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Optimization of the Health and Safety Protocol for Covid-19 through the use of the QR Code in the Tailing Disposal System Project, Quellaveco - Moquegua, 2020

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ABSTRACT

The purpose of this research work is to optimize the occupational health and safety protocol by increasing distancing and mitigating physical contact to prevent the spread of Covid-19, using QR catches to identify personnel. Contrasting the sanitary measures to protect the health and integrity of the personnel of the operations area of the Tailing Disposal System -Quellaveco project.

For the study of the database, factor analysis is used as a multivalent statistical method, with this method the number of 997 daily reports was analyzed, addressing the study of the structure of correlations between a large number of variables, factor analysis assists in the selection of a representative subgroup of variables and creates new variables called factors, when performing the analysis and treatment of 24 variables with the SPSS 25 software, the variables with the correlation matrix were reduced to 13, and with the total variance explained, a matrix different from that of identity was defined, reducing the dimensionality of the problem from 13 to 5 factors.

Keywords— QR Code, Factor Analysis, Covid-19

I. INTRODUCTION

The mining sector is always in constant global competitiveness, as a consequence mining companies seek to increase the efficiency of their production processes so that operations are increasingly profitable. However, at the beginning of 2020 the expansion of Covid-19, an infectious disease caused by a type of SARS-CoV-2 virus, recently discovered paralyzed much of the mining activities.

The present research work aims to improve the process of social distancing in mine through the use of Scanner by QR code, which after performing an analysis of the points necessary for controls where physical contact is high. The implementation of QR code, facilitates the management of personnel or collaborator during the necessary activities in the project such as staff recognition, transfer, supervision of collaborating personnel, among others, minimizing personal approach.

1.1 General Objective

Optimize the occupational health and safety protocol by increasing distancing and mitigating physical contact to avoid the contagion and spread of Covid-19 by implementing QR catches for identification of Tailings Disposal System project personnel at each meeting point, mobile unit, and work front.

1.2 Specific Objectives

- Contrast the sanitary measures to protect the health and integrity of the personnel of the operations area avoiding the contagion and spread of Covid-19 through the strategic selection of the location of the concentration points.
- Systematize the personnel identification procedure by implementing QR readers at each meeting point, mobile unit, and work front.
- Mandatorily regulate the use of Distance Social software to ensure social distancing and measure the proximity between workers through the Smartphone.

II. THEORETICAL FRAMEWORK

2.1 Background to the Study at the Local level

The superintendent of the health of Anglo American, doctor Renato Vargas Zegarra, indicated that the molecular test will be implemented in a general way in the project, it will be applied to all workers who enter the Project. "With this additional control, we will have accurate information on the health condition of each worker, minimizing the risk of presence and potential infections of Covid-19 in the Facilities of the Project," said the person in charge of the medicine area of the Quellaveco project (AAQ, 2020, p. 1).

In the Covid-19 situational report of the company Pevoex, the following is detailed: the situation of the working groups in the front of Presa, Cyclones, and Supermix, to the 28th working day. Pevoex, the JJC-Besalco consortium, and Supermix asked the International Clinic to carry out the rapid tests to the collaborators in the Salveani topic, resulting in four PR Positive collaborators to Covid-19, by medical order they went on to perform the isolation to comply with the quarantine (Pevoex, 2020).

2.2 Background to the Study at the National Level

The Bateas Mining Unit, located in the province of Caylloma Arequipa, published that given the extension of the State of Health Emergency due to

Covid-19 until September, it decided to voluntarily and temporarily postpone mining operations for 14 days. For this, it will only maintain a small team of workers to guarantee the maintenance of diligence and critical tasks, in conditions of safety, health, and environmental care (RM, 2020, p. 1).

In Shougang Hierro Peru, the iron mine belonging to Shougang Group Co. of China has paralyzed its operations following the measures imposed throughout the country to combat the spread of Covid-19, Bloomberg reported citing the portal Mysteel.com. the portal reported that mining activities will be interrupted from March 16 at least until March 31. Port iron ore reserves can guarantee exports at least until March 31, Mysteel reported (IIMP, 2020, p. 1).

On the other hand, the Institute of Mining Engineers of Peru (IIMP), a few months after the pandemic began, few imagined that the Coronavirus would spread to the point of becoming a pandemic that would cross our borders. Perhaps because of its distant origin (in Wuhan, China), at first it was seen with some uncertainty, but today we see that its effects already wreak havoc in our country. By 2020, Peru, as in most countries, will face unprecedented challenges in the fields of health and the national economy (IIMP, 2020).

For its part, the portal Tiempo Minero (TM), Peru currently faces one of its greatest economic challenges in the XXI century due to the decrease in the demand for raw materials, the closure of borders, and the State of Emergency that forces the total paralysis of almost all productive activities, these represent 60% of Peru's non-traditional exports, fell drastically this 2020 because of the Covid-19 pandemic in the country (TM, 2020).

In the ME portal, what you want is to work safely, safeguarding the integrity of others and yourself. Covid-19 is very dangerous, however, it is necessary to reactivate the economy based on mining, metals are very much in need in the world, if mining operations are paralyzed other industries are also paralyzed. Finding new ways of living with leaders, workers, and all the people around us, is the lesson that Covid-19 will leave us (ME, 2020, p. 1).

2.3 Background of the Study at the International Level

Chile's large state-owned mining company Codelco, the world's leading copper producer, recorded the death of the collaborator on Wednesday (June 24) amid the advance of the pandemic in Chile. The company disseminated an internal notice communicating the death of the collaborator Mr. José Alberto Levancini worker of the foundry area of the Chuquicamata Division, although they reduced the number of workers within the tasks and have applied distancing rules to prevent contagion, the death of a worker by Covid19 worried several workers (Ramos, 2020).

The decision was announced later of the death of a third worker affected by Covid-19 from his work in the north of Chile Chuquicamata division, amid the aggravation of the pandemic in Chile, which adds approximately 260,000 infections and 5,000 deaths confirmed by the Coronavirus. As a preventive provision and in the face of the complicated situation that the region of Antofagasta and the city of Calama are experiencing due to the health emergency of the Coronavirus, the Chuquicamata division has been conclusive in stopping the tasks in the smelting and refinery areas (Ramos, Natalia; Giraldo, Marion; Charme, Rodrigo, 2020).

