- ORIGINAL ARTICLE -

Technological Integration to Reactivate Paralyzed Organizations

Integración Tecnológica para Reactivar Organizaciones Paralizadas

María Romagnano[1,2] and Héctor Lépez[2]

[1] *Informatics Institute, Faculty of Exact, Physical and Natural Sciences, National University of San Juan, San Juan CPA: J5402CWH, Argentina*
maritaroma@iinfo.unsj.edu.ar

[2] *Informatics Department, Faculty of Exact, Physical and Natural Sciences, National University of San Juan, San Juan CPA: J5402CWH, Argentina*
lepezhr@ideigs.unsj.edu.ar

Abstract

The new way of sharing, communicating, storing, personal assisting, and even purchasing products or services, gender millions of data. In any application domain, this data will process and converted into information. The conversion implies the complementary relationship between several disciplines. A successful example occurs between the Internet of Things (IoT), Computational Intelligence (CI), Data Mining (DM), and Big Data (BD). Globally, various studies cases combined IoT, CI, DM, and BD. So, some sectors that provide services have a more advanced interaction, for example, the health with monitoring and detection, diagnostic and care technologies. In other service sectors, however, technological advances have not evolved at the same rate. A specific case in Argentina is long-distance land transport. This paper presents a plan and guide, combining different devices and technologies to reactivate this type of organization. We propose the integration of IoT, CI, Business Intelligence (BI), and Business Analytics (BA). Also, we experiment, in the transportation sector, with different algorithms and software to analyze images and data. Finally, we get conclusions about the proposed strategy.

Keywords: Business Analytics, Business Intelligence, Computational Intelligence, Internet of Things, Transport.

Resumen

La nueva forma de compartir, comunicar, almacenar, de asistencia personal e incluso de comprar productos o servicios, genera millones de datos. En cualquier dominio de aplicación, estos datos se procesarán y convertirán en información. La conversión implica la relación complementaria entre varias disciplinas. Un ejemplo exitoso ocurre entre Internet de las Cosas (IoT), Inteligencia Computacional (CI), Minería de Datos (DM) y Big Data (BD). A nivel mundial, varios casos de estudio combinaron IoT, CI, DM y BD. Así, algunos sectores que brindan servicios tienen una interacción más avanzada, por ejemplo, la salud con las tecnologías de monitoreo y detección, diagnóstico y atención. En otros sectores de servicios, sin embargo, los avances tecnológicos no han evolucionado al mismo ritmo. Un caso específico en Argentina es el transporte terrestre de larga distancia. Este artículo presenta un plan y una guía, combinando diferentes dispositivos y tecnologías para reactivar este tipo de organizaciones. Proponemos la integración de IoT, CI, Inteligencia de Negocio (BI) y Analítica de Negocio (BA). Además, experimentamos en el sector del transporte, con diferentes algoritmos y software, para analizar imágenes y datos. Finalmente, se obtienen conclusiones sobre la estrategia propuesta.

Palabras claves: Analítica de Negocio, Inteligencia de Negocio, Inteligencia Computacional, Internet de las Cosas, Transporte.

1. Introduction

Over time and technological advances, people have changed their behavior. Sharing, communicating, and accessing resources or services, even when receiving or providing help, generate a complex set of information immersed in the knowledge society.

In the day transactions, this "type of society" produces millions of data that must process and converted into information. Then, this information can use to predict future behaviors, make recommendations, define strategies, make investments, etc.

This current reality, almost invisible, supposes the complementary interaction between several dimensions: IoT, CI, BI, and BA. However, some sectors that provide services show a more advanced interaction. For example, the health area has been benefiting from significant advances in disruptive technologies such as telemedicine, teleconsultations, and mobile health (mHealth) [1]. The creation of connected health platonic allows for telemonitoring patients with multiple wearables [2].

Another sector that has made extensive forays into IoT, BI, and BA is transportation. Logistics, shipping control, vehicle management and security, surveillance systems, reservations, or any other type of knowledge in real-time are some specific cases of application of these technologies, to improve processes and increase productivity. Regarding the public transport service, in most cities, anyone with a smartphone and a mobile data plan can get information and track buses, trains, and taxis, through a real-time app such as Moovit, Transit, or Cuando SUBO, for example [3, 4].

However, to ease the difficulties caused by some contingency scenarios, other service provider sectors' technological advances have not evolved at the same rate. In Argentina, long-distance land transport is a specific case. This type of transport is almost paralyzing. Therefore, this paper aims to provide an alternative to reactivate this sector by integrating IoT, CI, BI, and BA technologies.

2. Trend in searches and publications

In this section, we analyzed the importance of the terms: IoT, CI, BI, and BA. The study we carried out by establishing two subtopics: searches and publications.

2.1. Searches analysis

In real-time, we analyzed search behavior. In July 2022, we ran a study using the online tool Google Trends.

Fig. 1 shows the search trend for the terms: IoT, CI, BI, and BA, using the following filters: worldwide, in the last five years, related to companies and industries, and across the web.

Fig. 2 shows the first five regions that searched for worldwide related companies and industries and carried the search getaway across the web; in the last five years.

Fig. 3 shows the search trend in Argentina related to companies and industries and carried the search out throughout the web; in the last five years.

Fig. 4 shows the first five subregions of Argentina where searchers related to companies and industries; in the last five years. We carried the search out throughout the web.

2.2. Publications analysis

For analysis, the number of publications on the topics we take as a reference to the ScienceDirect site in the last five years (Fig. 5). This figure presents the relationship between the amounts of publications in IoT, CI, BI, BA, and their integration, from 2018 to 2022.

3. Advances and benefits of technological integration

With the possibility of connecting devices to the Internet, a new archetype called the Internet of Things (IoT) has evolved.

IoT is a well-defined scheme of interconnected computing tactics and digital and mechanical devices that can transmit data through the web, without human intervention. The technology, actuating as a link to utilities of the products or the devices, satisfies the requirements in real-time [5]. By 2025, approximately, 75,000 million devices will be linked to the Internet [6].

IoT found wide applications in various sectors because of its ubiquity and pervasiveness characteristics. Healthcare, smart cities, smart grids, manufacturing industry, weather forecasting, environmental monitoring, logistics and resource management, agriculture, smart shopping, and automotive [7, 8, 9, 10].

The idea of connecting devices in the cloud, integrating the real world with the virtual one, has been applied for several years. Have proposed various technologies and standards to carry out interconnection. Although, the main challenge remains interoperability to achieve communication.

Web of Things (WoT) is presented as an added paradigm for IoT. IoT provides the communication and networking protocols necessary to get at things in the real world. The Web provides a platform for creating applications that integrate real-world objects on the Internet. So, IoT provides the network infrastructure for the use of real-world things, and WoT adds the application and service layer for real-world things to interoperate over HTTP [11]. So, the IoT creates opportunities for more direct integration across the physical world and computer systems, resulting in efficiency gains, economic benefits, and reduced human effort [12].

