



Relationship of Airports, Population, Competitiveness Indexes, and Human Development with Confirmed and Deceased Cases by COVID-19: Need for Transdisciplinary Systemic Decisions

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Received April 2, 2020; Revised April 19, 2020; Accepted April 21, 2020

Available online April 21, 2020 at www.atlas-journal.org, doi: 10.22545/2020/00135

In the face of the global crisis as a result of the COVID-19, with more than a million cases confirmed today, it is necessary to make the best decisions by world organizations, governments and authorities in nations, localities, families and individual level, etc. for survival and reduction of pain and uncertainty. In this way, the relationship of some variables with confirmed cases and deaths could be useful for decision makers. In this study, it is proposed to relate variables such as human development index, population quantity, area, competitiveness index and number of airports (including airfields and flight paths) of 14 countries in the region of Asia and 24 in the Americas.

The statistical method used for analysis was Principal Component Analysis, PCA. According to the evaluated variables, it was found that for the countries of Asia and the Americas; the variables with the highest correlation ($R > 0.96$) with the number of confirmed cases and deaths are the variables of population and number of airports (including airfields and flight paths). For both Asia and the Americas, there was a positive correlation between the number of confirmed cases and deaths and the competitiveness and human development index. The correlation of these variables is lower for countries in the Asia region with respect to the Americas. On the other hand, it was found second fortnight of March had drastic changes in the rise in the number of confirmed cases and deaths, as well as in the spread of contagion in more countries. It is interesting to become aware of the impact of individual or local decisions on what can happen in a devastating way in the world. In this way more than ever systemic decisions are necessary for the future and survival of humans.

Keywords: Systematic decisions, number of airports, confirmed cases with COVID-19, principal component analysis, variable correlation.

1 Introduction

Faced with the current problem of COVID-19 disease, where man is in terrible vulnerability, impotence and lack of knowledge; as well as human pain and poly-crisis, among other the economic and social. More than ever, learning to decide systemically is required, and awareness of how individual or group decisions can lead to a global crisis. An event that occurred in a market of the Hubei-Province, specifically in Wuhan city, at last December, caused the appearance of pneumonia cases starting with seller's pneumonia on December 8, 2019 (Cossarizza et al., 2020; Who-Report 1, 2020) [1-2]. As of December 31, it was reported to the World Health Organization (WHO), and in this way an outbreak began, which was declared by this organization as pandemic on March 11, previous declaration of January 30 as an epidemic and a public health emergency of international concern (WHO-Report 59, 2020) [3].

Perhaps within all this tragedy unprecedented in the history of humanity, one could reflect on an urgent need for man to modify his way of deciding. It is necessary to walk towards what would be systemic-transdisciplinary decision processes, to propose the various alternatives towards the best ways of solving real-world problems [4-7]. This 2020 pandemic started with individual, group, and local decisions, and had repercussions at the planetary level. Three months after the outbreak began, it spread to almost 181 countries worldwide with 1,013,157 confirmed cases (UJH, 2020-April 2) - [8]. It is when one observes the complexity of the systems, and their perfect interconnection of everyone with everyone and the repercussion of individual or group decisions with a whole, regardless of the kilometers of distance to which the decision maker is.

It is necessary to rethink, how are decisions made? Under what holistic awareness of the impact is decided on a day-to-day basis or about the consequence of the decision in the future? What would be the impact on the different systems? Right now; what you are deciding to do, deciding to think, deciding to buy, deciding to sell, deciding to say, deciding to feel, deciding to invent, deciding to have, proposing, etc. Do you think about your consequences?

Focused on who we decide, in ourselves or in others, in economic interests or in man. On what or who do we base our decision? And, as the individual decisions, it can affect the other (close), the other (distant) and the other (environment). In this study, some characteristic variables of 14 countries in Asia and 24 in the Americas are related to the number of confirmed and deceased cases as of March 29. Discussing some aspects related to the importance of systemic decisions, in case of decisions of the COVID-19 pandemic problem that is experienced globally.

A global problem, such as the one experienced, has multiple impacts, but especially life and death, due to the disease itself or the problems associated with the pandemic. In general, it could have repercussions and impacts on the near or distant future in different dimensions of life; to country level or the industry, economically level, educationally, nationally, to emotionally level, mental health, etc.

This event has shaken the world, where decisions are relevant within each country, within each state, each community and each individual. In this way, adopting systemic transdisciplinary approaches is the way to make the best decisions. It is useful to use methods that help visualize multivariable problems to assess the relationships of variables and support decision-making.