For both Chile, mining companies with operations in Peru have evacuated the vast majority of their workers, leaving in each operation only the personnel indispensable to ensure a minimum level of technical operation, complying with the standards given by the government. This, of course, has affected normal production and there have been delays in some operations and huge losses in the face of the slowness of the supply chain (TM, 2020).

For Laing (2020) the global Covid-19 pandemic has not only caused deaths. The mining sector is no stranger to these impacts, and the crisis has the potential to have serious short-, medium- and long-term consequences for mining. It is time to assess these impacts and give their importance for the industry to perform for economic development, a task that is now crucial to academic research (Laing, 2020).

According to (Bernauer & Slowey, 2020, p. 01) it is becoming increasingly evident that this crisis has significant and lasting effects concerning extractive industries and indigenous communities. In the case of Canada, researchers need to pay attention to and study those affected by the pandemic, to help indigenous communities and develop new strategies to cope with changes in relations between industry and communities. News headlines soon moved from cruise ships to mines. The Canarian coal mine had the misfortune of presenting cases and did not have any warning of Covid-19 was in the area of the group of respiratory and febrile infections that affects the health of the worker, and that in two weeks to 23 deaths. After that, the doors opened, so that by mid-April more than 7,000 deaths, one-fifth of all the U.S. (Sloane, 2020, p. 03).

2.4 Background to QR Code uses QR

Codes are widely used in various settings, such as consumer advertising, business tracking, ticketing, and marketing. People tend to scan QR codes and trust their content, but there is no standard mechanism to provide authenticity and confidentiality to the content of the code. Attacks such as redirecting to a malicious website or infection of a smartphone with malware are realistic and feasible in practice (Focardi, 2019).

China, in a powerful country for the use of technology and mobile devices, has launched a system based on big data, a mobile app, and the use of QR codes to identify the possible degree of affectation of individuals and thus limit/control their movements. Users must install an app on their mobile that is responsible for

generating and assigning an identifying QR code. This QR can have three states as a traffic light (Sancho, 2020, p. 1).

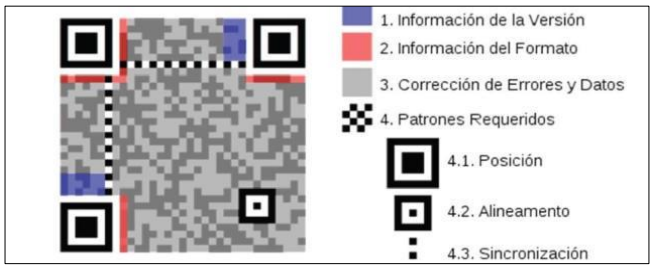
In addition, the use of the system uses the GPS of the cell phone to determine if a person has been in risk areas or near infected people and is used to enter both residential buildings and offices and public transport. One of the most advanced measures was the creation of a personalized QR code that indicates according to the state of health and depending on the probability that a person is infected with the virus or not (Sanchez, 2020).

Finally, for (García & Cuevas, 2014) by not having control in the personnel that is within an institution, company or organization leads to identity theft, it is proposed the implementation of this system that will help, in social distancing, to control this type of unwanted situations. In this way, it is intended that when using QR codes the data of the staff is protected.

2.5 Theoretical Basis

At present, technology advances very fast and the creation of codes with the data of the person who wear identification of the collaborator of the company Pevoex, as it is known, the QR codes, are based on patterns, this due to the detection of the position of the code that allows its easy and fast reading, so it is also possible to implement an application that allows the creation of these codes in PHP through a mobile device, the latter because it is easier to access smart devices than to a code reader itself (García & Cuevas, 2014).

Figure 1 shows the structure of the QR in which you can see the main points that are vital in the reading



of the data that the image can contain.

Figure 1: Structure and function of a QR code

In the graph the QR code is observed, it lends information of the version, format, error correctors and data, the required patones. Source: (García & Cuevas, 2014).

The quality of the image is very important since on it depends on the correct reading of the data it includes, there are four types of image: L, M, Q, and H; type H allows code to be read more efficiently, but decreases the capacity of the code. In general, a QR code is an array of black and white dots, which has the data encoded in binary. Wear a special marker on three of the four corners of the square to know the orientation. In addition, they are protected by an error correction code. For the design of a QR code, you have to take into account two important factors density and error correction. Up to 30% of errors can be corrected with the QR error correction system. For decoding, it uses a DES (56-bit) algorithm. The QR is read with a smartphone (SOZPIC, 2020).

The QR code has a representation of an array of bits to make identifications by a scanner of any device that has a QR reader, the bits allow the scanner to identify and orient the image, as well as to orient the information, version, and format (Yang, Sanabria, Wu & Zhu, 2014, p.04).

The concentration of information is varied; is capable of encoding all ASCII characters in addition to binary information; it is omnidirectional and can be read from a mobile device, which allows actions to be performed automatically on the device itself (Gonzalez & Garcia, 2016, p. 4).

III. MATERIALS AND METHODS

For the optimization of the safety and health protocol for Covid-19 through the use of the QR code, each worker will have an identification QR code, and also the QR reader will be linked to a link or link of a database to record the symptoms of Covid-19 daily, the monitoring, control of the health and integrity of the worker will be suppressed some manual control processes, ensuring social distancing with the social APP.

3.1 Type and Design of Research

The research according to the purpose is applicative, type of research is applied technological, in terms of the data manipulation method is quantitative and qualitative (Hernandez, Fernandez, & Pilar, 2014, p. 127).

The research design of this project is correlational, these designs describe relationships between two or more categories, concepts, or variables at a given time and the type of design to be used is descriptive transversal design (Hernandez, Fernandez, & Pilar, 2014, p.157).

3.2 Population

The population is constituted by a total of 32 workers in payroll, personnel in front of cyclones and dams, who work in the area of the Disposal Tailing System - Quellaveco Moquegua Peru 2020 project.