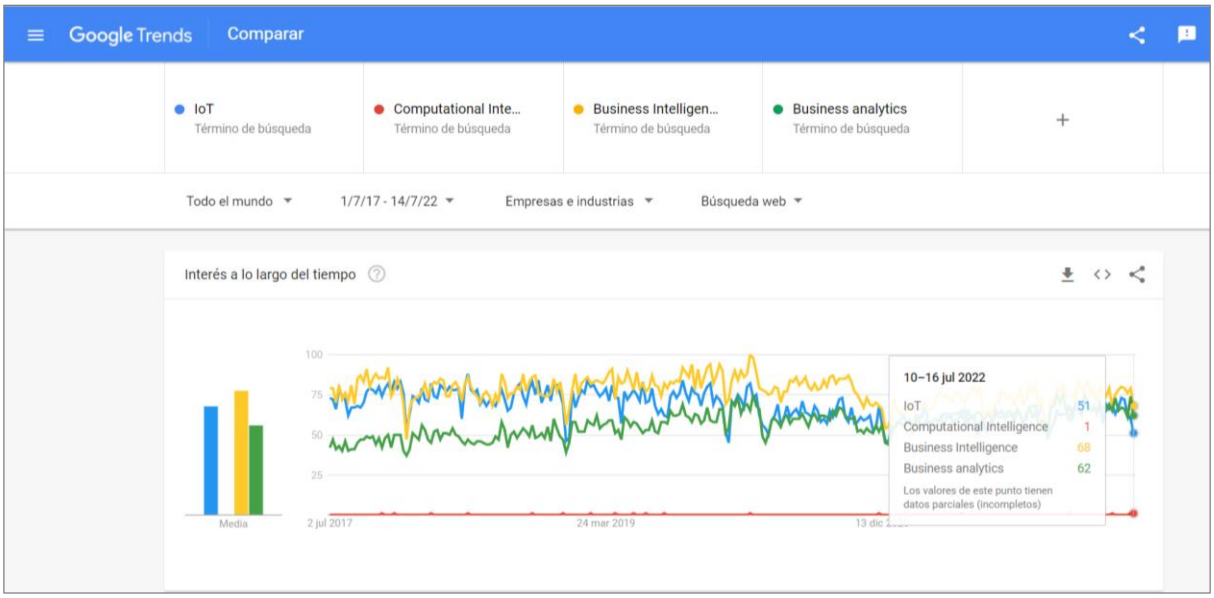


Fig. 1. Search trend for the terms IoT, CI, BI, and BA, worldwide. Source: self-made.

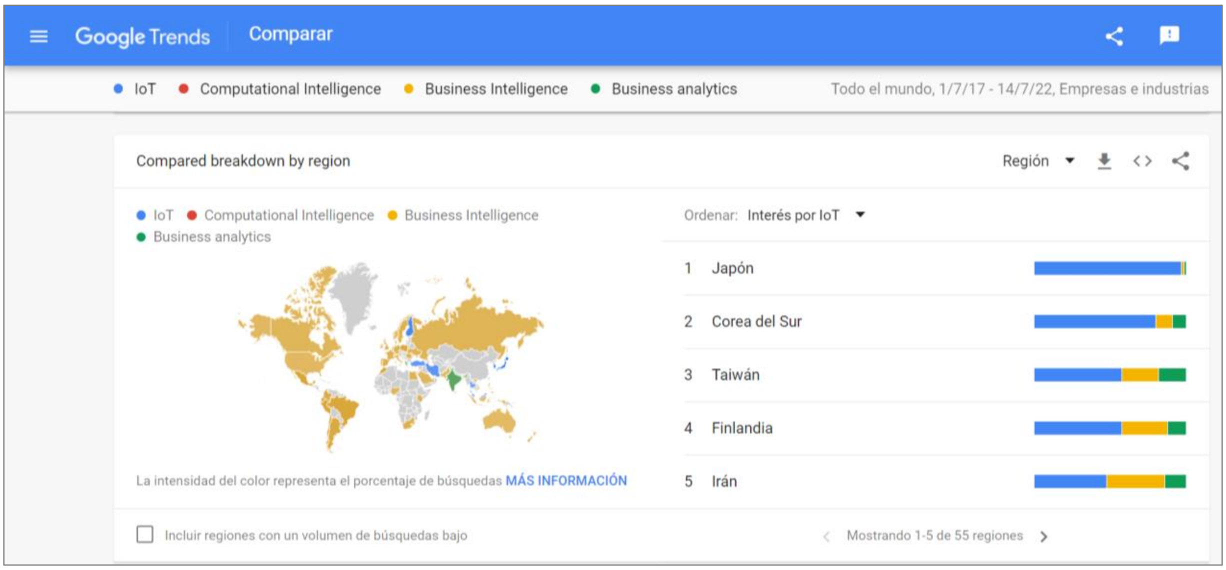


Fig. 2 Regions that searched for worldwide.

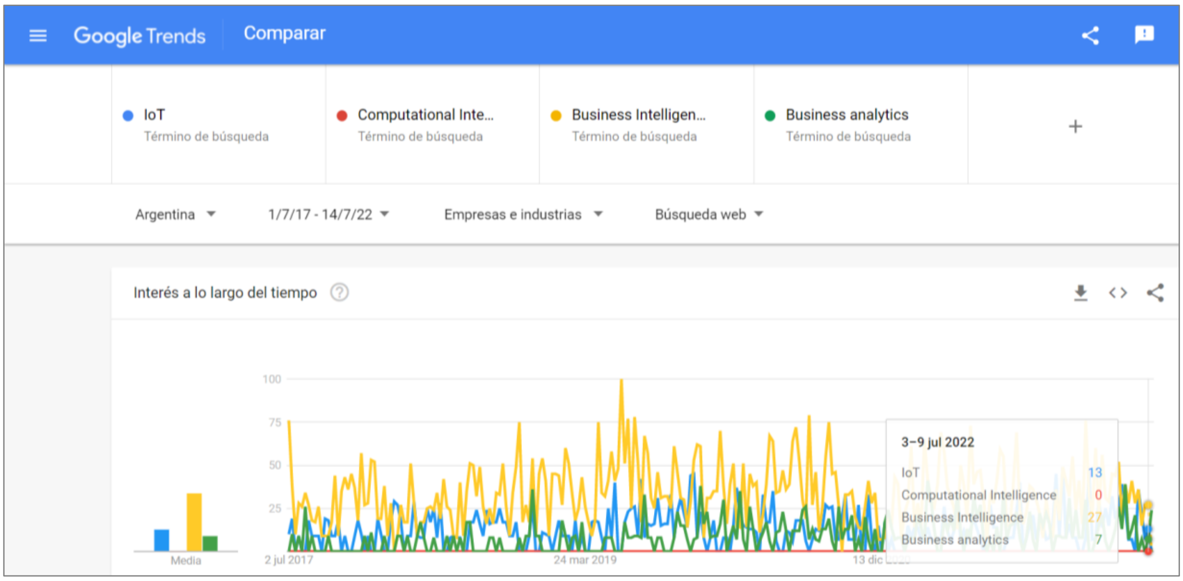


Fig. 3. Search trend for the terms IoT, CI, BI, and BA, in Argentina. Source: self-made.

