

**UNIVERSIDAD SAN FRANCISCO DE QUITO USFQ**

**Colegio de Ciencias e Ingenierías**

**Automation of information management in the Health, Safety and Environment (HSE) department of an oil operator: a customized technological solution**

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**Ingeniería Industrial**

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**HOJA DE CALIFICACIÓN**  
**DE TRABAJO DE FIN DE CARRERA**

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department of an oil operator: a customized technological solution**

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## RESUMEN

La industria del petróleo es una de las más grandes del Ecuador, y las empresas que están en esta industria tienen importantes procesos que cumplir, además incluye las responsabilidades contractuales y las regulaciones gubernamentales. Wayra Energy, tiene a cargo la operación de 3 campos en la región amazónica. Sus operaciones son de perforación y explotación de petróleo. Wayra Energy es una de las empresas de más rápido crecimiento en la región lo que ha originado un incremento en sus operaciones y responsabilidades. Todas las empresas de la industria cuentan con un departamento encargado de determinados procesos contractuales y habilitantes para la operación relacionados con la seguridad, la salud y el medio ambiente. El departamento de Salud, Seguridad y Medio Ambiente (HSE) de la empresa tiene a su cargo una de las responsabilidades más importantes de la operación relacionada con la gestión y seguimiento de la información del personal interno y externo a la compañía. La información recopilada por el departamento se utiliza para la generación de documentos habilitantes, así como informes para sus clientes y entidades públicas reguladoras.

El método de ingreso, almacenamiento y seguimiento de la información es obsoleto debido a que se realiza en tablas en Microsoft Excel sin ningún formato, ni estructura estandarizada, y no presenta ningún tipo de automatización ni en la generación de documentos ni en el seguimiento de la información. Por ello, se requiere una aplicación que les permita estandarizar y automatizar tareas que se realizan de manera repetitiva. Con esta premisa se debe emplear una metodología que permita desarrollar el proyecto. Para la realización del estudio se ha utilizado BPM (Business Process Management) debido a que permite mejorar procesos cuando se emplea tecnologías de la información. Los resultados han sido una aplicación en un entorno familiar de hoja de cálculo de Microsoft Excel que solía utilizar el personal de HSE. Mediante una interfaz amigable con el usuario, con unificación de bases de datos, monitoreo automatizado de la información, así como ingreso y estandarización de datos, de esta forma se elimina errores en el ingreso de datos, se puede realizar un monitoreo de manera más rápida y en general se puede tener una mejor visualización y manejo de la información del personal en la empresa. Esto significa un ahorro de tiempo y dinero para la empresa porque la aplicación realiza operaciones administrativas que ayudan al personal de HSE a tomar decisiones oportunas.

**Palabras clave:** BPM (Business Process Management), HSE (Salud, Seguridad y Medio Ambiente), Automatización, VBA (Visual Basic para Aplicaciones), SCRUM.

## ABSTRACT

The oil industry is one of the largest in Ecuador, and the companies that are in this industry have important processes to comply with, as well as including contractual responsibilities and government regulations. Wayra Energy, is an Ecuadorian oil operator that has been awarded for the operation of 3 fields in the Amazon region. Its operations are drilling and oil exploitation. Wayra Energy is one of the fastest growing companies in the region, which has led to an increase in its operations and responsibilities. All companies in the industry have a department in charge of certain contractual and enabling processes for the operation related to safety, health and the environment. The company's Health, Safety and Environment (HSE) department is in charge of one of the most important responsibilities of the operation related to the management and monitoring of information from internal and external personnel to the company. The information collected by the department is used for the generation of enabling documents, as well as reports for its clients and public regulatory entities.

The method of entering, storing and monitoring the information is obsolete because it is carried out in tables in Microsoft Excel without any format or standardized structure, and does not present any type of automation in the generation of documents or in the monitoring of the information. Therefore, an application is required that allows them to standardize and automate tasks that are performed repetitively. With this premise, a methodology must be used to develop the project. To carry out the study, BPM (Business Process Management) has been used because it allows improving these information processes when information technology is used. The results have been an application in a familiar Microsoft Excel spreadsheet environment used by HSE staff. Through a user-friendly interface, with database unification, automated monitoring of information, as well as automated data entry and standardization, in this way errors in data entry are eliminated, monitoring can be carried out more fast and in general you can have a better visualization and management of the personnel information in the company. This saves time and money for the business because the application performs administrative operations that help HSE staff make timely decisions.

**Keywords:** BPM (Business Process Management), HSE (Health, Safety and Environment), Automation, VBA (Visual Basic for Applications), SCRUM.

**TABLE OF CONTENT**

Introduction.....	10
Literature Review .....	11
Methodology.....	16
Case Study .....	18
Conclusions.....	35
Limitations.....	35
Recommendations/Future Work .....	36
References.....	37

**TABLE INDEX**

Table 1. BPM in the DMAIC framework.....	12
Table 2. Article analysis for the literature review.....	13
Table 3. Article analysis for the literature review.....	15
Table 4. BPM workflow implementation.....	16
Table 5. Problems found in each process key activity.....	22
Table 6. Cognitive Design Standardization Principle Example.....	27

## FIGURE INDEX

Figure 1. CTQ Tree Diagram.....	10
Figure 2. Staff Entry Process.....	20
Figure 3. Personal Protective Equipment (PPE) Delivery Procedure	20
Figure 4. Induction and Training Procedure in HSE (Health, Safety and Environment)	21
Figure 5. Defensive Driving Process	22
Figure 6. Pareto Diagram	24
Figure 7. Cause - Effect Diagram	25
Figure 8. Cognitive Design Use of Redundancies Principle Example	28
Figure 9. Cognitive Design Presentation of Clear Images Principle Example	28
Figure 10. Cognitive Design Use of Stereotypes Principle Example	29
Figure 11. New Staff Personal Information Registration Window	30
Figure 12. New Staff PPE Information Registration Window	31
Figure 13. PPE Monitoring/Update Window	31
Figure 14. New Staff Defensive Driver's Licence Information Registration Window	32
Figure 15. New Staff Defensive Driver's Licence Information Monitoring Windows	33
Figure 16. Proposed Scrum Process	34

## *Introduction*

Worldwide, the oil industry has experienced rapid growth, since too many of the products or goods used by people are derived from oil. Synthetic fabric, fuels, fertilizers, paints, soaps, and even cosmetics are examples of oil by-products. This situation has generated that this industry requires considerable demands on work force, financial and technology capabilities (Chen et al, 2014). In Ecuador, Petroamazonas EP is the Ecuadorian state company in charge of regulating all national and international oil operators that work in Ecuadorian territory. One of the companies working for Petroamazonas, is Wayra Energy, which carries out the exploration, operation and maintenance activities at oil fields in Ecuador. This company, as the other oil operators, have contractual obligations and standards to comply with Petroamazonas EP, in order to operate in the best way possible. The operations of Wayra have grown since they started their operations, raising up the volume of work at all departments, including the HSE (Health, Safety and Environment) department.