3.3 Sample

The sampling is constituted by the entire group of workers who work in the Pevoex company in the area of the Disposal Tailing System – Quellaveco Moquegua Peru 2020 project.

3.4 Materials and Equipment

3.4.1 Materials

- Photo check holder
- QR Photo check
- QR stickers
- Laptop to process data
- Printer
- Camera

- Infrared thermometer
- QR Reader Equipment.
- Smartphones.
- Computer.

3.5 Software

- Software Distance Social, Altiria
- Software Sublime Text 3
- Software PHP
- Software SPSS 25
- Software Microsoft Office: Word, Excel, PowerPoint.
- Software SAP MM
- Software modulo SAP ERP HCM
- PowerPoint.
- Software SAP MM.
- Software modulo SAP ERP HCM.

3.6 Method and Procedure

3.6.1 Methodology

The research will be developed in the Disposal Tailing System Quellaveco project, developing the methodology according to the respective Figure 2.

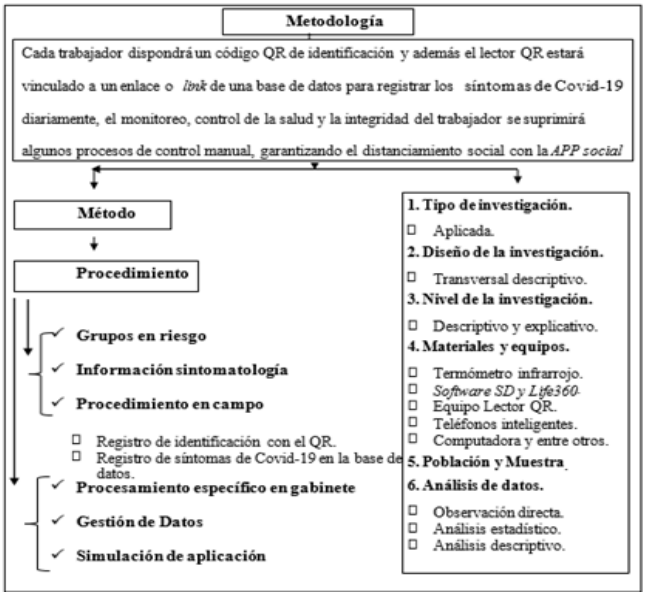


Figure 2: Methodology development

3.4.2 Procedure

As shown in Figure 3, According to (Bonsall, Parker, & Fraser, 2020, p. 5) the personnel checkpoints in your rooms will be identified, transport units, work areas, and other points where the use of the QR code, additionally has a Covid-19 control process flowchart, as shown in the following Figure 4.

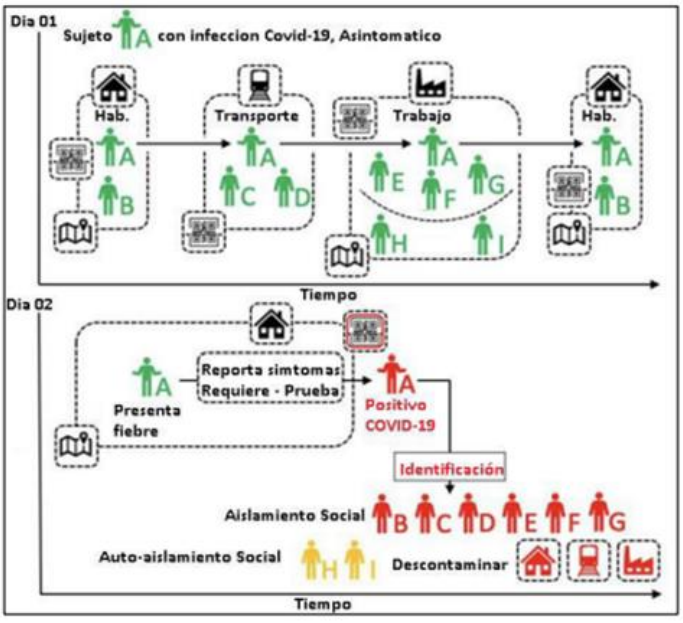


Figure 3: General control point distribution diagram

General diagram of the distribution of control points with QR, Taken and adapted from Sustainable containment of Covid-19 using smartphones in China. (Bonsall, Parker, & Fraser, 2020, p. 5).