Etymologically, deciding comes from the Latin *decidere*, 'cut', 'decide, resolve'. So today decision makers have to "solve" a problem. For which to have more analysis of variables, in this case correlations of variables related to the confirmed cases with COVID-19 and number of deceased could support to continue adding elements that allow better decision and to move towards transdisciplinary systemic decisions (TSD) where the one that makes the decision, the executor of it, i.e. the decision maker is of vital importance: his values and conscience, his self-investigation and his self-transformation towards a systemic thought is essential. In a systemic crisis, systemic decisions are required and for systemic decisions, a TDS focus on the decision maker or group of decision makers helps.

2 Materials and Methods

In this study, 24 countries in the region of the Americas (USA, Canada, Brazil, Chile, Ecuador, Peru, Mexico, Colombia, Panama, Argentina, Costa Rica, Uruguay, Dominican Republic, Venezuela, Honduras, Bolivia, Jamaica, Paraguay, Guatemala, Trinidad and Tobago, Barbados, Haiti, El Salvador and Nicaragua) and 14 of region of Asia (China, Republic of Korea, Australia, Malaysia, Japan, Philippines, Singapore, New Zealand, Viet Nam, Brunei Darussalam, Cambodia, Mongolia, Lao People's Democratic Republic, Fiji and Papua New Guinea) were characterized by confirmed cases with COVID-19 (CC), total deaths (D) (as of March 29), human development index (HDI), population, area, competitiveness index (CI) and number of airports (included airfields and runways) (NA) according to data from the World Health Organization, the United Nations, World Economic Forum, and the US Central Intelligence Agency (WHO-Report 69, 2020; UN, 2020; FEM, 2019; ACI, 2013) [9-13].

2.1 Statistical Analysis

The principal component analysis method was applied, where the percentage variability explained by each component were determined (Tadesse and Bekele, 2001) [14]. Variable correlation circle and factor map where clusters are formed using software R, R commander and FactoMiner (R Commander version 2.6-2) and Fitopac (version 2.1).

3 Results and Discussion

The countries formed various clusters based on their behavioral similarities in the evaluated variables: confirmed cases, death quantity, human development index, population, area, competitiveness index and # of airports (included airfields and runways). In the case of 14 Asian countries, three clusters were formed (Figure 1a): 1 (Philippines, Viet nam, Cambodia, Mongolia, Lao People's, Democratic Republic, Papua New Guinea), 2 (Republic of Korea, Australia, Malaysia, Japan, Singapoure, New Zealand, Brunei Darussalam) and 3 (China). Cluster 3 is characterized by the highest values in relation to confirmed cases, deaths, population and airports (Included airfields and runways), which is distant from the other countries represented by the distance of its representation in main component with respect to the other points of the other countries having the lowest values: the countries that make up cluster (1). Cluster 2 is characterized by the highest rates of human development index and competitiveness. Cluster 1 is characterized by the lowest rates of human development index and competitiveness.

In the Americas region, the 25 countries formed four clusters (Figure 1b): 1 (Venezuela, Honduras, Bolivia, Paraguay, Guatemala, Haiti, El Salvador, and Nicaragua) 2 (Chile, Ecuador, Peru, Mexico, Colombia, Panama, Argentina, Costa Rica, Uruguay, Dominican Republic, Jamaica, Trinidad and Tobago and Barbados), 3 (Canada and Brazil) and 4 (United States of America). Cluster 4 has the highest values of the variables CC, D, NA. The countries with the lowest values in these variables were those that make up cluster 1.

Figure 2 presents the circle of correlations of the variables evaluated in this study, where it is possible to observe that for the Asia region (Figure 2a), there is an absolute positive correlation (Angle formed between them is less than 15° , so the $\cos \Phi > 0.96-1$, where Φ is the angle formed between the two vectors of the correlated variables) between the variables confirmed cases and number of deaths; with the variables of population, number of airports and area of the country.

A moderate positive correlation ($R = \cos \Phi > 0.50$) was found between confirmed and deceased cases with the human development index and the competitiveness index. In this region all these variables are correlated. It is necessary to point out a strong correlation between confirmed cases of COVID-19 and the number of airports.