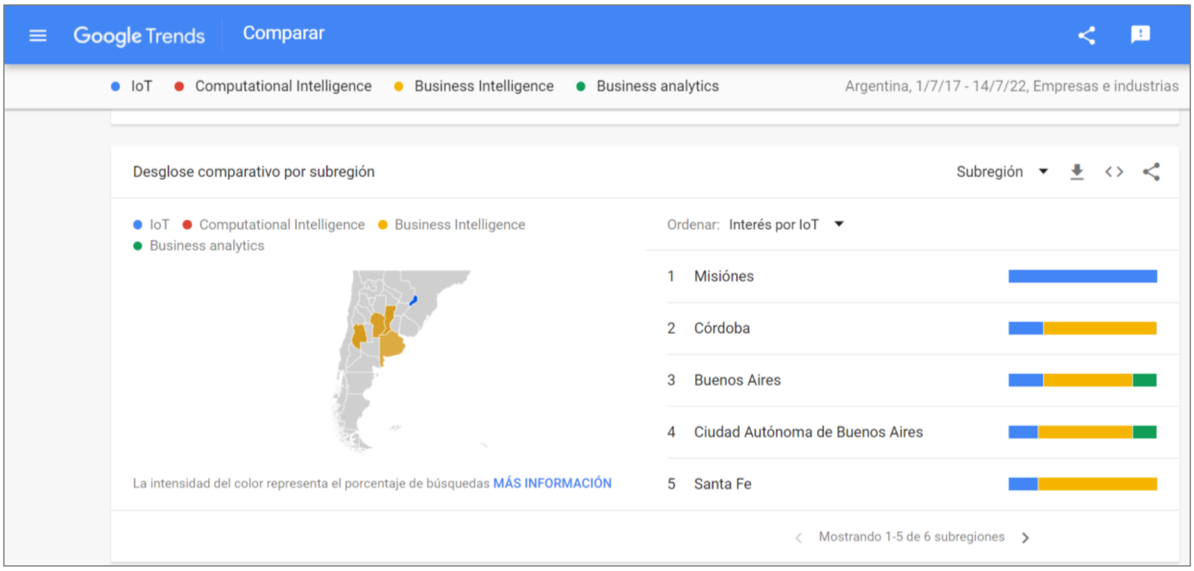
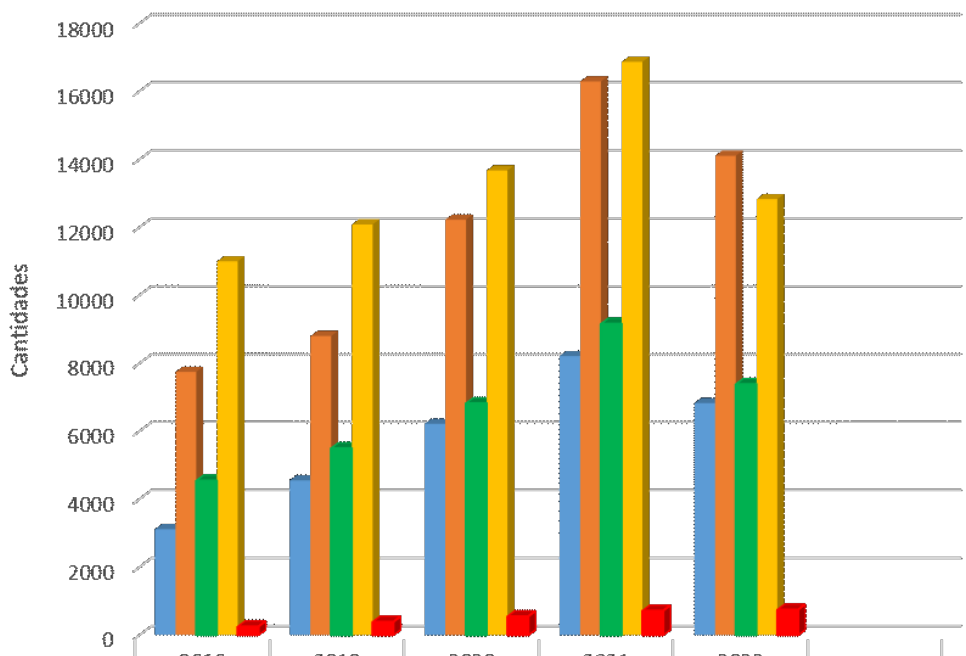


Fig. 4. Top five subregions of Argentina that searched the terms IoT, CI, BI, and BA, in the last five years. Source: self-made.



	2018	2019	2020	2021	2022
IoT	3125	4562	6227	8221	6836
CI	7754	8811	12235	16302	14114
BI	4553	5509	6833	9170	7394
BA	11011	12095	13685	16880	12843
Integrated Themes	261	399	561	725	756

IoT CI BI BA Integrated Themes

Fig. 5. Publications in ScienceDirect in the period 2018-2022.
Source: self-made.

CI studies adaptive mechanisms to allow the intelligent behavior of complex systems. It is a discipline that seeks to clarify the action in confusing decision situations and help to overcome uncertainty by finding the best alternative [13]. Further, CI has defined the study of adaptive mechanisms to enable or facilitate intelligent behavior in complex and changing environments. These mechanisms include the AI paradigms that show the ability to learn or adapt, generalize, abstract, discover and associate with new situations [14]. The following CI paradigms are covered: artificial neural networks, evolutionary computing, swarm intelligence, and fuzzy systems. Also, CI is a new automated information processing technology with minimal human intervention to solve complicated problems, which has attracted immense research efforts [15]. The CI techniques undertake considerable benefits for IoT that connects billions of smart devices. The CI exponentially enlarged the size of the IoT market and reach $281 million by the end of 2020 [16]. The CI techniques can enable smart devices to learn a specific task from data or behaviors. These techniques cover evolving computation, neural networks, fuzzy logic, learning theory, probabilistic, and similar computational models [17].

The combination of CI and IoT can create new markets and opportunities. However, the growing IoT also raises greater security concerns and challenges. CI techniques promise to avoid possible cyber-areas [18].

Then, the IoT is undoubtedly a significant source of Big Data and one of the largest market shares of Big Data applications. As sensors are used in most industries, the IoT has unleashed a massive influx of Big Data. IoT will have a considerable impact on the future of Big Data analytics.

Big Data generated from IoT requires proper management and analysis for IoT to be successful.

The presence of Big Data challenges traditional data management approaches. Therefore, the importance of Big Data analysis in IoT is a challenge [19].

Then, the large volume of data must be processed and converted into information. An alternative to carrying out this data processing is BI and BA.

BI refers to the optimized management of the data that is stored, collected, and analyzed. Then, BI allows to transform them into strategic decisions for designing actions aimed at achieving success [20].

Also, the proliferation of the use of the Internet has made BA a strong application area. It is impossible to deny its importance and impact on information technologies, quantitative methods, and decision science [21].

Too, the technique that explores large volumes of data to assist executives in decision-making is considered a BA. These analytics focus on collecting and combining a large amount of data to derive ideas that are not perceived on a smaller scale [22]. With BA, it performs statistics and quantitative analysis. It is used in exploratory and predictive models. The fact-based management enables or supports the decision-making or actions of an organization. Hawley approaches business analytics from another point of view. It focuses more on understanding organizational culture than mere technology. It proposes that, for successful implementation and exploitation of the benefits of business analytics, one must know the motivation of an organization, its strengths, and its weaknesses. [23].

BI complemented by BA, as a specificity of Data Science (DC), comes to offer knowledge management (KM). BI is presented as a set of processes, techniques, and technologies that facilitate the quick and easy getting of data from different sources of information. Therefore, the analyzed and interpreted data are transformed into relevant knowledge for decision-making. The processing capabilities offered by BI, enable organizations dynamically perform and respond in a highly impetuous universal environment, which requires constant decision-making to stay in the middle [24].

In short, the IoT technologies must be used in the daily life of a human being represents a constant challenge. So, integration with other technologies such as IC, BI, and BA can be highly productive and beneficial in terms of decisions and actions that must be taken, based on the data generated.

4. Background review

Some application domains present greater and better advances in terms of technological integration. The health area is a concrete case of the transformation of traditional medical care. Devices, mobile applications, and teleconsultations create a digital channel, where medical care can be delivered anywhere. Even the surgeon can improve and advance communication, with full intervention, with the patients' relatives [25].

Health platforms, with multifarious smart electronic devices, can be incorporated daily into clothing or any part of the body, allowing the continuous exchange of information through the Internet without requiring human intervention.

These devices are linked to mobile applications that support behavior modification through behavioral techniques and the use of gambling techniques (gamification). The data got is managed in the cloud by software that allows the health personnel to be alerted to clinical deterioration and to act early [26].