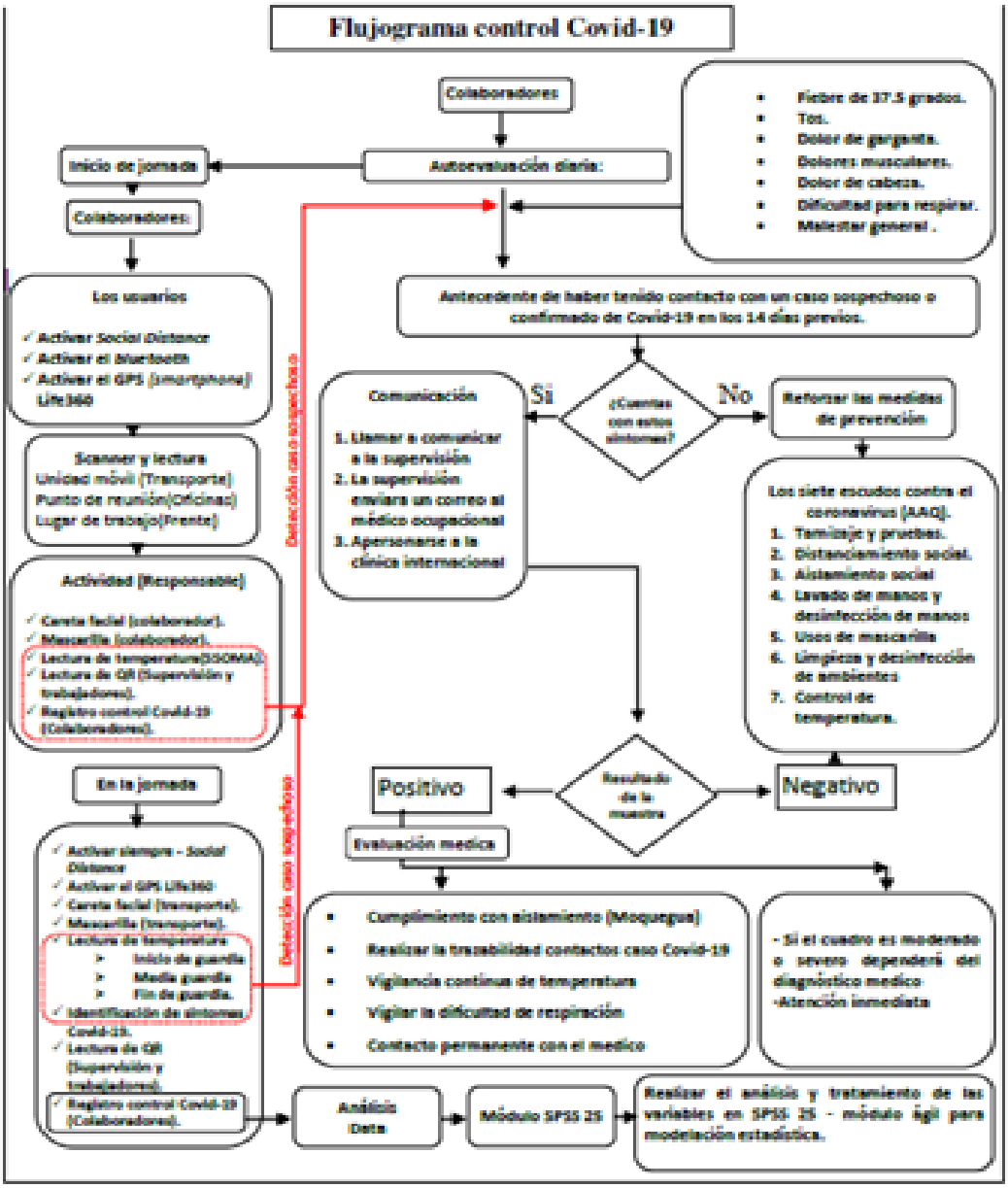


Figure 4: Covid-19 control flowchart

3.4.3 Processing

By using the QR reader on mobile devices in QRDroid and QRcode, it allowed to read, share and use these codes, and for the implementation of the project, the QR is linked to a database to record the symptoms in the Covid-19 Pevoex control, to evaluate daily the health and integrity of the worker, This database is on the Google Forms platform (Software), where each worker has an identification QR code and allows to suppress some identification control processes, guaranteeing social distancing. The processing, in general, considers people who are within the risk group to Covid-19, prioritizing the realization of remote work and refraining from entering the Quellaveco project, as long as the health emergency lasts (D.S. 0102020 TR / RM 193-2020 MINSA).

Exceptionally, the personnel of risk group that expresses their desire to attend to work in activities authorized by the government may send their intention through an affidavit of voluntary assumption of responsibility, following the provisions issued by the Ministry of Labor and Employment Promotion, in coordination with the Ministry of Health (DS 083-2020 PCM, RM 135-2020 MINEM/DM).

According to THE RM 128-2020 MINEM/DM, the Personnel Symptomatology Sheet contains information on:

- Symptoms: Verifying symptoms compatible with Covid-19.
- Risk group: If you belong to the Risk Group for Covid-19.
- Contact: Obtaining contact information with a suspected or confirmed Covid-19 case, specifying the date of contact.
- Travel abroad: Not having made or been in contact with someone who has traveled abroad.
- Use of current medication: detailing medication used by the patient.

3.4.4 Field-Specific Processing

A. The supervisor or any worker responsible for the task, performs the temperature reading with an infrared thermometer and the QR readings with a reader or with a Smartphone, to verify the personal data, the identity number of the collaborator, the telephone number, and the QR contains a link or link to update the daily Covid-19 control record of each collaborator.

B. With the QR reader or with a Smartphone they will be connected through the link in the database, where: their identification will be recorded and the temperature validation will be with an infrared thermometer at the time of boarding the transport or start of the guard.

C. The QR link will be used to register and update the daily Covid-19 control, it will be during the development of the day and rest in the mining camp.

D. In the link that contains the QR, it allows the registration of the identification and registration of temperature at the end of the day, since; the symptoms do not have an exact time to appear, but it will depend on the collaborator, for this reason, the imperative need to do it constantly is seen and its evolution can be evidenced during their days in the project.

3.6.5 Specific Processing in Cabinet

At the end of the day, a dynamic statistical report is generated over time verifying the average increase in QR readings, the percentage of participation in the Covid-19 control registry, the monitoring of participation by charges, and individually of each collaborator, as can be seen in Figure 5.

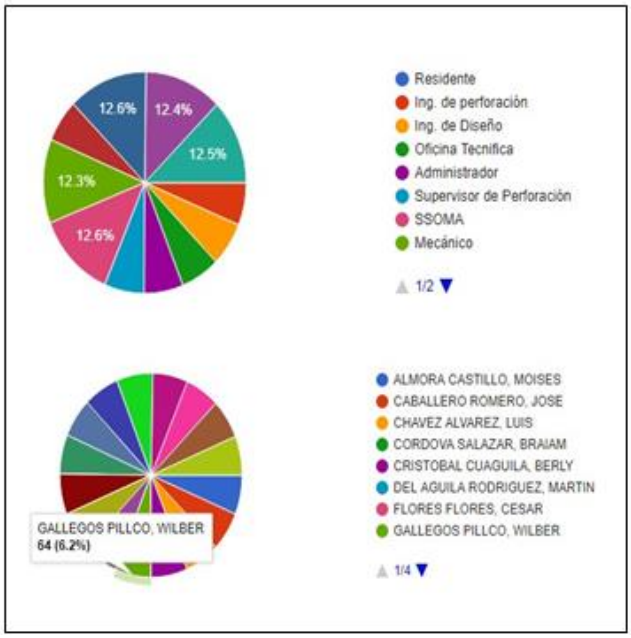


Figure 5: Daily statistical report control Covid-19 Pevoex

Note: At the end of the day, the monitoring was carried out, the position and name of the collaborators in the registry and daily statistical report control Covid-19 Pevoex.