In the Americas region, the number of airports and the number of population are the most highly correlated with the number of deaths and confirmed cases (Figure 2b), it can be seen the vectors that represent the variables CC, D and HDI and CI forming an angle less than the formed with the other

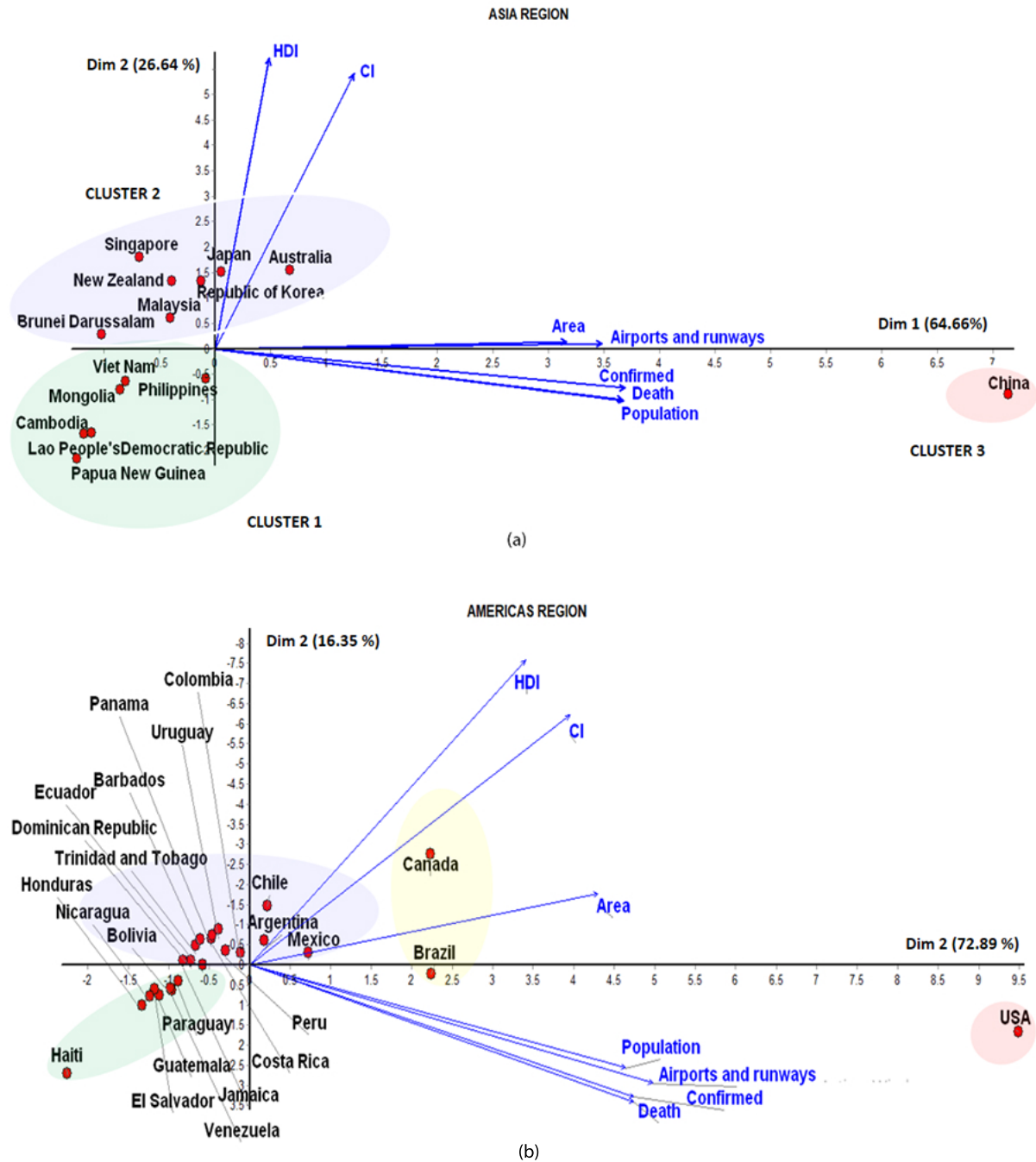
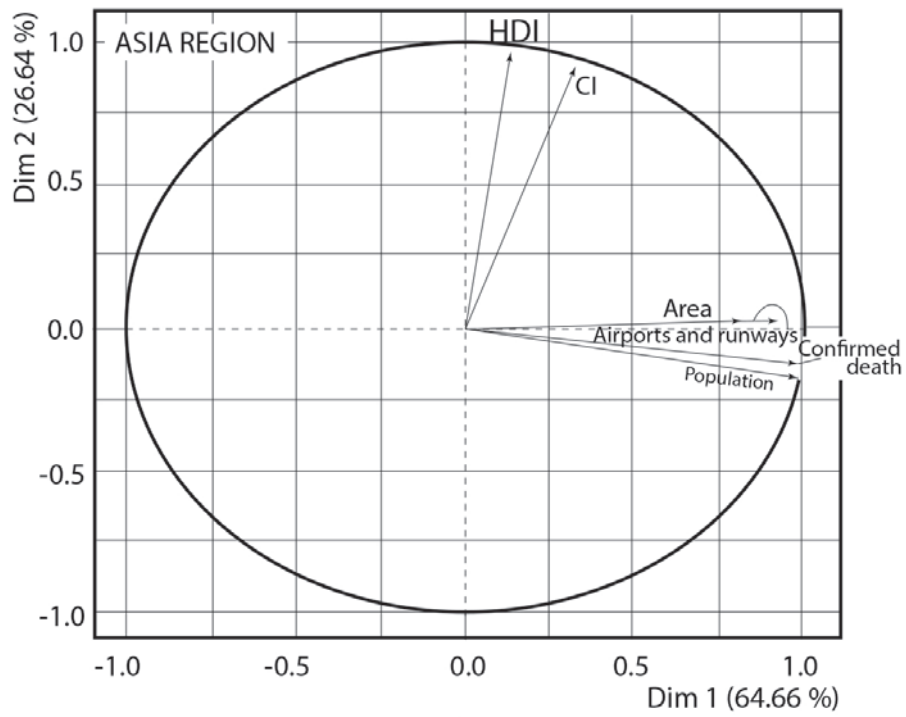
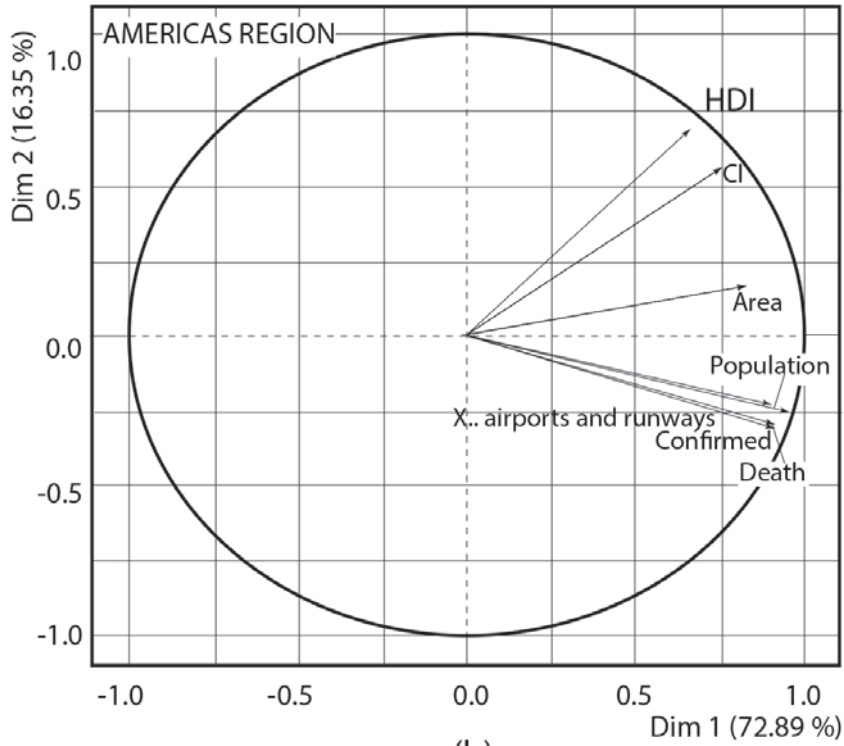


