemic, healthcare and crisis management are likely to be addressed by unleashing cutting-edge digital technology such as Artificial Intelligence (AI), Machine Learning (ML), and Internet of Things (IoT) to fight against the new pandemic challenges (Loey et al., 2020; Vaishya et al., 2020). Also, it is
necessary to understand if there were any substantial barriers and challenges involved when applying the advanced technology and innovation in making decisions. This may also raise issues on the kind of technological readiness and organizational change (Saraswati & Patria, 2021). From this, various problems obstructing the effective use of advanced artificial intelligence (i.e., machine learning, deep learning) for leadership and decision-making research can be revealed.

Further to the above implications, it seems imperative for future regional or global analysis to be performed by taking into account the context of emerging countries, instead of merely focusing on particular fields such as clinical and healthcare research. By combining the research on leadership and decision with other fields, a more holistic analysis in understanding interdisciplinary perspectives of leadership and decision research can be accomplished (Patria, 2020).

From this standpoint, it may also enrich queries and keywords which can further reveal the diverse scientific themes of decision-making (Cobo et al., 2018). Last, the evolution of the research themes could be studied by using other scientific tools such as the web of science (WoS) as one approach to expanding on the articles published. It is one of the most imperative bibliographic datasets applied over the last ten years (Cobo et al., 2018).

**Limitation of the Study**

Despite the evidence generated in this study to support the conclusion and implications, this study is also constrained in some ways. First and foremost, the complex nature of the leadership and decision-making (LDC) and used within interdisciplinary research serves as the limitation, particularly in the selection of datasets (Nooraie, 2008).

Second, by focusing only on the Scopus retrieval system, this study is also restricted by publications of different sources. In reality, many articles related to LDC had also been published out of the Scopus retrieval system. In addition to the database limitation, the datasets were gathered using generic key terms merely found in either the title or abstracts only. This kind of limitation is common in bibliometric studies (Chen et al., 2012), hence there is a need to concentrate on this gap for interpretability and generalizability of the findings.

Nonetheless, despite the limitations, the findings had visualized the intellectual structure and evolution of decision in the stage of crisis planning and intervention in different settings including the mainstream case of economic and finance and clinical sectors. Future research may consider assessing the generalizability of these findings by implementing the approach in different situations and settings.

**Notes on Contributor**

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