Artificial Intelligence (AI) has made it possible to redesign health care, impacting on three levels:

1. Healthcare professionals; with a fast and accurate interpretation of images.

2. In healthcare systems; by improving workflow and the possibility of reducing medical errors.

3. In patients; allowing them to process their data to promote their health [27].

AI image analysis applied to facial recognition is the first for next-generation mobile devices. These devices are capable of biometric recognition with maximum precision. After this facial unlocking system, the key can be found to diagnose the first signs of diseases in an early and reliable way, since facial expressions allow for to classification of pain and other emotions [28].

By integrating BI and BA, the professional is provided with information and knowledge of their patients. Then, these technological tools help you visualize, analyze, predict, and/or prescribe and make accurate decisions. The global industry spends an annual average of $14 trillion on BI software. Gartner Group predicted that in 2018 more than half of the world's largest organizations will compete using advanced analytics and proprietary algorithms, causing large-scale data analysis volumes. Also, it was forecasted that for this year the fastest-growing segment in the analytical market will be Business Intelligence, representing over 40% of new investments in a company [29]. Besides, that machine learning could power data analysis on a scale greater than humans expected companies invested 30% more in artificial intelligence in 2017 than in 2016. [30].

IoT, coupled with big data analytics, is anticipated to be a useful tool in converting conventional methodology to more advanced technology wherein data generated by these devices can be analyzed using big data approaches for informed decision-making [31]. Thus, the large data created by wearable devices creates an opportunity for the application of AI techniques, such as deep learning, to these data in the future. With the infusion of AI, intelligent IoT (IIoT) systems are created, augmenting existing IoT applications [32].

For complex data analysis and intelligent data visualization, the Python language and deck.gl algorithms could be utilized, respectively, in the system [33].

In Argentina, there are several successful cases of relationship and development between these disciplines. Thus, for example, we can cite the case of the Italian Hospital, through its Department of Health Information Systems, and the Institute of Clinical and

Health Effectiveness, which carry out different training and implantations [34, 35].

In the commercial transport sector, technological integration is growing by leaps and bounds, from the use of satellite trackers for mobile units and the use of digital tickets or tickets. According to a survey carried out by Freie Universität Berlin as part of Nahverkehrstage 2017, in Germany, around 30 public transport companies currently offer digital ticketing services, whereby relevant applications automatically collect passenger and transaction data [36]. Willis Towers Watson Company Offers:

1. Integrated services improve efficiency in fleet management, and route control, allowing route optimization, and reducing fuel, personnel, and vehicle costs.
2. The management behind the wheel, improving help to drivers and control of their habits, for example, allowing to know if a driver is stopped too much or if he is driving recklessly. Also, the Swedish and American company Fathym Innovation Framework is applying it and big data solutions to route control traffic status or road works [37].

China developed smart public units of transport with facial recognition capabilities and tools to combat Covid-19. According to Lucy Ingham in her article "Transport of Tomorrow", these units have thermal camera technology with artificial intelligence and an ultraviolet system in the air conditioning ducts. The Healthcare Bus, is designed to autonomously and non-invasively screen passengers and they board, as well as actively sterilizing the vehicle's interior. Facial recognition powered by artificial intelligence (AI) and an infrared thermal imaging camera have both been installed next to the ticketing machine, which alert the driver when a person with a fever boards, and also identifies those not wearing face masks. Also, the bus is equipped with UV lighting in its air ducts, to sterilize and kill the virus. Because the process is completely automated and contact-free, it does not slow down the boarding process, even during busy commuter times [38].

In [39] was introduced new Android Application based Smart Bus Transportation System which guides the passengers in booking the bus tickets using the Android Application, and it also helps the passengers to keep an update on bus location based on their request. This system also sends alert message few minutes in advance to the passengers before the bus reaches the passengers boarding point, and also, sends the precautionary instruction priory to the passengers that have to be followed while travelling in the bus. In order to provide additional safety to the passengers, the temperature of the passengers is monitored and intimated to the bus to change before they are permitted into the bus. The passengers can book the available seats in the bus through Android App after checking the seat availability and cash payment process. After booking the seat, the message will be sent to registered mobile number and an online ticket will be generated, and it will be stored in Application itself. The passengers can also check the location of the bus using the Android App. In order to monitor the health of the passengers entering into the bus, temperature sensor is used which is used to monitor the temperature of the travelers.

As for transportation, in Argentina, in different regions, and using a rechargeable card with RFID technology is implemented to prevent the use of money. In the province of San Juan, 99% of the transport units have GPS and tracking technology, which allows the driver to be notified if he is late or early on his journey, and to notify passengers, through a mobile app, of the unit at the different stops [40].

5. Proposed strategy

Considering the imminent need to prepare cities for the new mobility challenges, this research work proposes guidelines to follow as part of a strategy that, combining different technologies, allows reactivating this sector:

- Change the ticket sales system from origin to destination to a system of selling kilometres or "miles". The passenger would buy "miles" to use whenever they want, confirming their use 24 hours before, if there is seat availability. This possibility provides the passenger with peace of mind that their "investment" in miles freezes the price of their trip. It also gives you the flexibility to choose a destination, without having to worry about changing or canceling a trip. Likewise, this type of sale reduces the use of face-to-face communication channels or telephone calls to companies. This sales system, besides, would allow us to have passenger data and track their movements. With the data collected, it is possible to make a study of the purchase profile of passengers, make promotions for frequent passengers, give away the miles for behavior, buy with those miles a better travel menu, drinks on board, etc.
- Incorporate a digital passport. The transport units should contain a barcode or a QR scanner. The passenger should be able to enter the unit as long as they display and scan their code. This code must contain your personal data and health status information, if COVID tests were carried out and its result, place of residence, places they frequented, and direct contact with positive COVID patients, at least 48 hours before. For this purpose, the digital ticket should be authenticated with the passengers' data, using a

circulating traceability database, and then issue the code. Likewise, the transport unit should be accompanied by devices and cameras that can identify that the person who is using that ticket and code belongs to him.

- Implement IP cameras that capture the occupational capacity, the location of the passengers, if the distance is respected, and the use of chinstraps, or masks. The government could use the information from videos and images taken by these cameras to reward or find the circulating citizen. For example, according to the images from the cameras, if the citizen complies with all the pre-established protocols, his future tickets are reduced by a percentage. As for companies, they are exempted from some taxes or fined for not being able to provide the service for a stipulated time. An alternative, which provides more details, is thermal imaging cameras, helping to detect anomalies in the normal temperature of a passenger during the trip. Smart devices or terminals have now been launched on the market. For example, Hikvision [41] is marketing an intelligent terminal that detects the temperature of the skin without contact, detects the use of a mask, and incorporates audio alarms in case of abnormal temperature.

All transport companies (land and air) should share a single database in the cloud, from where they get this information, but also update with the information on each of the passengers who board any of their units. The communal, provincial, or national government should administer this database. With this information, concentrated and updated, the government could visualize, analyze, and predict behavior patterns and future actions to be carried out to start the transport sector.

In summary, the state should support the reactivation of the sector by making this database and the essential technological devices available to long-distance land and air transport companies. Likewise, the local, provincial, or national authority has the responsibility of regulating the operation of this system by carrying out intelligence and business analytics.

6. Experimentation

6.1. Image analysis

Among the wide range of devices that can be connected to the Internet, and that represent a tool to help in the reactivation of the transport service, the IP cameras stand out. Like a computer, the network camera has its IP address. It is directly connected to the network and can be placed in any location where there is a network connection [42].

To respond to the need to acquire knowledge and identify patterns, it is possible to integrate this IP camera technology with CI algorithms and AI tools. Then, through the visualization and analysis of the data obtained, predictions can be made, and prescriptive actions are taken.