However, the last few years Wayra's HSE department, have been carrying out their daily activities in an obsolete manner. As an example, mistakes when entering information for new staff have been incurred. The 21% of the total registers the department has done, include errors. These errors, that will be deepened later, are related to incorrect information, non standardization and incomplete information. These mistakes are responsible for wasting time for the operators of the HSE department of Wayra, considering the department has made more than a thousand registers in the last year and have corrected whenever a problem presents. In this case, time is an important factor as the process under normal conditions can take up to two weeks. If data is entered incorrectly, for later being corrected, this process could take up to a month. In the study done by Breck et al. (2019), mentions that errors in the entered data can annul any advantages on speed and accuracy when talking about automation. In this way, opportunities for improvement have been detected in some activities of the HSE department

that can be automated in a certain way in order to reduce key processes times when entering data or making reports. For this reason, this project will aim to optimize the information management of the HSE department, analyzing the activities required to comply with standards and contractual agreements with their client, to reduce operating times and costs.

## *2. Literature Review*

In this section, a literature review will be handled related to the methodology that will guide this research. At the beginning, the use of the DMAIC (Define, Measure, Analyze, Improve and Control) methodology for the development of the project was considered because it can be implemented for projects within the industrial engineering area, in which an opportunity for improvement is detected and an action plan is taken. However, given the nature of the study, in which a technological problem is trying to be solved, the BPM is the one that best suits the project. “BPM helps companies focusing on value-adding end-to-end processes and supporting them with IT systems” (Thiemich & Puhmann, 2013).

At any rate, the BPM and DMAIC methodology share some similarities. Both methodologies are developed following 5 steps. In the first instance, you must define the problem or identify the initial needs of the customer. Then, the current process must be mapped and then, as a third step, be able to identify opportunities for improvement and develop and propose improvements or changes in the processes. As a fourth step, we talk about the phase of implementing these improvements, and as a fifth step the control or management of the process through continuous improvement. For this you can use multiple tools such as VOC (Voice of the Customer), flowcharts for process mapping, Pareto diagrams to identify problems, as well as Ishikawa diagrams with the aim of identifying the causes and effects of the problem or problems identified. In Table 1 will be presented a characterization of each of DMAIC and BPM, which show similarities between them.

*Table 1. BPM in the DMAIC framework*

<b>DMAIC phases</b>	<b>BPM phases</b>	<b>Other tools facilitating BPM</b>
Define	1. Initial need analysis	<ul style="list-style-type: none"> <li>● CTQ tree diagram</li> </ul>
Measure	2. Documentation, design and analysis of the current process	<ul style="list-style-type: none"> <li>● Process Flowchart</li> <li>● Data collection</li> <li>● Cause and effect diagram</li> <li>● Pareto Diagram</li> </ul>
Analyse		
Improve	3. New Process design and structure model  4. New process implementation	<ul style="list-style-type: none"> <li>● Description of Functional and Non-Functional Requirements</li> <li>● IT Software Development</li> <li>● Video-User Manual Development</li> </ul>
Control	5. Process Management	<ul style="list-style-type: none"> <li>● Mistake-Proofing</li> </ul>

BPM methodology has some variations depending on the field of application the research is carried out. An example of this is the CBPM (Cognitive BPM). “The basic idea is to mine the data of business operations, monitor execution, gather information, and use this data to train the Cognitive System to automatically respond to business situations.” (Zebec, 2019). Another characteristic of this methodology is that the final result is based on the implementation of a technological solution. The principal objective of CBPM is automation (Zebec, 2019). The following table presents three of the researched papers related to the BPM

methodology and a brief description of their content, which were used to perform an analysis and take a decision on the methodology mentioned before:

*Table 2. Article analysis for the literature review*

<b><i>References</i></b>	<b><i>Title</i></b>	<b><i>Article Description</i></b>
(Pereira, et al., 2019)	<b><i>Information systems for industrial processes support and optimization</i></b>	This paper is inspired by the digital transformation of industry 4.0. It indicates the implementations that were made in VBA in order to reduce time, money and resources within a Toyota branch in Portugal. The methodology used in this article is BPM, which is an agile methodology created for process automation.
(Thiemich & Puhlmann, 2013)	<b><i>An agile BPM Project Methodology</i></b>	This article proposes the combination of the Agile BPM and SCRUM methodology in order to develop a methodology that can overcome the limitations that can be found in traditional BPM methodologies. The contrast of both methodologies is interesting to the reader, since the paper at the end details lessons learned and how it can be done to implement this combined methodology.
(Zebec, 2019)	<b><i>Cognitive BPM: Business process automation and innovation with artificial intelligence</i></b>	The BPM methodology can be combined with Cognitive Computing. Thus, the paper proposes the CBPM methodology in such a way that information can be provided and an action can be carried out based on past or new situations. In this way, as the beginning of

		the implementation of artificial intelligence in a company, the system can learn, adapt and determine which would be the best option to carry out.
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Following the bases of the chosen methodology, the literature suggests that process mapping is necessary in the first place. “Processes often contain duplication, inefficiencies, and wasted effort that can be easily corrected once the process is clearly documented and understood.” (Pojasek, 2005). Elaborating the process mapping allows researchers to visualize the activities in a better way and to observe problems such as rework or activities that do not add value in order to propose improvement actions. “A process-focused organization can use process analysis to diagnose all types of problems.” (Prasad et al., 2018)

Due to the fact that part of the documentation carried out within the processes of the HSE department was being carried out in Excel, it was necessary to look for a software that allows the automation of the documentation and that also allows the information to be migrated without having the risk of losing data. Automation lets people use their time efficiently and is done to help them by performing repeated processes by itself. The ability an Information System (IS) can add value in an activity is the performance of continuous revision and management of information which otherwise the human would have to do by themselves. That is the main reason for Zebec (2019) to propose a turn to the BPM, the Cognitive Business Process Management which has also been considered for the realization of this work, “The basic idea is to mine the data of business operations, monitor execution, gather information, and use this data to train the Cognitive System to automatically respond to business situations”. This principle has been one of the main axes for the accomplishment of the solution. Since the fact that a technological solution was considered to be implemented, literature review was carried out on programming softwares. In this way, it was found that the VBA (Visual Basic

for Applications) programming language was one of the potential candidates because it is user-friendly, multipurpose, and adaptable. (Rossato et al., 2017). The next mentioned authors agree that the automatization of their processes in VBA helps companies to compete in a highly competitive market and allows them to cope with customer needs (Pereira, et al., 2019). Additionally, Rossato et al. (2017), have identified that data quality and entry data time optimization are the VBA implementation main advantages.