Figure 1: Superposition of variables and clusters formed according to behavioral similarities of variables: confirmed cases, deaths, human development index, population, area, competitiveness index and # of airports (Included airfields and runways), a) Asia region and b) Americas region.

variables (NA). It is possible to mention that in the Americas region the correlation between CC and D is higher than in the ASIA region, where it is an absolute correlation.



(a)



(b)

Figure 2: Variable correlation circles (a) Asia Region, (b) Americas Region

It could be visualized to support decision-making, which is the variable most correlated with the problem in cases of cases confirmed with COVID-19, which for both cases is the number of airports. This type of mobility that allows people to be transported from one place to another could contain populations infected with the SARS-CoV-2 virus or sick with COVID-19. This has worsened since an outbreak in one locality turned into a pandemic. Decision makers take on relevance in this spread of the disease since perhaps it could have been stopped by having a systematic vision.

The SARS-CoV-2 virus is infecting more and more populations, and currently there are no treatments or vaccines. Although infection does not lead to serious illness for many people, around 10-20% of infected people need hospital care (Robert Koch Institute), it is collapsing the hospital system in different cities around the world (Muller *et al.*, 2020) [15]. So the best decisions must be made for the benefit of the populations in the world. In addition, today more than 30,000 deaths and thousands of people with pain and panic in different countries, etc. Systemic decisions to avoid impacting so many human lives, it is necessary, a change of focus towards transdisciplinary systemic decisions would be indispensable.

Since the international emergency was announced on 30, January to decision makers, they would have been supported by a systematic TDS approach. Because there is no vaccine for this new virus that causes harm and death, it is important to take appropriate action at points of mobility. This study demonstrates the absolute correlation between the number of confirmed COVID-19 cases and the number of airports. In fact, one of China's radical measures was lockdown of Wuhan on Jan 23, 2020, and suspended all outgoing tour groups beginning Jan 27, 2020 (Pung *et al.*, 2020) [16]. Despite these measures, many travelers had already left and the great spread that is today occurred.

Right now, we should learn about the main strategies that have been successful for the countries that are having greater control over this problem, such as Korea, Japan, a single population in Italy, etc. This means that the decision maker with a transdisciplinary systemic approach would also have to see how the problem is addressed in the real world by other decision makers. Changes regarding the number of countries infected were growing rapidly, as well as the number of confirmed people and deaths. The global interconnection allowed rapid expansion due to being a type of virus that is so easily spread from human to human (Bernheim *et al.*, 2020) [17]. Systemic decisions that also involve anticipating what may happen are required. In the case of Lombardia, Italy decision makers implemented measures to limit viral transmission – including restricting movement, despite imposing strong decisions on March 8th (Remuzzi and Remuzzi, 2020) [18], perhaps those should have been made earlier.

A rethinking of decision making and its modification is necessary. Future generations would be wise to train in a type of systematic transdisciplinary decisions, for the survival of the human species. A challenge for the following years in the training of children and young people, future decision makers. Who will pass after pain some of them in an evolution of thought.

Callaway (2020) [19], published in Nature and warned that the disease was becoming unstoppable, when it spread at 100 countries, and more than 100,000 infected people. A systemic approach could help, as it will stop if interconnectivity does not stop in the world. So decisions that involve stopping interconnectivity also have consequences, but evaluating the best alternatives is necessary and still remains necessary to stop this pandemic but make them under the TDS approach.

Figure 3a shows the six clusters formed by behavioral coincidences of the analyzed variables: number of confirmed cases, number of countries where the virus spread and number of deaths. The first Cluster is formed by the behavior of the variables in December (15-31) and January (1-15): the changes were abrupt every 15 days, having the most drastic as time progressed in the three variables analyzed by period of time. The highest changes being in March according to the period of time analyzed in this study. Figure 3b shows the absolute correlation between the number of confirmed cases with disease and the number of deaths.

The numbers of confirmed cases varied, as of the first half of January, there were 46 cases, but it took another 15 days to increase the number of confirmed cases. On January 23rd, the United States reported the first case of covid-19 disease and it spreads to Europe on January 25th, with the first cases being reported in France (WHO-Report 5, 2020) [20]. Subsequently European countries that confirmed cases with covid-19 were Germany, Finland and Italy (WHO-Report 8, 2020) [21]. At the end of January, 11

days after starting the World Health organization the case reports, the spread of the virus went to 19 countries, outside China, with a confirmed number of cases of 9 826 (WHO-Report 11, 2020) [22], of which 2.16% (213) died.

In the month of February, the number of confirmed cases increased more than eight times, from those that existed in January; amounting to 85 403 with 3.42% of deceased (2 924). However, the worldwide status of confirmed cases with COVID-19 changed surprisingly in March. At the first half of March, there were 153 517 confirmed cases and at the end of the month it reached more than half a million confirmed cases with COVID-19, with a total of infected countries of 183. The intuitive vision of the systemic decision-maker is essential. As well as, attend to what is reported regarding future problems. In the case of the present pandemic, it had been mentioned before that the environmental changes and constant contact of humans with zoonic organisms could result in transmission between species and human diseases (Becker *et al.*, 2008) [23]. Even, some authors considered was the emergence of SARS-CoV heralded a new era in the transmission of severe respiratory illness, which could be of rapid spread around the world due to the globalization with great massive economic impact (Peiris *et al.*, 2004; Menachery *et al.*, 2015) [24-25]. Of course, the impact is being today in different dimensions, not only the economic one.