This section of the paper introduces some image processing algorithms. Then experimentation is carried out using an open-source tool. CI algorithms for image analysis are based on deep neural networks. Deep learning models calculate feature vectors associated with each image. That is, the algorithms obtain feature vectors representative of each image. These vectors can then be classified (supervised learning) or clustered (unsupervised learning) with traditional AI algorithms. An example is seen in Fig. 6. Clustering is applied to a set of face images (obtained from https://fei.edu.br/~cet/facedatabase.html). For this particular example, the cosine metric was used to measure distances. The objective was to convert this set of images into a set of numerical characteristics that represent and that can be used by the different classification or clustering algorithms.

Among the popular and prominent applications for image processing and analysis, Orange stands out. This open-source software developed in Python allows for visualization and analysis, machine learning, and data mining [43].

Internally, current IP cameras already have different intelligence algorithms such as fingerprint, face, or temperature detection in the case that they are thermal. In this experimentation, was used the Orange open-source tool, because it is a simple and intuitive analytics platform. Orange allows users of different types of trained networks and algorithms to characterize the images. With the "Image Embedding" widget, you can choose the deep neural network algorithm to use to extract the feature vectors from the images (Fig. 7). In this case, users VGG-16. The result is a set of images that were transformed or discretized into a data set that can be interpreted by various AI algorithms through mathematical calculations (Fig. 8).

The VGG-16 algorithm obtained 4095 different characteristics for each image. The next step is to measure using the distances widget. The metric to be used (Euclidean or Cosine) is chosen between rows or columns. The idea is that the images with the smallest distance are the most similar to each other. In this case, the cosine distance was applied. The yellow dots are the images with the smallest distances, or they are also said to be the most similar (Fig. 9).

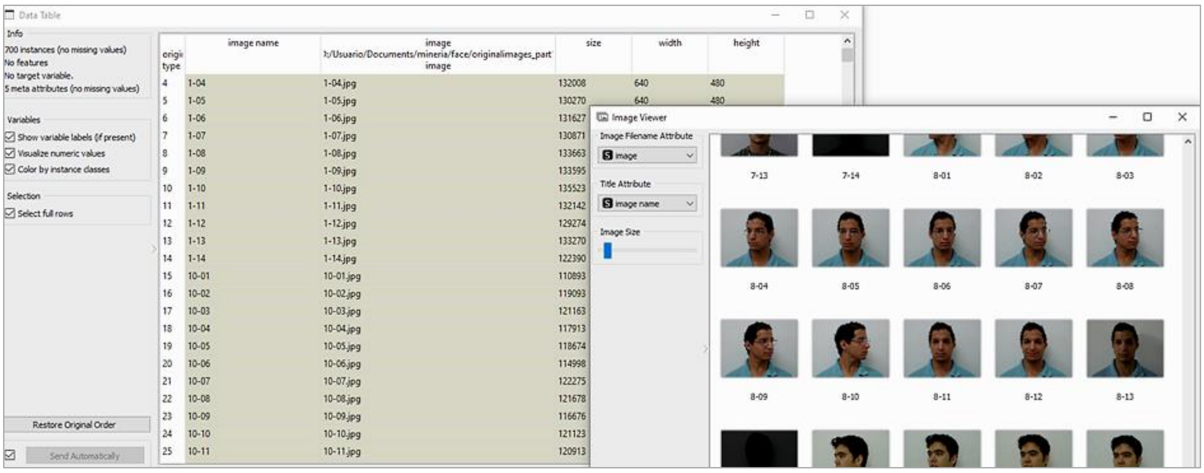


Fig. 6. Clustering to an example dataset of faces. Source: self-made.

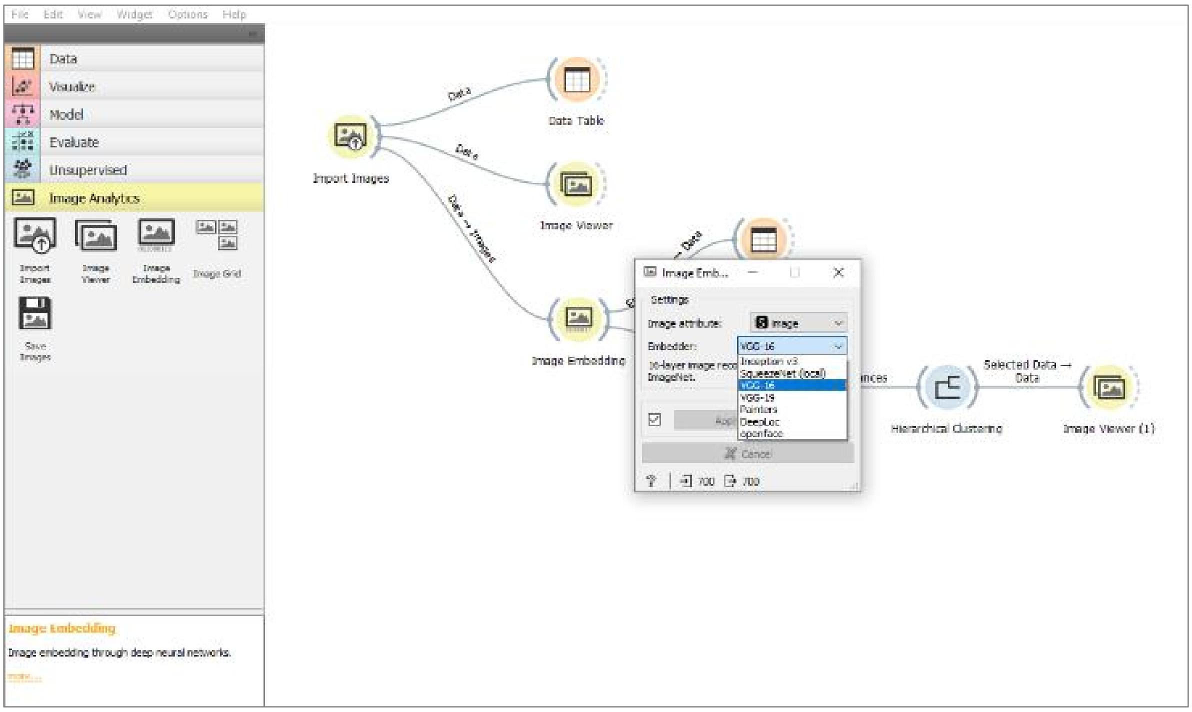


Fig. 7. Widget "Image Embedding" / VGG-16. Source: self-made.

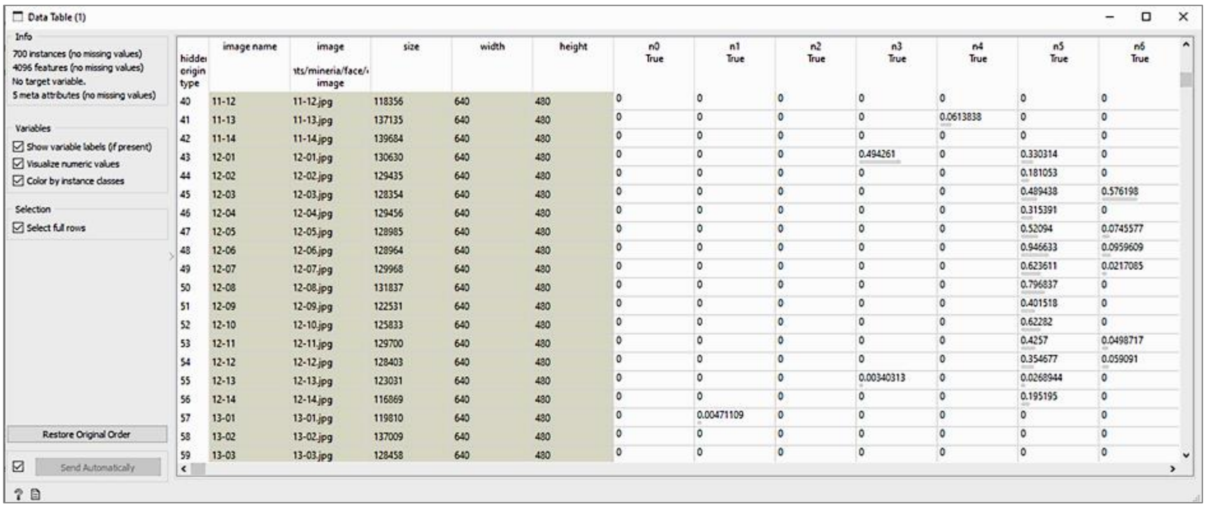


Fig. 8. Set of discretized images when applying VGG-16. Source: self-made.