*Table 3. Article analysis for the literature review*

<b><i>References</i></b>	<b><i>Title</i></b>	<b><i>Article Description</i></b>
(Pereira, et al, 2019)	<b><i>Information systems for industrial processes support and optimization</i></b>	This paper is inspired by the digital transformation of industry 4.0. It indicates the implementations that were made in VBA in order to reduce time, money and resources within a Toyota branch in Portugal. The methodology used in this article is BPM, which is closely related because BPM is an agile methodology created for process automation.
(Rossato, et al, 2017)	<b><i>A Data Entry System for Dietary Surveys Based on Visual Basic for Applications Programming</i></b>	This article shows how VBA (Visual Basic for Applications) programming language was implemented for a food and diet system called DietSys. This paper highlights how VBA can be used as a first instance when you don't have the resources to implement more complex programming software. It also mentions that VBA is the most user-friendly programming language
(Ge &	<b><i>The application and</i></b>	The explanation of how visual perception is important

Yu, 2019)	<i>design of neural computation in visual perception</i>	for people in how they see the outside world is discussed in this paper through simulation and mathematical models of which it is possible to explain the role of orientation sensitivity mechanism in visual perception by using multi -level orientation sensitivity in visual pathway, and then a visual perception model is constructed.
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### 3. Methodology

In the previous section, it was identified that the BPM methodology helps companies focusing on value-adding processes and supporting them with IT systems (Thiemich & Puhlmann, 2013). There are tools within BPM methodology that allow developing a project under a framework for planning, analysis, implementation design and deployment. There are also sprints that have served to gather information and helped to deploy the tools that will be implemented in the development of the solution as well as future continuous improvements. BPM's main objective is to develop a framework that allows continuous improvement in order to optimize the performance and efficiency of companies through process management. (Pereira, et al., 2019). In sequence to optimize the performance and efficiency of organizations through process management it has been used a workflow for the implementation, it shows as follows:

*Table 4. BPM workflow implementation*

BPM workflow	Description
1. Initial need analysis	Identify the process to be mapped, in addition to the duration, cost and your goal.

2. Documentation, design and analysis of the current process	Document, draw and analyse the existing process to improve the conditions of execution and operation.
3. New process design and structure model	Model the new development process to provide a better structure analysis and identification.
4. New process implementation	After modelling and simulating, the new process is implemented through validations that ensure its execution
5. Process management	The implemented process continues to be controlled and monitored to seek further improvements, initiating new analysis for a continuous lifecycle.

By implementing this methodology workflow it is possible to reduce operation costs and cycle time of processes and have the advantage of increasing the operational efficiency of companies to make them more competitive (Pereira, et al., 2019). Due to time constraints at the time of developing this project, it will be limited to the New Process Implementation phase.

#### *4. Case Study*

##### *4.1 Initial Need Analysis*

Wayra Energy is a company that carries out exploration, operation and maintenance activities at oil fields. It was incorporated in 2018 in Ecuador and has an important contribution of capital from foreign countries such as Venezuela and Spain. Nowadays, it is the fastest growing oil operator in the Andean region. In order to carry out its operations correctly, Wayra is structured by the following departments:

- CEO (Chief Executive Officer)
- Projects Department
- Planning and procuring Department
- Operations Department
- HSE Department
- Economics Department
- Legal Department
- IT Department

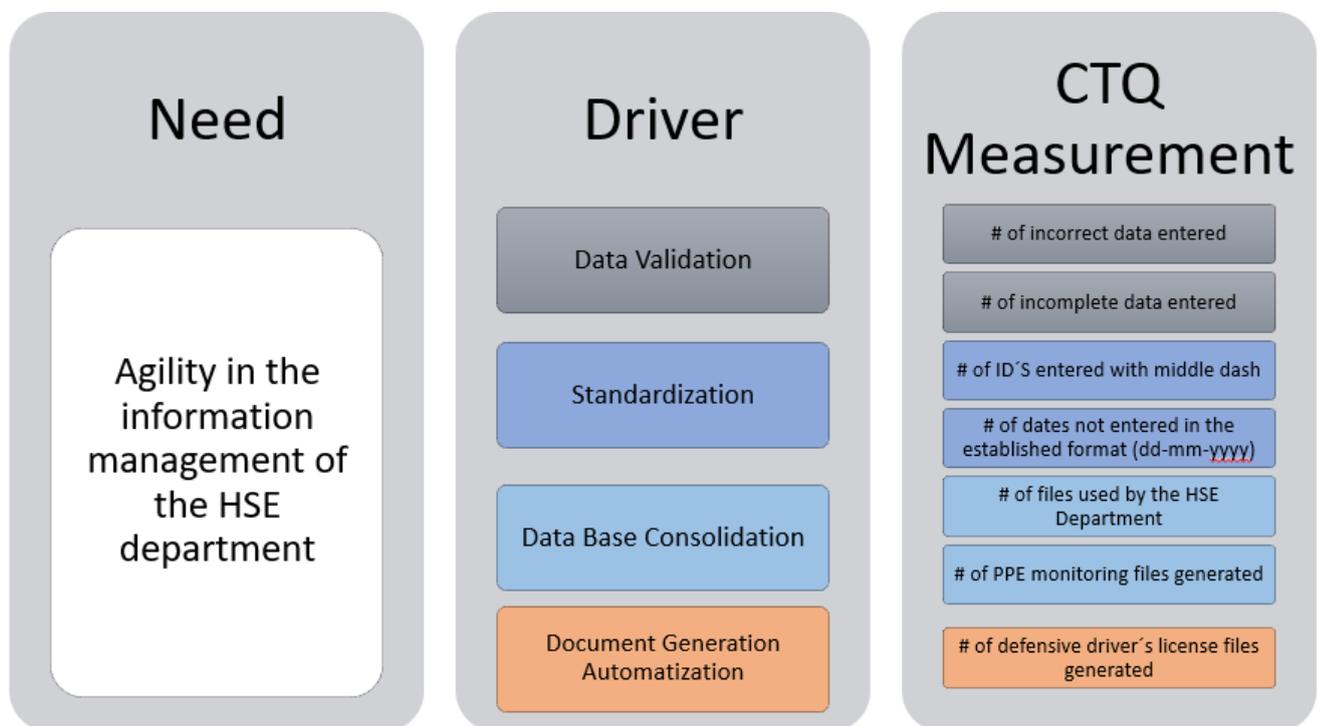
As it was mentioned, the HSE department has been experiencing problems related to the development of their activities in an obsolete manner. They do all the registration of the information in matrices and tables in a common spreadsheet without any data validation or automation. This has caused mistakes to be made when entering information for new staff.

Therefore, the HSE department's process mapping and analysis will be carried out in order to start the analysis of improvement opportunities, focused on the needs of this department. After multiple meetings with Wayra's HSE Department experts, it was understood then, that the solution to their problems could be solved with the automation of some of their processes.

Likewise, it is intended to optimize information management through the implementation of a technological solution with the purpose of improving the operation of the HSE department. The proposed solution has been an Information System that is made up by people, procedures,

data and IT components (like hardware, software and communication), which gather, process, reserve, analyse and supply information with specific functionalities (Pereira, Ferreira & Silva, 2019). Finally, the economic analysis of the implementation will be carried out and the application and effectiveness of the proposal will be demonstrated. Based on the analysis carried out and the feedback from the department staff, it was possible to establish lines of action within it. With that information, the action plan has been to work together with the department staff in order to structure the process so it can be automated. Thus, a Critical to Quality tree diagram was made in order to translate broad customer needs into specific, measurable performance requirements. In other words, help to translate the Voice of Customer (VOC) to metrics that can be measured.