Figure 3. Relation of confirmed cases of covid-19, number of countries where it has spread and number of deaths per day (March 26, data obtained from the WHO-Reports 1-69, 2020) a) Clusters for time periods (December-March), b) circle of correlation of variables.

On the other hand, Pung *et al.* (2020) [12] indicated that SARS-CoV-2 is transmissible in community settings, and local clusters of COVID-19 are expected in countries with high travel volume from China before the lockdown of Wuhan. The respective mobility points, such as airports, must have adequate control and measures.

Decision makers have an essential role in proposing the necessary strategies in the entry and exit points, as can border, maritime and land points, in a need to keep posing to control an outbreak. Each country must have a preparedness, alert and response plan (WHO, 2000) [26]. Preparedness is a combination of activities started before a crisis occurs and its objective is to create infrastructure and empower public health workers (Moradi *et al.*, 2020) [27]. It is really far-sighted what Korea did, four days after the notification of new cases in china, decision-makers in Korea started screening and quarantine plan at the airports. Future vision is one of the characteristics of the systemic decision maker. Among many other established strategies, that despite being one of the first infected countries, to date they reach a total of 10,284 confirmed cases and 184 deaths. In comparison, for example with countries such as the United States, in the Americas region, where it was also one of the first infected, but today the number of infected are 367 507 with number of deaths of 10 980 according to the University of Johns Hopkins (April 6, 2020) [28].

In this way, knowing the history of the problem and its evolution, as other countries that have already experienced similar problems are solving. It is part of the transdisciplinary systemic vision that could help decision makers of the governments of various nations. Some patients started in December in Wuhan, later it is observed (Figure 3), that behavioral changes reflected by the different clusters formed started in just 15 days of difference. Clusters were formed due to the similarities between variables of confirmed cases, deaths and number of countries infected.

According to reports from the world health organization; after Wuhan the Chinese provinces affected by the virus were Guangdong, Beijing Municipality and Shanghai Municipality. Later it happened in other countries such as Thailand, Republic of Korea and Japan, which are countries located a few km from the epicenter of the epidemiological outbreak. Regarding the number of confirmed cases, the WHO started the reports on January 20th, 2020, where a total of 258 cases were located in the Chinese provinces and a single case in the neighboring countries (WHO-Report 1, 2020) [2], not yet there were reports of deaths at that time. But at 31 January, there were already 10,000 cases, which 106 Outside of China in 19 countries. It began to spread uncontrollably (WHO-Report 11, 2020) [22]. The United States began implementing public health entry screening at 5 major airports as of January 23rd (Din *et al.*, 2020) [29]. In February, 59 airline companies suspended or limited flights to Mainland China and several countries including USA, Russia, Australia, and Italy have also imposed travel restrictions (Chinazzi *et al.*, 2020) [30]. However, to