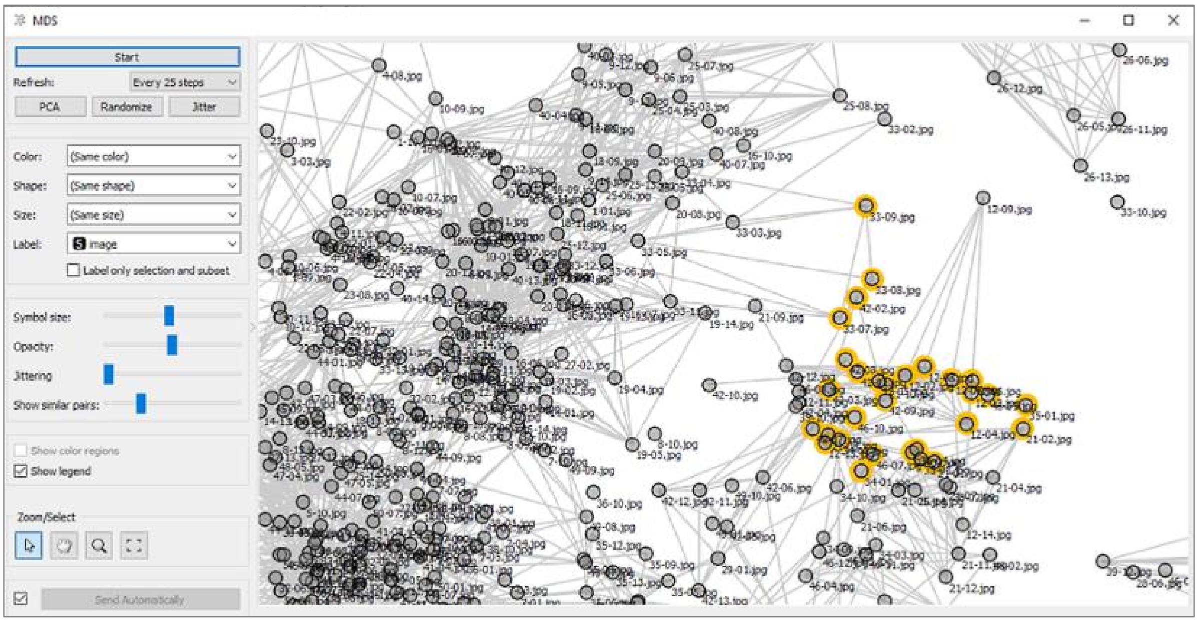


Fig. 9. Result of applying cosine metrics to the characterized dataset. Source: self-made.

Then with the widget "Hierarchical Clustering", it was possible to create a clustering, thanks to the matrix of distances previously obtained. The result was the grouping of similar images taken from the dataset available at https://fei.edu.br/~cet/facedatabase.html (Fig. 10).

This same or similar process can be automated with Python free code of libraries, to be used in real-time face detection tools. There are several alternatives, but in this work were analyzed OpenCV [44] and MTCNN [45].

To carry out the experimentation, in a first example was used OpenCV, running in Anaconda as a support environment (Fig. 11). Then, the code used to detect faces can be viewed in Fig.12.

An example of a shot from a high resolution or the HD security camera can be seen in Fig. 13, on the left side. On the right side of Fig. 13, as a result, four detected faces and some false detection boxes are displayed in blue. As an example, were used images downloaded from https://stockphoto.com/.

In a second example, the MTCNN library was applied, which also requires a Python environment and to install of the TensorFlow framework. It is an end-to-end open-source platform for machine learning, developed by Google. The result of the detection is shown in Fig. 14.

The results shown in Fig. 14 showed that MTCNN obtained better results detecting five faces, while OPENCV detected one less and several false positives.

6.2. Data analysis

To conduct the tests with the data again was used Orange and incorporated another tool, KNIME. Is open-source software, developed in Java and prepared in Eclipse by AG KNIME in Zurich, Switzerland. To extract data can connect to database engines and files like Excel or CSV [46].

Like Orange, it offers integrative data analysis and visualization but adds data mining, and the discovery of hidden data structures, among other benefits. Also, it presents a remarkable efficiency in the previous treatment of the data as well as in its extraction, transformation, and loading.
Some fields of its application are pharmaceutical research, the financial sector, and BI [47]. Regarding the algorithms provided by both tools, they can be divided into two large groups: supervised and unsupervised learning.

Therefore, after analyzing the algorithms and techniques that can be used to mine data, both the State and the organizations have no excuses for not carrying out an analysis of their data. In Argentina, as the proposed strategy expresses it, there is not yet an integrated database that can be analyzed by the authorities of the Nation and the transport companies. So, to demonstrate the benefits of visualization and analysis of open-source tools, a transport company from the province of San Juan Argentina was taken as a case study. The data was collected from an Excel file that had 2750 records corresponding from November 2019 to March 2020. With Orange, using the Feature Statistics widget, it was possible to identify that the database had outliers. In Fig. 15, for example, a dispersion of 19 years can be observed when considering the year 2000.

Fig.10. Similar image clustering. Source: self-made.

```
In [1]: pip install opencv-contrib-python

        Collecting opencv-contrib-python
          Downloading opencv_contrib_python-4.3.0.36-cp37-cp37m-win_amd64.whl (40.0 MB)
        Requirement already satisfied: numpy>=1.14.5 in c:\users\hrlep\anaconda3\lib\site-packages (from opencv-contrib-python) (1.18.
        1)
        Installing collected packages: opencv-contrib-python
        Successfully installed opencv-contrib-python-4.3.0.36
        Note: you may need to restart the kernel to use updated packages.
```

Fig. 11. OpenCV installation using the pip package management system. Source: self-made.

```python
import numpy as np
import cv2
face_cascade = cv2.CascadeClassifier('haarcascade_frontalface_default.xml')

image = cv2.imread('imagen.png')
grayImage = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)

faces = face_cascade.detectMultiScale(grayImage, 1.03, 2)

print (type(faces))

if len(faces) == 0:
    print ("No faces found")

else:
    print (faces)
    print (faces.shape)
    print ("Number of faces detected: " + str(faces.shape[0]))

    count = 0
    for (x,y,w,h) in faces:
        crop_face = image[y:y+h, x:x+w]
        cv2.imwrite('/mnt/d/' + str(count) + '.png', crop_face)
        count+=1
        cv2.rectangle(image,(x,y),(x+w,y+h),(255,0,0),2)

    cv2.rectangle(image, ((0,image.shape[0] -25)),(270, image.shape[0]), (255,255,255), -1)
    cv2.putText(image, "Number of faces detected: " + str(faces.shape[0]), (0,image.shape[0] -10), cv2.FONT_HERSHEY_TRIPLEX, 0.5,  (0,0,0), 1)

    cv2.imwrite('/mnt/d/resultado.png',image)
    cv2.waitKey(0)
    cv2.destroyAllWindows()
```

Fig. 12. Face detection code example using OpenCV. Source: self-made.