*Figure 1. CTQ Tree Diagram*



#### *4.2 Documentation, design and analysis of the current process.*

Based on what have been mentioned before, the first step is to diagram the processes the HSE department develops, and then analyze which ones are susceptible to automation. With that information the action plan has been to work together with the department staff in order to

structure the process so that it can be automated. In this way, the main processes of Wayra’s HSE Department are susceptible to automation and have been mapped. All the information and documentation have been provided by the HSE department analyst. The main processes of the HSE department that were mapped are listed below:

Figure 2. Staff Entry Process

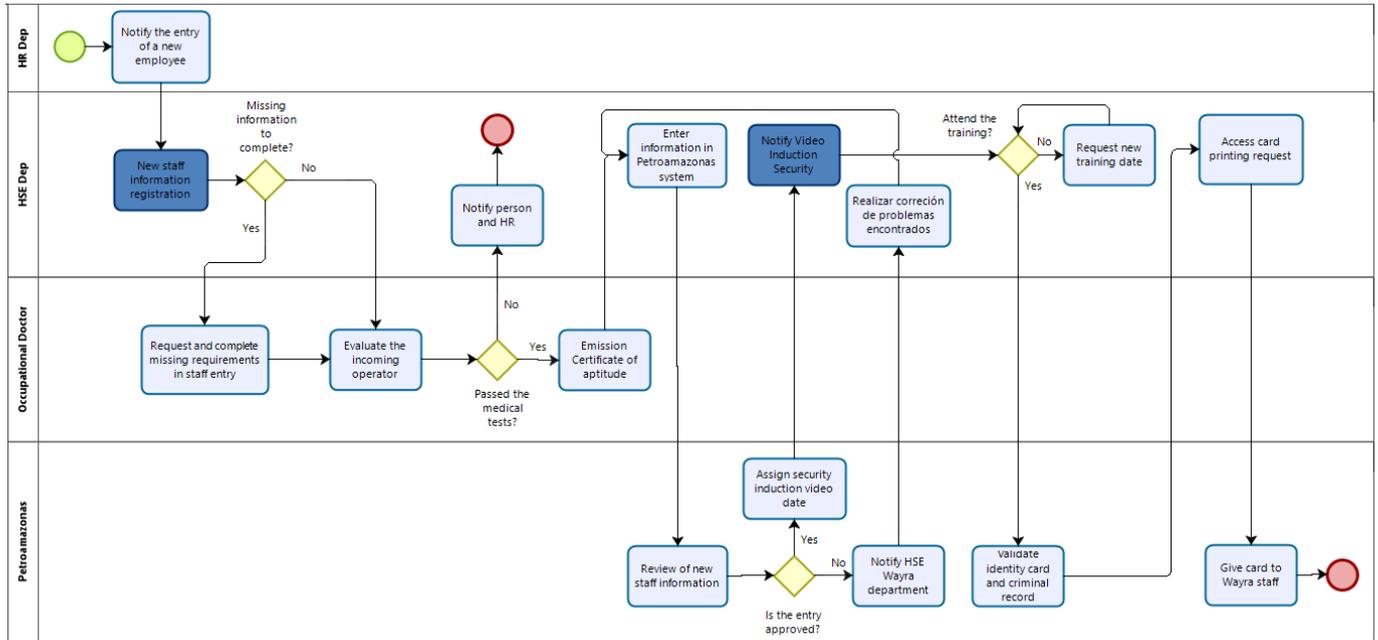


Figure 3. Personal Protective Equipment (PPE) Delivery Procedure

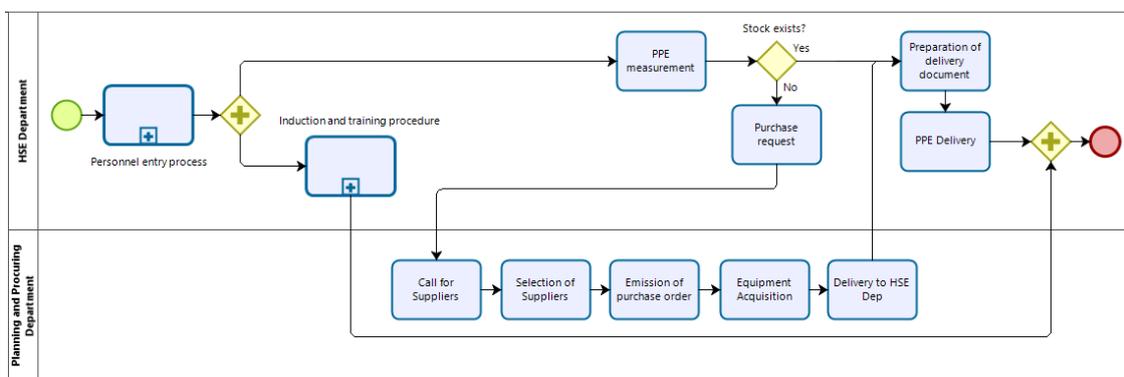


Figure 4. Induction and Training Procedure in HSE (Health, Safety and Environment)