3.7 Data Management

Distribution and statistical analysis at the end of the day, a statistical report on Covid-19 monitoring will be generated, as shown in Figure 6.

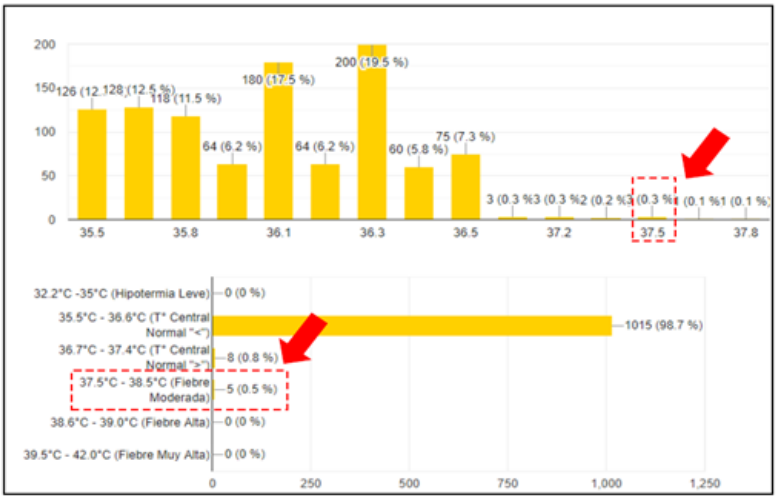


Figure 6: Statistic at the end of the temperature monitoring day

Note: Monitoring temperature reading and temperature scales, with alert attention in readings greater than or equal to 37.5 °C meaning that they present moderate fever in the collaborators, daily statistical report Control Covid-19 Pevoex.

For the application of the project, the following process was designed: Update of the identification photo check, which includes the QR code that will have as information the following: Personal data, position or position of the collaborator, ID number, and telephone. As shown in the localhost.

For the project, the identification photo check was designed, which includes the QR code that contains the following information: Personal data, position or position of the collaborator, ID number, and telephone. As shown in Figure 7.

Figure 7: Photo check of identification with QR.

Note: Photo check identification, contains the QR code that will have as information the identity of the worker and a link to update the Covid-19 control record.

Implementation of QR code through stickers on each of the workers' helmets, QR stickers on the safety helmet, and identification photo check to the SSOMA supervisor as shown in Figure 8.

Figure 8: QR code on helmets and SSOMA ID photo check

Execution of QR code readings through the QR Scanner application, in each of the workers' helmets, this identity control methodology facilitates and helps to maintain the distance between the collaborators, as shown in Figure 9.

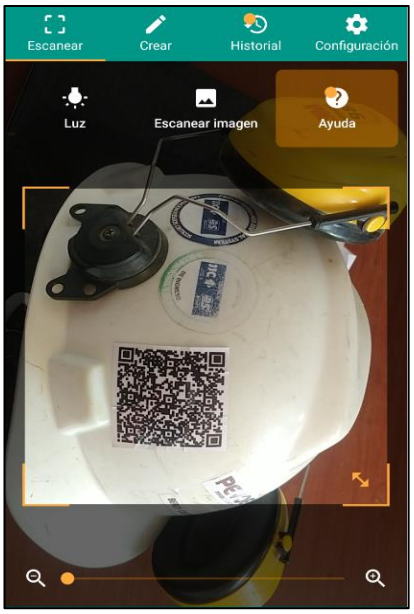


Figure 9: QR code reading using the QR Scanner app

Note: Reading of QR stickers on each of the employees' helmets.

QR reading of the photo checks using the mobile device, on each of the buses that transport camp personnel to the project, as shown in Figure 10.

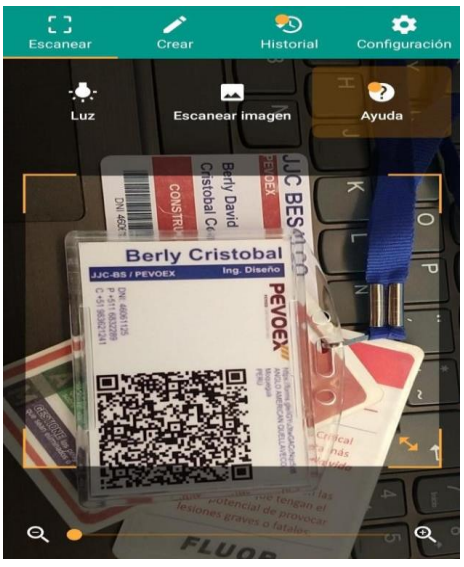


Figure 10: QR reading in The Fotocheck

The first identification control is when the staff boards the buses from camp to the projector at the beginning of the day, which must scan their photo check in the QR reader.

For the implementation of the project, there were 03 units QR Code Reader 2 Two-dimensional Wireless Ccd, it will also be a working instrument of the

command line in the work areas where there is no internet coverage.

Finally, the collaborator should only attend the talk or safety meeting in case one is scheduled, always respecting the social distancing protocol with the help of the Social Distance application that detects the Bluetooth signals of all nearby devices.

The Social Distance application detects the Bluetooth signals of all devices, It uses two conditions to work: distance and time, in addition, it detects nearby Bluetooth signals, online users in the background. Distance and time are configurable to the need of the collaborator and present a warning alarm (Torres, 2020).

In the Disposal Tailing System project, employees always keep the Bluetooth of their mobile devices activated, additionally the volume of the mobile device is configured in an average volume, to disturb the worker's environment with the alarms it emits to the Social Distance application.

3.8 Analysis Factorial

To perform the factor analysis and the treatment of the variables, the SPSS 25 software was used, as shown in Figure 11.