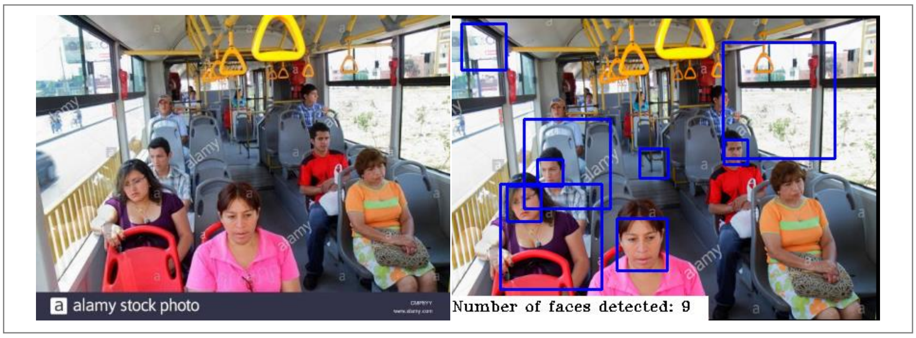


Fig. 13. The image resulting from applying the code in figure 7. Source: self-made.

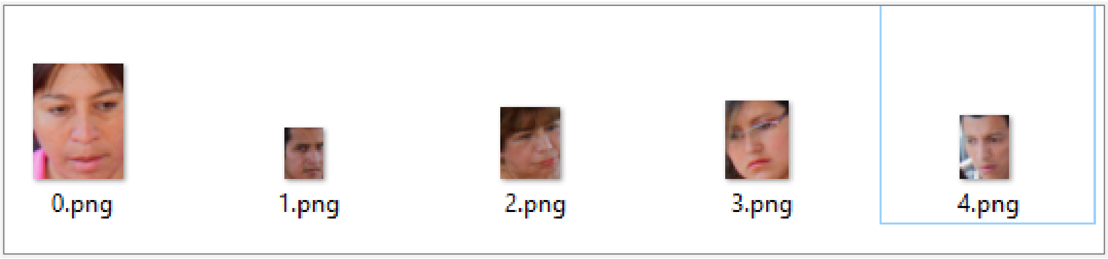


Fig. 14. Result of applying MTCNN library. Source: self-made.

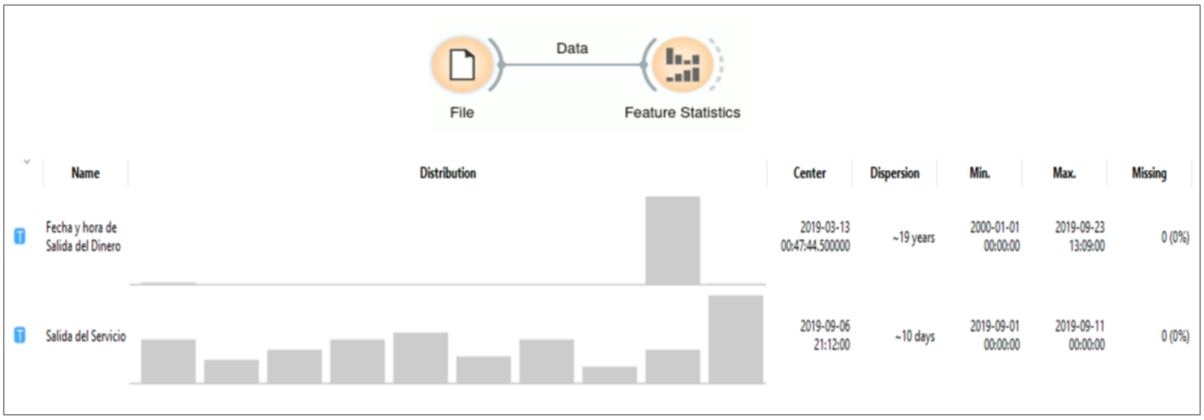


Fig. 15. Result of applying Feature Statistics. Source: self-made.

Average occupancy percentage was another visualization that was made. Through the "Select Rows" and "Feature Constructor" widgets, the new attribute % occupancy was built (Fig. 16).

To estimate the occupancy of a transport unit during a tour was used the KNN training algorithm. The model was trained and obtained a forecast based on a dataset. For example, in Fig. 17 it is observed that KNN estimated for the SJU/TUC cycle 5:45/21:45 semi service, the highest occupancy on Friday, and the lowest on Thursday.

With KNIME, supervised learning algorithms can also be applied. A new analysis of the SJU/TUC cycle 5:45/21:4semi-service was carried out by training a neural network of the RProp MLP type [48]. Fig. 18 is presented the network training to estimate which services are more expensive.

The network was trained with the variables per diem, service expenses, breakage costs, etc. Assuming that the interest is to study the expenses presented by the SJU / TUC 5:45/21:45 semi-route service, Fig. 19 shows a higher expense on Mondays.

7. Conclusions

This paper analyzed the trend in the search for information related to IoT, CI, BI, and BA. We conclude that: globally and in a five-year range, the most searched terms are BI and IoT. In third place is BA, and, in Argentina, the search for BI predominates. So IoT and BA are even. Finally, CI does not present evidence in either of the two cases. In terms of publications, taking the years 2019 to 2021 as a reference, the panorama varies from that of searches. We observed a broad growth in publications on CI and BA.

We analyzed the advances and benefits of integrating technologies to reactivate commercial and service sectors affected by the global pandemic. These technologies with health protocols are the starting point to activate the transport and tourism sectors.

We made a background check on two indispensable services for humanity: health and transportation. We identified that the health area reflects a widely developed technological integration, which places it in the first place concerning other services to ease the global crisis. However, long-distance land and air transport have not presented the same progress. We could say that the sector is globally paralyzed. We made comparisons about technological advances and integrations worldwide concerning Argentina. Specifically, we identified only proposals from China, India, and Argentina.

Given this analysis and the lack of actions to face the new challenges of citizen circulation, guidelines we proposed to be followed as part of a strategy that, combines different technologies, and allows reactivating this sector. The importance of having a centralized database in the cloud was highlighted, where all companies converge and provide updated information on citizen circulation. Likewise, the active participation of the State by viewing and analyzing this database to take preventive actions. Also, identifying patterns and making predictions of future behaviors.