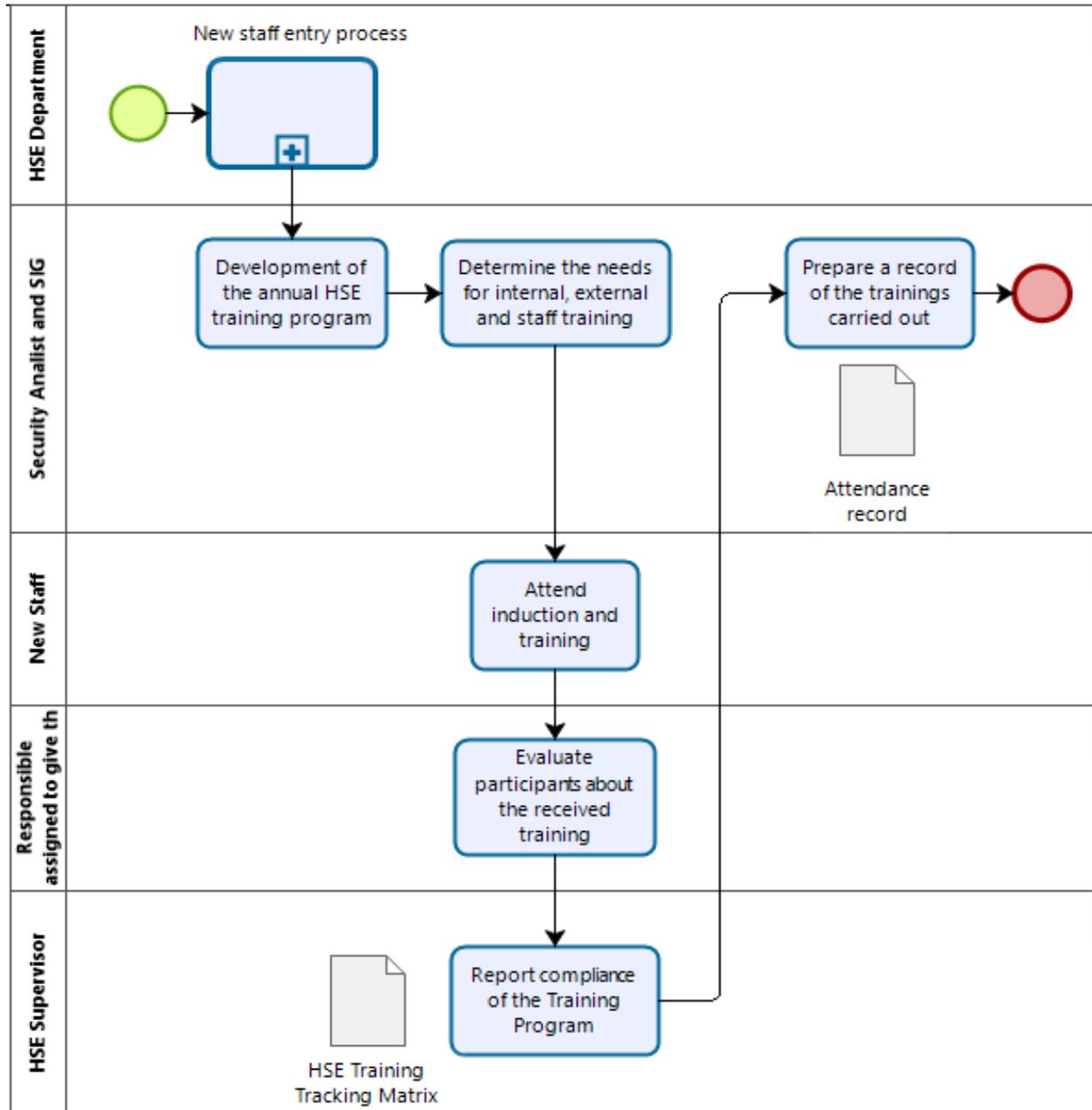
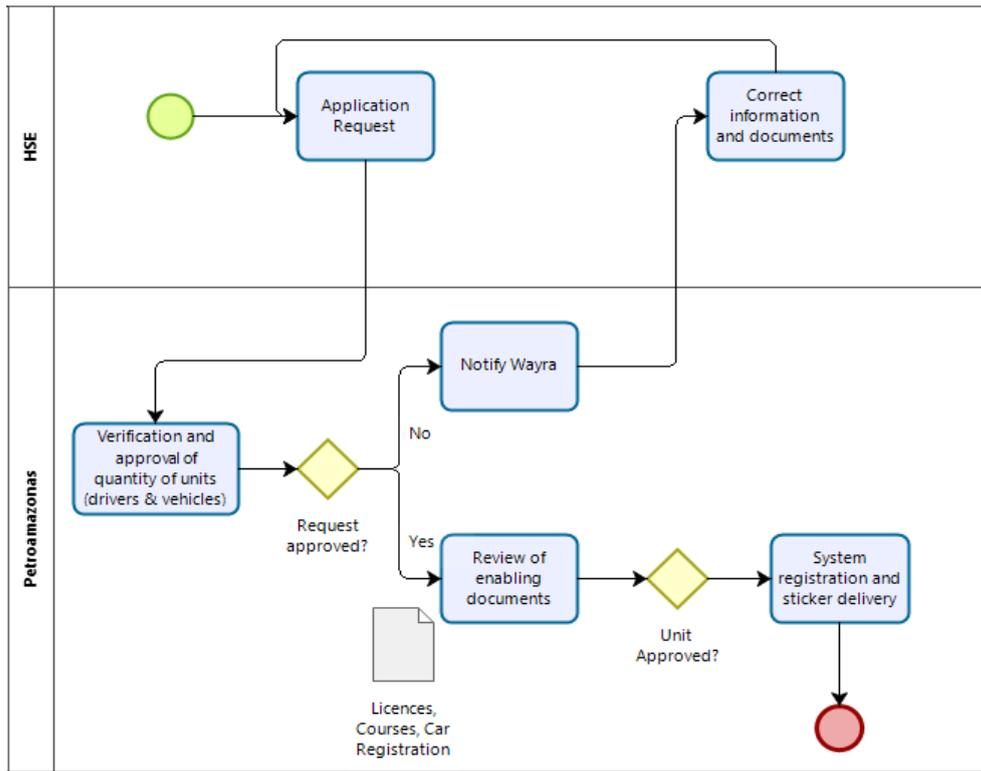


Figure 5. Defensive Driving Process



For each one of the mapped processes of the HSE department, the key activities in which there is an opportunity for improvement have been identified. These problems have been identified with the help of experts in the different processes of the department through meetings. The problems found for each activity are described in the following table:

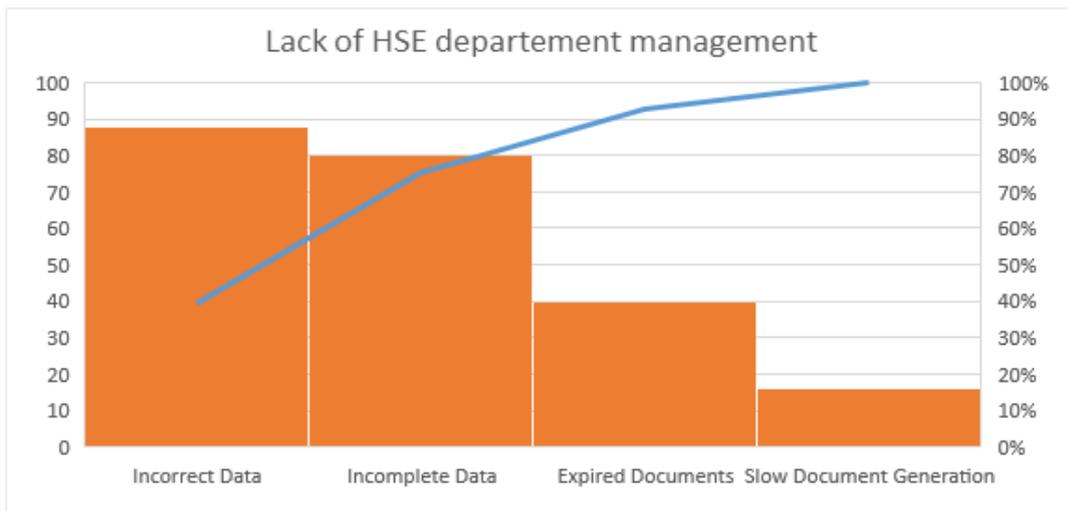
Table 5. Problems found in each process key activity

<i>Process</i>	<i>Key Activity</i>	<i>Problems Found</i>
<i>Staff Entry Process</i>	New Staff Information Registration	<ul style="list-style-type: none"> <li>● Incorrect Data Entry</li> <li>● Incomplete Data Entry</li> <li>● Non-Data Standardization</li> </ul>

	Notify Security Video Induction	<ul style="list-style-type: none"> <li>● Missed Induction and Training Date</li> <li>● Delay in preparing reports for Petroamazonas EP</li> </ul>
<i>Personal Protective Equipment (PPE) Delivery Procedure</i>	PPE Delivery	<ul style="list-style-type: none"> <li>● Lack of PPE Monitoring</li> <li>● Difficulties at searching records</li> </ul>
<i>Induction and Training Procedure in HSE</i>	Prepare a record of the trainings carried out	<ul style="list-style-type: none"> <li>● Delay in preparing reports for Petroamazonas EP</li> </ul>
<i>Defensive Driving Process</i>	Correct information and documents	<ul style="list-style-type: none"> <li>● Incorrect Data Entry</li> <li>● Incomplete Data Entry</li> <li>● Non-Data Standardization</li> </ul>

Then, in the Pareto Diagram presented in Figure 6, the frequency of occurrence for the most critical problems the department has, is shown. The problem that describes the greatest variability in the lack of HSE department activity development is the “Incorrect Data” problem. On the other hand is the “Incomplete Data” problem that has also influenced the lack of management. Both of the problems derive in the consequences for the operator, they have to solve these issues in order to accomplish contractual agreements and national laws.