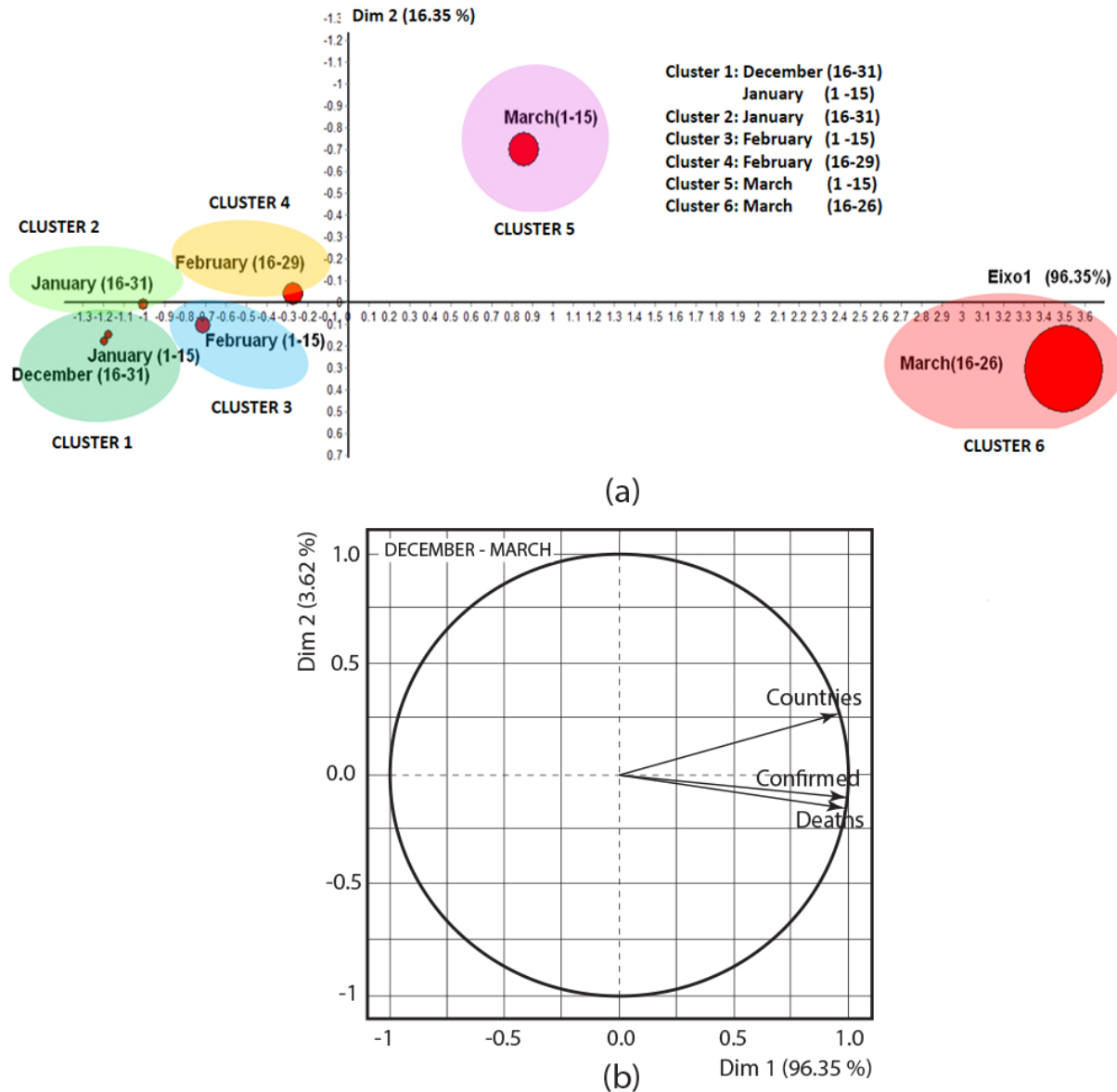


Figure 3: Superposition of variables and clusters formed according to behavioral similarities of variables: confirmed cases, deaths, human development index, population, area, competitiveness index and # of airports (Included airfields and runways), a) Asia region and b) Americas region.

date it has not been enough, to stop the pandemic.

Although on a small scale, there have been decisions by authorities that have managed to contain the disease. In Vo'Euganeo, 50 km west of Venice, the authorities made the strategic decision to close the town of 3,000 people in mid-February. They applied RNA tests to the entire population, those who tested positive were quarantined, the number of people suffering from covid-19 decreased from 88 to seven in less than 10 days. Sergio Romagnani, a professor at the University of Florence, said that, in this population, most people infected with covid-19—50-75% - were asymptomatic, but represented “a formidable source” of contagion (Day, 2020) [31]. The decisions of the decision makers were immediate and radical.



Figure 4: (a) Global cases in the world according University Johns Hopkins (March 28) and (b) Commercial flight map in the world (Internet, 2020).

Therefore, there are populations where tests are not applied to most of the population, in this way, all would have to behave as if they had COVID-19 and to be in quarantine, not to infect. Because if the tests are not done, it is not known if you have it or not, since there are asymptomatic cases. Decision makers play a relevant role in what happens in their towns that are their responsibility. Choosing what is convenient and at the same time the population becoming aware of the importance of obeying are signs of humility in the face of the crisis, and hence the success of the place. Decision makers with humility, learning from others is also necessary to stop the pandemic that started as an epidemic.

It is highlighted that the COVID-19 epidemic was declared this way by the WHO on January 30th, 2020, and after of 30 days, on March 11 it was formally declared a pandemic when 114 countries were infected, confirmed cases 118 000 and 4 291 people who had lost their lives. The aspects that unleash the pandemic could be diverse. Knowing of the evolution of the problem can serve, any minimum detail that could foresee greater impacts of the problem, and when it comes to life and deaths it's essential; it is systemic, radical and fast decisions that must be made by decision makers. The decisions of the group of decision-makers have a great impact.