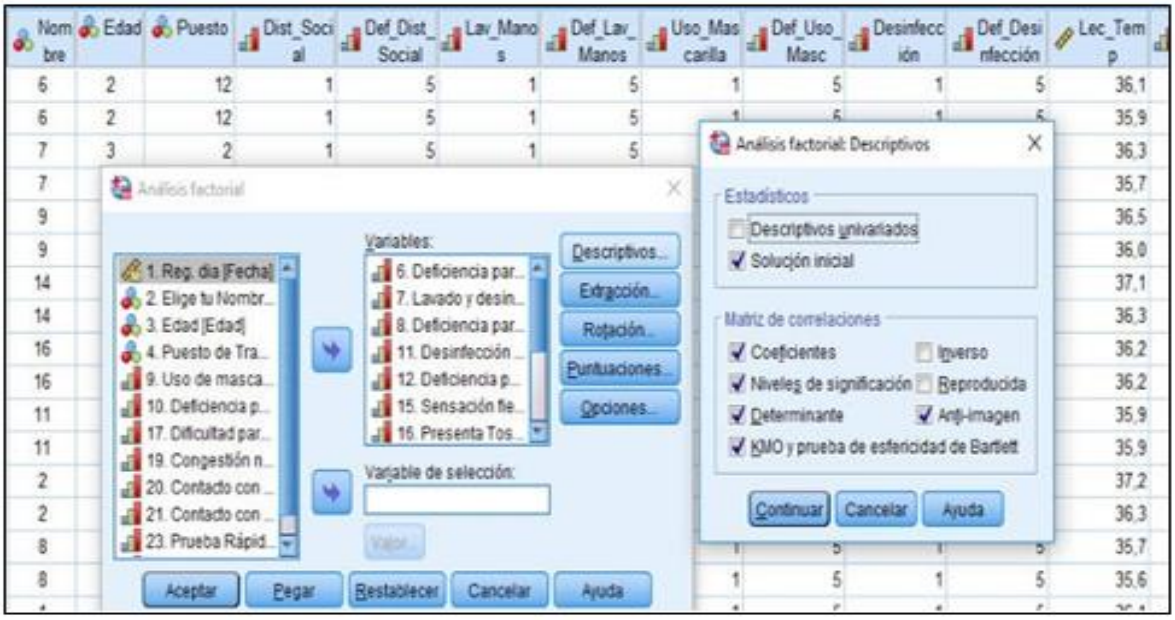


Figure 11: Treatment of the 24 variables in SPSS

For the analysis of results, it was convenient to exclude variables number 09, 10, 17, 20, 21, and 23 because these variables have very low or no correlations.

3.9 Barlettç Sphericity Test

To clarify the relevance and possibility of a factor analysis based on the data obtained through the research questionnaire, the KMO sample adequacy (Kaiser, Meyer-Olkin) was verified (Carmona, 2014, p. 02). The results justified acceptable goodness of fit with a coefficient greater than 0.5. The results of Barlett's sphericity test (p = .000) showed that the correlation matrix is distinct from the identity matrix. The results showed that they demonstrate the competence to the application of factor analysis. The degrees of freedom of the adjustment is acceptable, justifying the AF since the kmo sample adequacy measure (0.605) takes a value greater than 0.5, and Bartlett's sphericity test, therefore, shows that the correlation matrix is different from the identity matrix see Table 1.

Table 1: KMO and Bartlett test for the possibility of factor analysis.

KMO y Bartlett	
Measure Kaiser – Meyer – Olkin sampling adequacy	0.605
Sphericity test of Bartlett – Aprox. Chi – square	14884.547
Gl	78.00
Sig.	0.00

3.10 Communalities

The calculation was executed from the matrix of factorial loads. In the matter of main components, it was computed retaining all the variables, the commonality is always 1, in the extraction no discriminant value is appreciated, since, all are greater than 40%.

In SPSS 25 it shows an initial tentative solution of factorial type. In the case of extraction by main axes, the commonalities are those shown in Table 2.

Tabla 2: Communalities

Communalities	Initial	Extraction
5. Social distancing.	1.000	0.954
6. Deficiency for social distancing.	1.000	0.953
7. Hand washing and disinfection.	1.000	0.982
8. Deficiency for hand washing and disinfection.	1.000	0.982
11. Disinfection of the work environment.	1.000	0.994
12. Deficiency for disinfection of the work environment.	1.000	0.994
13. Temperature reading.	1.000	0.737
14. Temperature in the table.	1.000	0.935
15. Feeling fever.	1.000	0.920
16. Presents a cough.	1.000	0.725
18. Throat pain.	1.000	0.994
22. History of Covid-19.	1.000	0.938
25. Social isolation (by Medical Order).	1.000	0.925

3.11 Total Variance Explained

The total variance explained lends us the choice of the number of factors to consider in the model that can be made according to various discernments. A reasonable estimate consists in reasoning the meaning of self-values, indicators of the proportionality of variance explained. For this case, the total variance, the sum of the self-values is 13.

Thus, the first factor explains 25.48%, the second 18.96%, the third 15.69%, and the fourth 14.49%, indicating that the first five factors together explain 88.78% of the total variance. It is logical to select these five factors, reducing the dimensionality of the problem from 13 to 5 factors, as shown in Table 3.

Table 3: Total variance explained

Factor	Initial eigenvalues			Sums of loads squared from the extraction			Sums of charges squared in the rotation		
	Total	% variance	% accumulated	Total	% variance	% accumulated	Total	% variance	% accumulated
1	3.312	25.480	25.480	3.094	23.800	23.800	2.832	21.787	21.787
2	2.465	18.964	44.444	2.319	17.835	41.635	2.451	18.853	40.641
3	2.040	15.693	60.136	2.011	15.466	57.101	1.979	15.223	55.864
4	1.884	14.495	74.631	1.821	14.008	71.109	1.930	14.847	70.711
5	1.838	14.137	88.769	1.762	13.554	84.663	1.814	13.953	84.663
6	0.494	3.799	92.567						
7	0.373	2.867	95.435						
8	0.358	2.756	98.190						
9	0.093	0.714	98.904						
10	0.064	0.489	99.393						
11	0.035	0.266	99.660						
12	0.032	0.249	99.908						
13	0.012	0.092	100.00						

3.12 Rotated Component Matrix

Table 4 of the component matrix shows the distribution of each variable by the grouping of the components, the participation of each variable in its respective component, and these variables will be evidenced in the grouping of the rotated component matrix.