*Figure 6. Pareto Diagram*



The cause and effect diagram that is presented in Figure 7 shows the main causes for the lack of HSE department management. Among them, it is possible to highlight that people are the one that reflects the majority of causes together with the method, and the measurement and machine results in the effects that are the same that are presented in Pareto's diagram. From the diagram presented above it follows that people can improve together with the method because the second one is driven/developed by the operators.

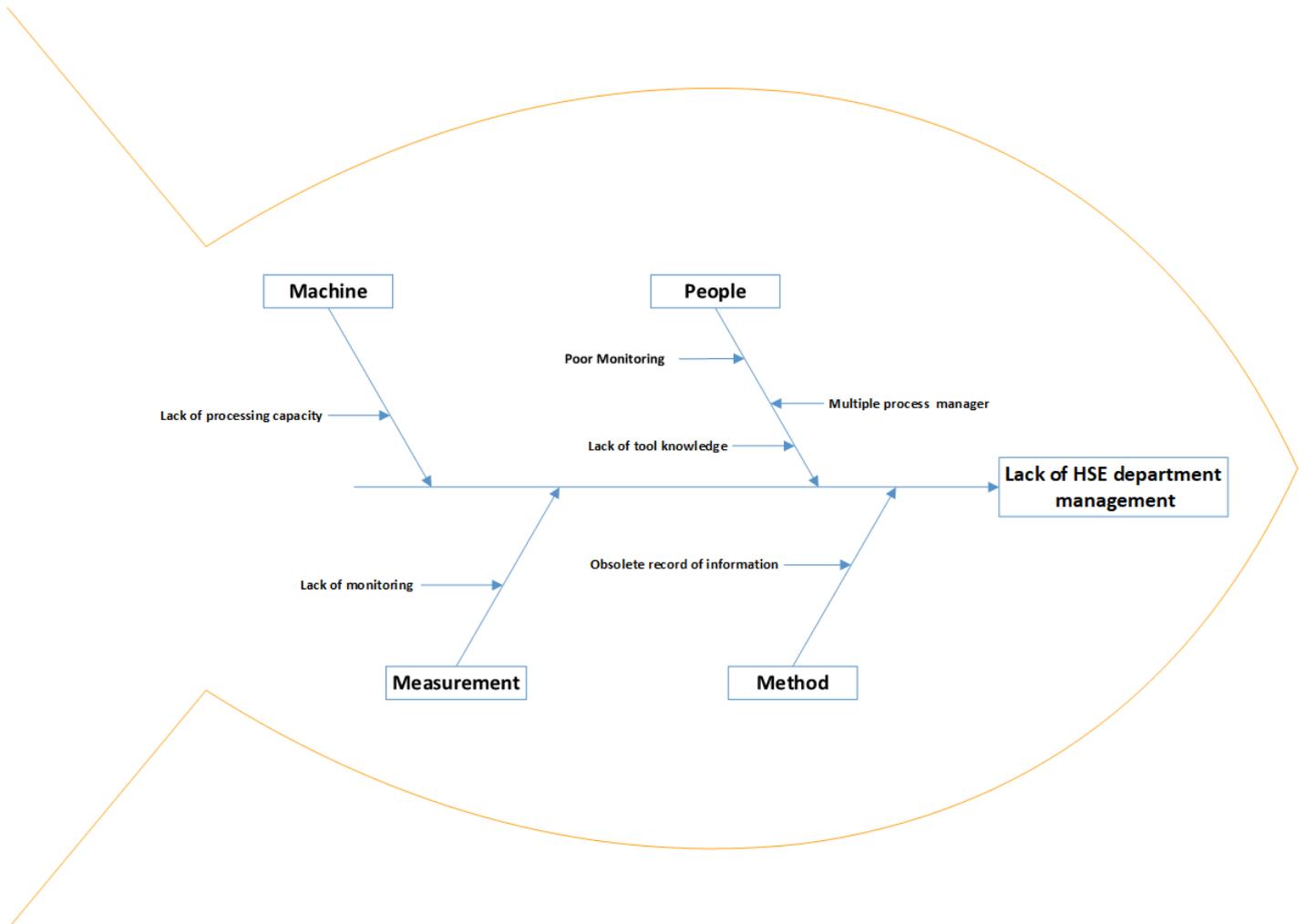
#### *4.3 New Process Design and Structure Model*

Once the mapping of the HSE Department's processes was done, the functional requirements and the non-functional requirements for the development of the technological solution were identified and listed. The functional requirements are related to the qualities that the system is anticipated to do, while non-functional requirements are the attributes that are required for the fulfillment of the functional requirements. Within the functional requirements, for example, is considered all the information as input towards the proposed interface, and all the reports that result from an output of the processing of this information.

As part of the non-functional requirements instead, are considered performance measures or security measures such as the use of passwords or users with their different

permissions to be able to edit or manage the application in VBA were taken into account. (M.Pereira et al, 2019).

Figure 7. Cause - Effect Diagram



The following have been considered as functional requirements:

- Delete data that does not generate value
- Data validation in different fields and records
- Automatic reminders with warnings

The following have been considered as non-functional requirements:

- Access code require for entry
- Only the administrator has the permission to add users and grant permissions
- User-friendly Interface intrinsically used

#### *4.4 New Process Implementation*

Following the current methodology, the sprints have been carried out to have feedback on the flow of information in the application. In order to automate certain processes, an application has been programmed in Visual Basic for Applications (VBA) to streamline them. For the development of the interface through the use of the VBA, a subsequent analysis and design was carried out following the principles of cognitive design. These principles include but are not limited to: standardization, use of redundancies, presentation of clear images, simplification of the presentation of information in the interface, and the use of stereotypes.

Through the principle of data standardization, it is intended to eliminate most of the errors related to the entry of incorrect data. This goes jointly with data validation and will be achieved through the use of drop-down lists in which the operator who enters the data must only enter one of the default options so that information can be stored correctly. Table 6 details examples of how the records of personal identifications or dates were improved with the principle of standardization. Taking into consideration the principle of using redundancies, pop-up windows were implemented which reconfirm the operator's decision at the time of entering, editing or deleting data. Figure 8 shows an example of a pop-up window that complies with the principle of using redundancies in such a way as to improve the reduction of errors. In the initial menu of the proposed interface you can see clear images about the operation of each button that can be used. In addition, there is no excess of information in the different option windows that can be selected through the interface, so there is an obvious simplification of the information presented. Figure 9 shows the initial menu of the interface with the aforementioned considerations. Finally, the use of stereotypes is something that can be evidenced throughout the interface. The stereotypes used are related to the use of colors in the selection buttons. The green color has been used to advance, register or accept, while the red color has been used to

return or cancel while browsing the proposed interface. An example is represented in Figure 10.