Figure 4a and 4b present the cases confirmed worldwide with COVID-19 as of March 28 issued by Johns Hopkins University, and a commercial flight map found on the internet (Internet, 2020) [32]. These maps observe similarities between the regions with the highest confirmed cases in the world and the concentration of commercial flights. It is possible to observe, the regions of East Asia, Europe and America where most of the confirmed cases with COVID-19 are centered is where there is the most concentration of international flights. It could be seen that the pandemic, among other aspects, is due to the mobility of air passengers, but it could be extrapolated to air, sea and land mobility. The first strategies by some countries were directed in that direction (mobility of passengers), control of those entry and exit points, despite them, it has not been enough to contain the pandemic. Systemic Decisions in the face of a systemic problem, where individual systemic decisions will have relevance for the near future will continue to apply, which involve transformation of thought and consciousness to work all the humanity.

Represent the study system systemically (Figure 5), analyze it systemically, visualize behavioral variables associated with the system and the problem, define the different holistic levels, as well as contextualize them in the present, past and future, form Transdisciplinary groups to decide, etc., could support decision-making.

The future, decision-makers must train transdisciplinarily, where they invite them to be self-investigating in order to self-transform and, thus, reach the decisions that opt for survival and minimal disaster. The decision makers of the world, at different scales, must become aware of their decision and become co-responsible with what their world is going through, that is, all of humanity, because global problems require global decisions and we should all participate in stopping what is happening. The transformation of the

world's decisions demands this moment that is currently lived.

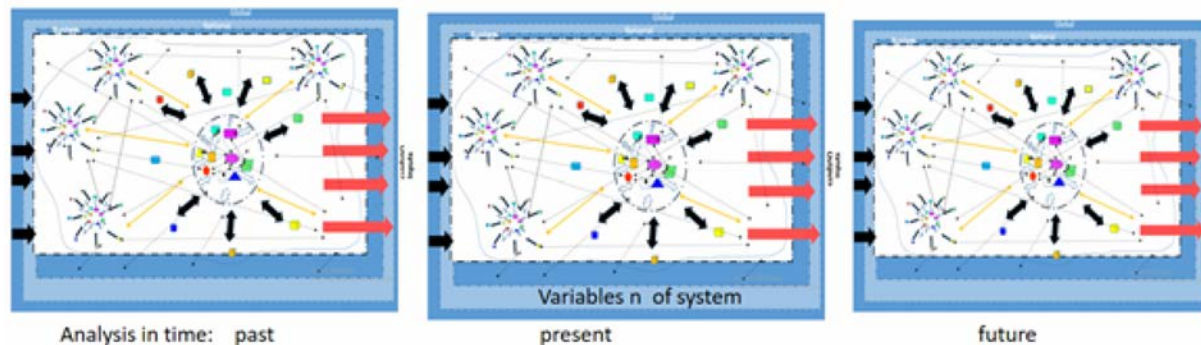


Figure 5: Systemic representation of the problem to be decided (present, past and future).

Einstein said: “You cannot solve a problem at the same level of thought in which it was created”, therefore the importance of evolving our thinking in order to propose solutions in a holistic way. In this way, living a process to decide would be relevant. Live a process to decide systematic even more, in these times of crisis. From the culture that one has, from the beliefs that are lived and coexisted, it is time to become aware of the importance of a spirituality. In this case too, the transdisciplinary perspective could serve to return to oneself and, auto-take self and transform self, to achieve those necessary transdisciplinary systemic decisions in these times, which would simply be human decisions.

4 Conclusions

An absolute positive correlation was found between the analyzed variables with the highest correlation between the cases confirmed with COVID-19 and the number of airports; the correlation for the Americas region being more notable. It is necessary to adopt transdisciplinary systemic approaches for solving global problems, training new students in systemic decisions will be necessary in future generations.

Acknowledgments

We would like to thank our institution, all our teachers, our students, our families. These are times of crisis, and thank you all for your strength in the face of pain. Thank you for your teachings, in this step through life. Today are times of so much learning, that they could be so good in the sense of the transformation of humanity. I thank everyone with intense pain. We thank everyone who is having the courage, the patience and the humility, without losing hope, envisioning a better world.

Contributions: Both co-authors contributed equally.

Funding: This research received no external funding.

Conflicts of Interest: The author declares no conflict of interest.

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