Table 4: Component Matrix

Variables	1	2	3	4	5
25. Social isolation (by Medical Order).	0.854	0.408			
22. History of Covid-19.	0.798	0.424			
16. Presents a cough.	0.715				
18. Throat pain.	0.568				
15. Fever sensation.	0.548	-0.710			
14. Temperature in the table.	-0.625	0.690			
13. Temperature reading.	-0.436	0.526			
11. Disinfection of the work environment.			0.897	-0.418	
12. Deficiency for disinfection of the work environment.			-0.896	0.419	
5. Social distancing.			-0.308	-0.620	0.650
6. Deficiency for social distancing.			0.320	0.630	-0.636
7. Hand washing and disinfection.		0.525		-0.521	-0.578
8. Deficiency for hand washing and disinfection.		-0.522		0.520	0.576

Orthogonal rotation was necessary for the axes, keeping the perpendicularity while using the Varimax method aimed at maximizing the variance of the factors, which makes some factors have high values and others low.

The matrix of rotated factors with Varimax and the transformation matrix is shown in Table 5, the values of the matrix with the extraction method: principal component analysis, and the rotation method: Varimax with Kaiser normalization, the rotation has converged in 5 iterations. The rotated factors indicate that variables 16, 22, and 25 have the high load in the first factor, while 13 and 15 have high in the second and high inverse load in the 14, it can be said that the first depends on a different mechanism than the others.

Table 5: Rotated Component Matrix

Variables	1	2	3	4	5
25. Social isolation (by Medical Order).	0.968				
22. History of Covid-19.	0.932				
16. Presents a cough.	0.749				
18. Throat pain.	0.664				
14. Temperature in the table.		0.988			
15. Fever sensation.		-0.961			
13. Temperature reading.		0.720			
11. Disinfection of the work environment.			0.994		
12. Deficiency for disinfection of the work environment.			-0.993		
7. Hand washing and disinfection.				0.981	
8. Deficiency for hand washing and disinfection.				-0.980	
6. Deficiency for social distancing.					0.952
5. Social distancing.					-0.952

3.13 Component Chart in Rotated Space

The reading led to the analysis of the items concerning the load and saturation with other dimensions. It will be necessary to execute the adjustments and extract exclusively the six main components through a second-order analysis in two dimensions.

The reading of the rotation graph Figure 12, reinforced the proposal of the grouping of rotated items, since the graph of components of the rotated space, do not help to identify the groups of variables.

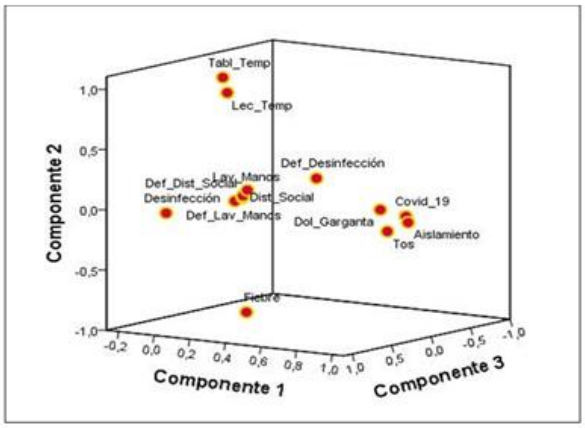


Figure 12: Component graph in rotated space.

IV. RESULTS

With the rotation method: Varimax with Kaiser normalization, the extraction of the factors was continued through a factor analysis of main components and Varimax rotation. The results of the Kaiser rule tested 5 main components that explained 92.57% of the total variance.

The first factor is made up of the variables of Social isolation, history of Covid-19, presentation of cough, and sore throat. All these variables saturate in a single factor because they constitute a specific group of variables of the correlation matrix. Therefore, they help to identify and differentiate the variables. The social isolation and antecedent by Covid-19 present a high positive correlation, it was necessary to consider the conceptual or theoretical similarity to define the allusion to the management and monitoring of confirmed Covid-19 cases. Therefore, this component and factor present a worrying behavior to the management and monitoring of the disease as shown in Figure 12, which is explained by 21.79% of the variability of the data of the sum of loads squared of the rotation of type Varimax.

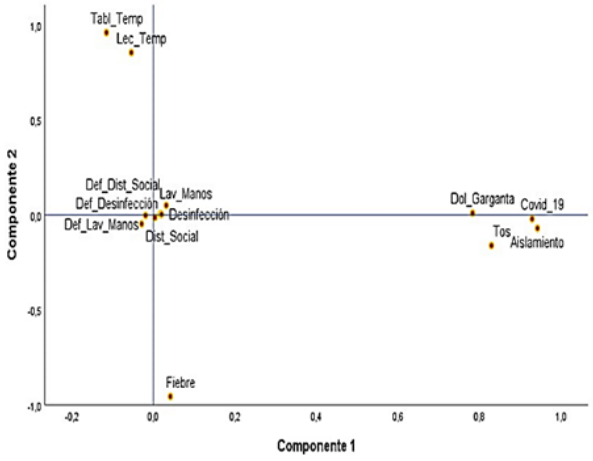


Figure 12: Graph ratio of components 1 and 2

The second factor is made up of the variables of Temperature validation and reading record. These variables saturate in a single factor because they constitute a specific group of variables, the Validation of temperature and registration present a high positive correlation, the variable sensation fever presents a high inverse correlation, it was necessary to consider the conceptual or theoretical similarity to define the allusion to the management and monitoring of the daily temperature record. Therefore, this component and factor present a behavior sensitive to the management and monitoring of temperature, as shown in Figure 12, which is explained by 18.85% of the variability of the data of the sum of loads squared of the rotation of type Varimax.

The third factor is made up of the variables of Disinfection of the work environment and deficiency for the disinfection of the work environment. These variables saturate in a single factor because they constitute a specific group, the variables present a high opposite correlation, alluding to the management and monitoring of disinfection. Therefore, this component and factor present a sensitive behavior to the management and monitoring of disinfection of the work environment, as shown in Figure 13, which is explained by 15.22% of the variability of the data.