Table 6. Cognitive Design Standardization Principle Example

	Standardized	Non - Standardized																				
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Figure 8. Cognitive Design Use of Redundancies Principle Example

Ingresa Nuevo Trabajador

Información | Dir Domicilio | Info Emer | Vacunas | Manejo Defensivo | Ropa de Trabajo

Ingresa Número de:  Validar

Nombres:  N Proceso BPM:

Apellidos:  Campo donde labora:

Fecha de Ingreso:  Fecha Inducción Wayra:

Fecha de nacimiento:

Tipo de Sangre:

Correo Personal:

Área / Departamento:  Tipo de Tarjeta:

Cargo:  Scan de tarjeta:

Registrar Cancelar Regresar Siguiente

Wayra HSE

No se guardarán los datos ingresados, ¿Está seguro de regresar?

Sí No

Figure 9. Cognitive Design Presentation of Clear Images Principle Example

 Ingresar / Buscar / Actualizar Trabajador

 Ingresar Nuevo Registro Encuesta Drogas

 Monitoreo de Vacunas



 Monitoreo EPP

 Monitoreo Manejo Defensivo

**USO ADMINISTRATIVO**

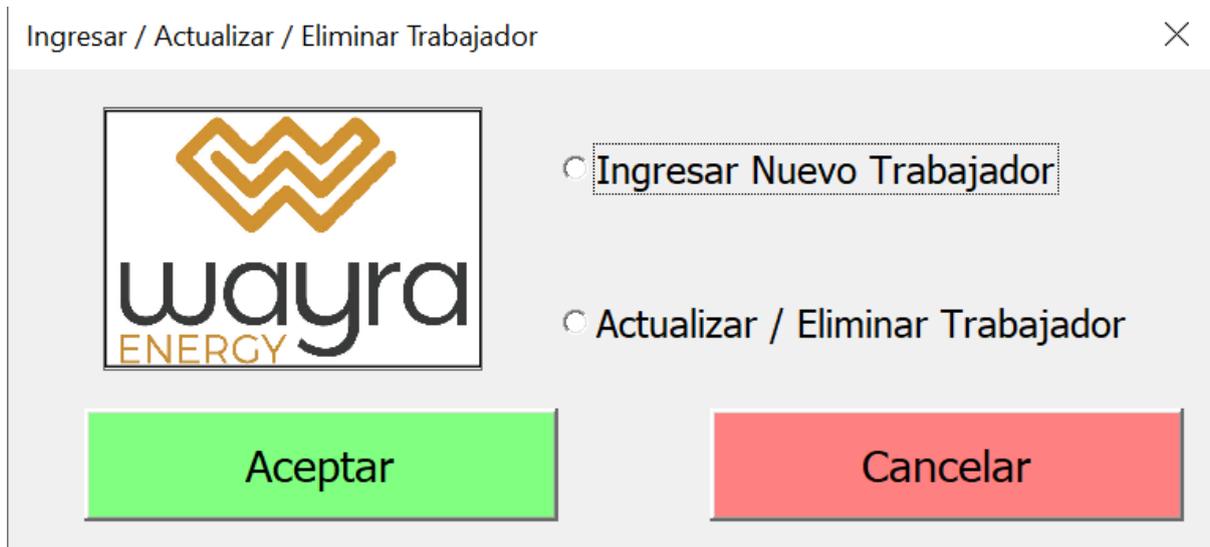
 Agregar Usuario  Modificar Permisos

 Eliminar Usuario

 Salir

Bienvenido SCARRERA / Administrador

Figure 10. Cognitive Design Use of Stereotypes Principle Example



In the same way, the functional requirements and non-functional requirements of section 4.3 for the development of the interface were analyzed. Once the mapping of the processes had been carried out and the activities in which the automation could be developed were identified, the following was implemented for each process analyzed in section 4.2:

- Staff Entry Process

This process is considered the most important process in the HSE department, since the entry of the personnel is the starting point for all other processes carried out by the HSE department. All data requested from new operators must be entered correctly, carrying out a precise data validation plays an important role in this process. Within the data validation it is possible to have a ten-digit entry as the identification number, admission of personnel with legal age, mandatory information fields to continue with the process, validation of one size fits all to supply personal protective equipment, vaccination record with their respective doses and dates, and finally validation of the defensive driving license.

*Figure 11. New Staff Personal Information Registration Window*

- Induction and Training Procedure in HSE (Health, Safety and Environment)

The Induction and Training Procedure in HSE is the second most important process that the HSE Department executes. This process continues the Personnel Entrance Process so that, once the operator is hired and before entering the field to work, they must attend an induction that consists of a series of training given by Petroamazonas EP. In this way, the Wayra HSE Department is in charge of communicating to the new operator about the date assigned by Petroamazonas EP for their training. Additionally, Wayra must monitor the progress of this induction since it is carried out virtually. As a final step, the HSE Department takes a lesson from the training and must record them to see if the operator had a satisfactory grade that allows them to enter the field and work.

- Personal Protective Equipment (PPE) Delivery Procedure

Before entering the field, operators must have their appropriate Personal Protective Equipment to carry out their tasks. This PPE must be supplied to field operators with the correct sizes of; footwear, upper garment, lower garment, gloves, helmets, and glasses. In this way, data validation and cognitive design principles in this process regarding clothing sizes are important so that the head of the Wayra HSE Department does not make mistakes. In the case

of upper and lower garments and gloves, the following sizes have been validated: 2-extra small (XXS) extra small (XS), small (S), medium (M), large (L), extra large (XL) and 2-extra large (XXL). For footwear, American adult shoe sizes from size 5 to 15.5 have been validated. In the case of helmets and glasses, they are one size fits all as they are adjustable.

Figure 12. New Staff PPE Information Registration Window

The screenshot shows a software window titled "Ingresar Nuevo Trabajador" with a navigation bar containing tabs: "Información", "Dir Domicilio / Info Emer", "Vacunas", "Manejo Defensivo", and "Equipo Protección Personal". The "Equipo Protección Personal" tab is active, showing a sub-menu with items: "Camisa", "Pantalón", "Calzado", "Impermeable", "Casco", "Orejeas", "Gafas", "Botas de Caucho", "Overall", "Guantes", "P. Respiratoria", "P. Visualización", "S.Ergonomica", and "Mousepad". The main area contains three input fields: "Cantidad Camisa/s:" with a dropdown menu, "Talla:" with a dropdown menu, and "Fecha de entrega:" with a date picker. At the bottom, there are two buttons: "Anterior" and "Siguiente".