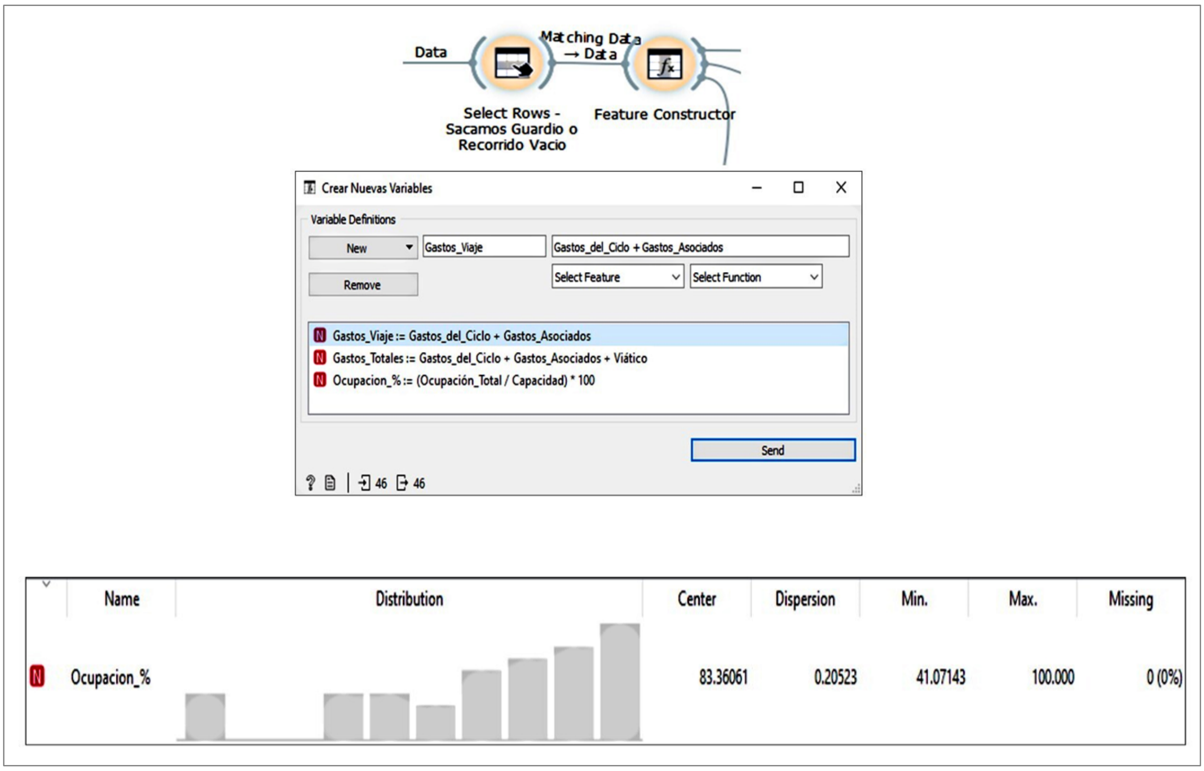


Fig. 16. Construction and display of a new attribute. Source: self-made.

kNN	Num Escenario	Dia Semana	Ciclo	Descripción	Tipo de Servicio
81.786	13	viernes	SJU/TUC 05:45/21:45	semi	normal
78.450	6	viernes	SJU/TUC 05:45/21:45	cama/semi	normal
80.046	10	martes	SJU/TUC 05:45/21:45	semi	normal
74.826	3	martes	SJU/TUC 05:45/21:45	cama/semi	normal
77.439	7	sábado	SJU/TUC 05:45/21:45	cama/semi	normal
78.937	14	sábado	SJU/TUC 05:45/21:45	semi	normal
73.151	9	lunes	SJU/TUC 05:45/21:45	semi	normal
82.209	2	lunes	SJU/TUC 05:45/21:45	cama/semi	normal
73.441	8	domingo	SJU/TUC 05:45/21:45	semi	normal
80.318	11	miércoles	SJU/TUC 05:45/21:45	semi	normal
76.224	4	miércoles	SJU/TUC 05:45/21:45	cama/semi	normal
78.236	1	domingo	SJU/TUC 05:45/21:45	cama/semi	normal
72.143	12	jueves	SJU/TUC 05:45/21:45	semi	normal
66.944	5	jueves	SJU/TUC 05:45/21:45	cama/semi	normal

Fig. 17. Prediction using KNN supervised learning algorithm. Source: self-made.

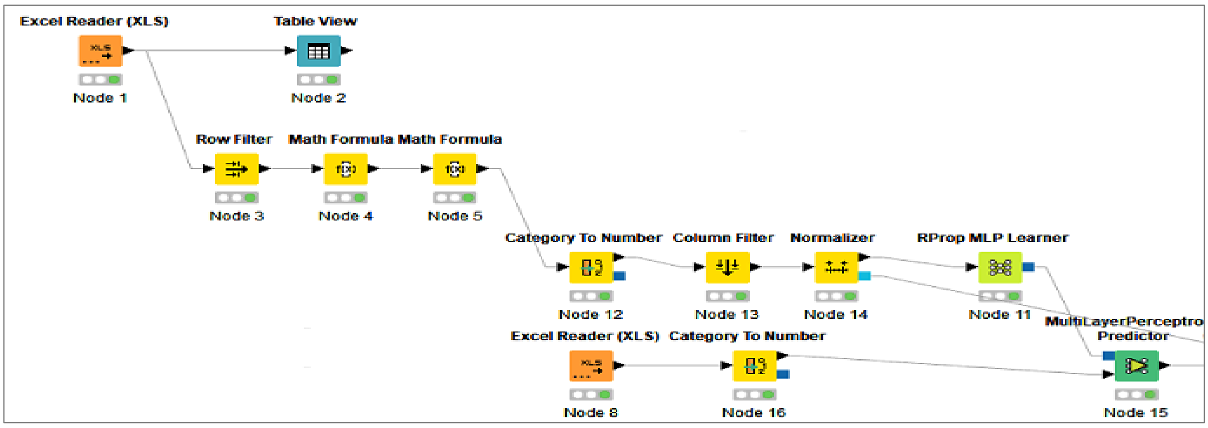


Fig. 18. Training MLPRProp network with KNIME. Source: self-made.

Denormalized output - 0:18 - Denormalizer

e Hilite Navigation View

ble "default" - Rows: 14 | Spec - Columns: 12 | Properties | Flow Variables

Row ID	I Num Es...	S Dia Se...	S Ciclo	S Descrip...	D Gastos...
Row8	9	lunes	SJU/TUC 05:45/21:45	semi	25,959.877
Row6	7	sábado	SJU/TUC 05:45/21:45	cama/semi	24,185.401
Row13	14	sábado	SJU/TUC 05:45/21:45	semi	23,845.248
Row5	6	viernes	SJU/TUC 05:45/21:45	cama/semi	22,979.931
Row9	10	martes	SJU/TUC 05:45/21:45	semi	22,581.556
Row7	8	domingo	SJU/TUC 05:45/21:45	semi	21,529.724
Row4	5	jueves	SJU/TUC 05:45/21:45	cama/semi	21,035.659
Row12	13	viernes	SJU/TUC 05:45/21:45	semi	19,301.47
Row3	4	miércoles	SJU/TUC 05:45/21:45	cama/semi	18,643.544
Row2	3	martes	SJU/TUC 05:45/21:45	cama/semi	16,596.218
Row1	2	lunes	SJU/TUC 05:45/21:45	cama/semi	16,474.27
Row11	12	jueves	SJU/TUC 05:45/21:45	semi	14,229.383
Row10	11	miércoles	SJU/TUC 05:45/21:45	semi	12,945.995
Row0	1	domingo	SJU/TUC 05:45/21:45	cama/semi	12,202.149

Fig. 19. Result of the RProp MLP KNIME model. Source: self-made.

Tests were carried out with algorithms and open-source tools, allowing the analysis of an image dataset and data that can be collected by different IoT devices. Features were obtained from those images and then clusters could be formed. Finally, using a local company's database, and supervised and unsupervised algorithms we made visualizations, and predictions. Therefore, it was shown that Orange and KNIME allow the discovery of data and behaviors.

Therefore, the ideal situation is that a large amount of data in different formats generated IoT, later processed by CI, and finally visualized and analyzed with BI and BA. In this way, whatever institution manipulates them will use precise data to make the right decisions.

Open-source tools are available to everyone, and devices such as IP cameras are relatively inexpensive. Therefore, the State and companies must implement technological integration to reactivate the labor market.

Competing interests

The authors have declared that no competing interests exist.

Funding

The work was supported by the project Organizational Information Systems for Decision Making. Resolution No. 0591-20-R-CICITCA – San Juan, Argentina.

Authors' contribution

MR conceived the idea and wrote and revised the manuscript.

MR and HL conducted the experiments and analyzed the results.

All authors read and approved the final manuscript.

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Citation: M. Romagnano and H. Lépez. *Technological Integration to Reactivate Paralyzed Organizations.* Journal of Computer Science & Technology, vol. 23, no. 1, pp. 55-70, 2023.
DOI: 10.24215/16666038.23.e05
Received: April 22, 2022 **Accepted:** October 24, 2023.