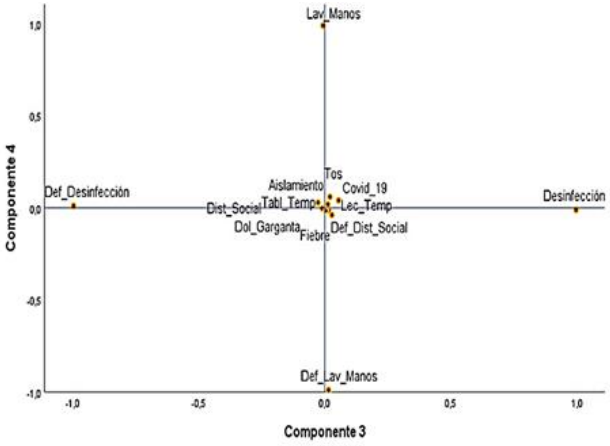


Figure 13: Graph ratio of components 3 and 4

The fourth factor is made up of the variables of Hand washing and disinfection and deficiency for hand disinfection. These variables saturate in a single factor because they constitute a specific group, the variables present a high opposite correlation, alluding to the management and monitoring of disinfection. Therefore, this component and factor present a sensitive behavior to the management and monitoring of disinfection as shown in Figure 14, which is explained by 14.85% of the variability of the data.

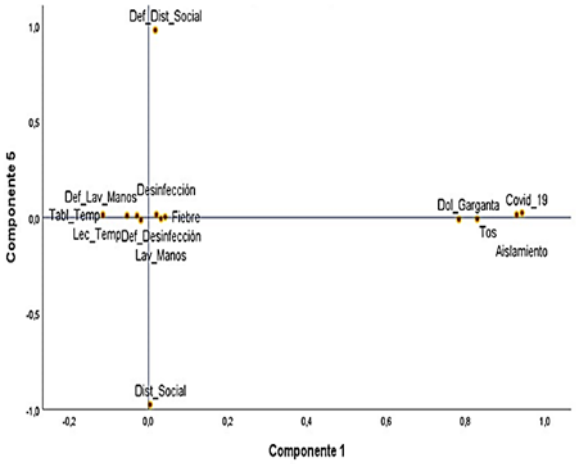


Figure 14: Graph ratio of components 1 and 5

The fifth factor is made up of the variables of Social distancing and deficiency for social distancing, with an opposite correlation to the management and monitoring of distancing, as shown in Figure 36, which is explained by 13.95% of the variability of the data.

From the analysis of results, a table that controls Covid-19 is formed, as shown in Table 6, to take corrective actions in a preventive manner, this surveillance is carried out in advance to guarantee the inherent activities of the contractually defined service.

Table 6: Table of main components for Covid-19 control

Main components for Covid-19 control			
History of Covid-19.	Yes	( )	Medical discharge less than four months – express climbs to the place.
	No	( )	Perform quarantine Pass the molecular test
Presents a cough.	Yes	( )	Give notice to the immediate supervisor Pass the medical screening
	No	( )	Collaborate - Apt
Throat pain.	Yes	( )	Give notice to the immediate supervisor Pass the medical screening
	No	( )	Collaborate - Apt
Temperature greater than 37.5º Celsius	Yes	( )	Give notice to the immediate supervisor Pass the medical screening Perform a preventive quarantine
	No	( )	Collaborate - Apt
Fever sensation	Yes	( )	Give notice to the immediate supervisor Pass the medical screening
	No	( )	Collaborate - Apt
Disinfection of work environment	Yes	( )	Enabled work environment
	No	( )	Disabled work environment
Hand washing and disinfection	Yes	( )	Continue with activities
	No	( )	Wash or disinfect your hands immediately
Social distancing	Yes	( )	Collaborate - Apt
	No	( )	Make a list of direct contacts Give notice to the immediate supervisor

V. DISCUSSION OF RESULTS

The analysis of the factors formed by the variables of: Temperature validation and reading record. It presented a high positive correlation, the variable sensation of high fever presented an inverse correlation, it was necessary to consider the conceptual or theoretical similarity to define the allusion to the management and monitoring of the daily temperature record. Therefore, this component and factor present a behavior sensitive to the management and monitoring of temperature, which is explained by 18.85% of the variability of the data of the sum of loads squared of the rotation of type Varimax.

In the analysis of the factors conformed by the variables of Disinfection of the work environment and

deficiency for the disinfection of the work environment. These variables presented a saturation in a single factor because they constitute a specific group, the variables presented a high opposite correlation, alluding to the management and monitoring of disinfection. Therefore, this component and factor have a sensitive behavior to the management and monitoring of disinfection of the work environment, which is explained by 15.22% of the variability of the data.

In the analysis of the factors conformed by the variables of: Washing and disinfection of hands and deficiency for hand disinfection. These variables saturated in a single factor because they constitute a specific group, the variables presented a high opposite correlation, alluding to the management and monitoring of disinfection. Therefore, this component and factor have a sensitive behavior to the management and monitoring of disinfection, which is explained by 14.85% of the variability of the data.

VI. CONCLUSIONS

In the present work, the identification of workers through QR codes was systematized and implemented, making readings or scans to the collaborators in the Pevoex company at each meeting point, mobile unit, and work front, minimized the percentage of physical contact among the personnel working in the disposal tailing system project area.

The implementation of QR codes and application technologies on smartphones became a very creative digital tool that allows and accelerates the use of technology to record Covid-19 control information, allowing the geolocation of collaborators, and alarms or notifications before an eventual approach between collaborators. Capturing attention allowed to be more versatile in the management variety of information, immediacy in the registration of data, the interaction between collaborators, allowing loyalty to the use of QR codes.

The implementation meant a great change in the management of the safety and health protocol for covid-19, since, previously the daily record of Covid-19 control was carried out manually in printed formats and separate folders, no type of daily monitoring regarding Covid-19 was carried out, evidencing the deficiencies in social distancing, hand washing, cleaning of the work area, daily temperature record, symptoms of Covid-19 and among others.

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