Figure 13. PPE Monitoring/Update Window

The screenshot shows a software window titled "Monitoreo / Actualización EPP". At the top right, there is a search field labeled "Cédula:" and a green "Buscar" button. Below this is a table with the following data:

#	CEDULA	NOMBRE	APELLIDO	AREA/DEPARTAMENTO	CARGO	CAMISA	TALLA	FECHA DE ENTREGA
1	4152636352	PAOLA DANNA	LOPEZ NARVAEZ	Dirección de Operaciones	GERENTE CAMPO YURALPA	1	S	17/12/2020
2	1111111111	ROBERTO CARLOS	BONILLA PEREZ	Dirección de Planificación y Procura	DIRECTOR/A PLANIFICACIÓN Y PROCURA	2	S	29/11/2020
4	5454545454	ROSA MARIA	RODRIGUEZ ZAPATA	Dirección de Planificación y Procura	DIRECTOR/A PLANIFICACIÓN Y PROCURA	2	M	10/7/2020
6	3232323232	JUAN CARLOS	SANCHEZ SANCHEZ	Dirección de Planificación y Procura	DIRECTOR/A PLANIFICACIÓN Y PROCURA	1	S	29/11/2020
8	6946546545	ANDRES SEBASTIAN	GOMEZ MARTIN	Gerencia General	DIRECTOR/A PLANIFICACIÓN Y PROCURA	1	L	10/7/2020

At the bottom of the window, there are two buttons: "Modificar EPP" and "Cancelar".

- Defensive Driving Process

The company activities require operators to be able to mobilize in the oil fields and between them, that is why the people that are going to drive must have their enabling documents updated and current so that they can drive between the oil fields. The enabling documents are the drivers license and the defensive driving course.

It is crucial that they have these documents because otherwise the Ecuadorian oil operator will sanction or not allow access to the fields. Validation has been included in the date entry fields to later validate the expiration dates of the documents in order to be able to monitor and take action or decisions if appropriate.

*Figure 14. New Staff Defensive Driver's Licence Information Registration Window*

The screenshot shows a web application window titled "Ingresar Nuevo Trabajador" with a close button in the top right corner. Below the title bar is a navigation menu with tabs: "Información", "Dir Domicilio / Info Emer", "Vacunas", "Manejo Defensivo" (which is the active tab), and "Equipo Protección Personal". The main content area contains the following fields:

- Tipo de Licencia: [dropdown menu]
- Fecha de Expiración Licencia: [date input field]
- Empresa donde recibió C.M.D.: [dropdown menu]
- Fecha de aprobación del curso: [date input field]
- Scan de licencia de conducción: [dropdown menu]
- Scan de certificado emitido por empresa: [dropdown menu]

At the bottom of the form, there are two blue buttons: "Anterior" on the left and "Siguiete" on the right.

Figure 15. New Staff Defensive Driver's Licence Information Monitoring/Update Window

Monitoreo / Actualizar Manejo Defensivo

Cédula:

#	CEDULA	NOMBRE	APELLIDO	AREA/DEPARTAMENTO	CARGO	LICENCIA	FECHA CADUCIDAD	C.M.D
1	4152636352	PAOLA DANNA	LOPEZ NARVAEZ	Dirección de Operaciones	GERENTE CAMPO YURALPA	B	30/10/2020	Capetra Risk Consulting
2	1111111111	ROBERTO CARLOS	BONILLA PEREZ	Dirección de Planificación y Procura	DIRECTOR/A PLANIFICACIÓN Y PROCURA	A1	31/10/2020	Camara de Orellana
4	5454545454	ROSA MARIA	RODRIGUEZ ZAPATA	Dirección de Planificación y Procura	DIRECTOR/A PLANIFICACIÓN Y PROCURA	B	17/10/2020	Capetra Risk Consulting
6	3232323232	JUAN CARLOS	SANCHEZ SANCHEZ	Dirección de Planificación y Procura	DIRECTOR/A PLANIFICACIÓN Y PROCURA	A1	26/12/2020	No Aplica
8	6546546545	ANDRES SEBASTIAN	GOMEZ MARTIN	Gerencia General	DIRECTOR/A PLANIFICACIÓN Y PROCURA			
9	9879879878	PEDRO LUIS	SANCHEZ PEREZ	Dirección de Planificación y Procura	GERENTE PLANIFICACIÓN Y CONTROL COSTOS			

#### 4.5 Process Management

Due to the limitations encountered over time for the development of the project, the scope of the project has been developed until the New Process Implementation phase. The current situation in 2020 with the COVID 19 pandemic has not allowed the team to be physically in the company, and be able to control and obtain results on the proposed IT solution. However, for the development of this phase, it is proposed to use the SCRUM process framework. SCRUM is an improvement of the mostly used iterative or incremental object-oriented development cycle. (Schwaber, 1997). There are several activities that must be developed so that the process can be carried out successfully. First, the product backlog must be defined. This means, the objectives and the expected scope of the product to develop, prioritizing according to the importance and value that it generates with respect to the cost and the client's

needs. Once the above has been specified, the project is divided into sprints. A sprint is each of the phases of the project where the progress is presented to the client which tests the product and approves it as it is or suggests changes. For these changes, they are assigned a priority and it is decided if they are executed at the moment or they are sent to a second value that is to say to a pending list to be executed later. The great benefit of working collaboratively and repetitively is that the client knows the stage in which the project is located and together with the work team they are defined the requirements according to its progress. Finally, once all the necessary sprints have been carried out, the final product is delivered. The advantage of the SCRUM process is to do the projects in the shortest time and cost possible. It is a work methodology that promotes innovation, motivation and commitment of the teams involved, which also reduces the margin error and project risks and whose main objective is to maximize the return on investment (Engberg, 2020)

*Figure 16. Proposed Scrum Process*



*(Engberg, 2020)*

## *5. Conclusions*

Based on what have been presented it is possible to conclude:

Due to the fact that the project required the development of a technological solution for the automation of the information management of the HSE department, the process of the methodology used for the development of the project (BPM) fitted correctly. The tools used like the; CTQ Tree Diagram , the Pareto Chart or the cause and effect diagram, allowed the team to identify the problems to be solved and take an action plan to mitigate those problems.

With the new technological solution that was implemented successfully, the company has now an advantage in the management of the information that is processed daily. The staff information entry method has changed, automation of data entry has allowed HSE staff enter the information much faster and easier, eliminating the entry of incorrect or incomplete data, reducing the time the department uses at the end of every month making reports.

The automated monitoring of the registers permits the company personnel to take the best decisions or actions at the right time, reducing / eliminating delays or fines that may arise when enabling documents are not met.

The application allows the administrator to give permissions either to other administrators or users who will use the application, allowing to control the changes that any user of the application can make.

## *6. Limitations*

Due to the fact of the COVID 19 impact, the team was not able to collect the data in-situ. All documents, data and information of the company used in this research was delivered virtually by members of the HSE of Wayra. In the same way, due to time limitations, the scope of the project was limited to the BPM phase of New Process Implementation, leaving proposals

on how the Process Management phase could be carried out with the SCRUM procedure respectively.

#### *7. Recommendations / Future Work*

Even though the program is local, it means it only works on the computer that has it, it can be shared and edited by many people if the company shares a folder in their servers. Another way to make the same program run on the cloud could be to make a webservice and the database will be hosted by own servers on any platform available in the market. In this way, it is then suggested that the company can migrate this program prepared in VBA to the cloud and share it with all collaborators and managers in this process, so that editing can be facilitated and the management of information within the company can be improved. avoiding all types of errors mentioned in the project.

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