Chapter 4 A case of Software automation through the use of "Robotic Process Automation" tools

Capítulo 4 Un caso de automatización de Software a través del uso de herramientas de “Robotic Process Automation”

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Abstract

The automotive industry has positioned itself in Mexico as one of the main producers and exporters, due to its access to other markets, and with prospects for high growth; facing challenges, like a very competitive environment, migration towards new technologies, and research. This chapter explores a case of software automation, using robotic process automation tools aimed at learning process flows quickly and dynamically. The product used is called RPA (Robotic Process Automation), it is a general software, developed by a company, which can be customized, or trained, by technicians of a user company, as is the case that is presented, to turn it into a virtual worker or Robot, it is able to carry out transactions, or activities to support the business in finance, purchasing or accounting. This software is based on artificial intelligence techniques. Its implementation is done through the Lean Six Sigma methodology and the use of its five-step approach (DMAIC Define, Measure, Analyze, Improve and Control) clearly defining the problem, sizing it, analyzing the possible causes, delivering the best alternative solution and controlling the results obtained, to make the solution sustainable. The aim is to show through a real example, the use of a RPA was implemented to make tasks more efficient within a massive price update process. It describes the use of a computer robot, which is the best way to solve problems in the industry by reducing time and costs due to human errors, in repetitive tasks within the information systems. The results in terms of efficiency were of 96.4% reduction in processing time of the price update, and the error rate was 0%.

Automation, Robotic Process Automation, Software Automation Tools, Lean Six Sigma, DMAIC

1. Introduction

The automotive industry is one of the main markets for the development of Mexico, because it has been consolidated as a sector that is undergoing a process of constant transformation mainly due to its design and innovation that are outstanding elements in that industry. Each year, Mexico extends its collaboration in various engineering activities, adding to the search for alternatives to examine solutions and respond to the challenges it faces around the world. This requires keeping an eye on the changes that are taking place and taking advantage of the opportunities that this industry represents, especially in Mexico..

The term "Robotics" has become a reference in this sector; it is very important to highlight the use of its tools to explain the exponential growth it is having, and the direct impact in the business field. On an existing technology, it has been able to respond to the expectations required to reduce complex processes, being able to automatically execute assigned tasks, manipulate data and drive technology towards a new way of reducing time and costs. Innovation is the main value of this technology, because it has been the vital element in the improvement of process management solutions. Understanding the automation of processes through robots, requires understanding the software that for decades have been the basis of computer science. The purpose of this chapter is to show how the use of an RPA was implemented through a real example. [1] (Robotic Process Automation) to make the tasks more efficient within a massive price update process; product based on artificial intelligence techniques, developed by a company, which allows to connect different computer systems with each other, generate information, create new databases, and execute tasks in the business world.

The real example to explain the use of RPA, consisted in the process of updating prices in an automotive company in Puebla. In this, it will be appreciated the optimization and improvement of the management through its implementation, which allowed to reach an efficiency of 96.4% in the reduction of the time of data processing, and error rate of 0%, thanks to the use of the computer robot. To have an overview of the information, we resorted to the use of the "Lean Six Sigma" methodology[2] and its five-step approach (DMAIC Defined, Measured, Analyzed, Improved and Controlled) that leads to a clear understanding of the problem, realizes the dimensioning of this, analyzes the possible causes, delivers the best solution alternative and controls the results obtained to make the solution sustainable.

[1] and its five-step approach (DMAIC Defined, Measured, Analyzed, Improved and Controlled) that leads to a clear understanding of the problem, realizes the dimensioning of this, analyzes the possible causes, delivers the best solution and controls the results obtained make the solution sustainable (Galusha, 2017).

[2] Six sigma is a rigorous improvement methodology developed by Motorola in the 80s, whose fundamental principle is the customer focus. Use the DMAIC process and statistical methods in order to: Define the problems and situations to improve, Measure to obtain information and data, Analyze the information collected, Implement process improvements and finally, Control the processes or products in order to achieve sustained results, which in turn generates a cycle of continuous improvement (Mantilla CElis & SAnchez García, 2012).

This is a new trend that promotes the increase of productivity, the reduction of errors, and the quality of products in the digital world of every company. The process to migrate a traditional software system managed by users to an automated system through the use of RPA, is explained step by step in this chapter. Something very important to take into account before taking the first step, is that the user company must clearly define their information needs through sessions to establish objectives and determine information requirements in which all the directors participate simultaneously. the departments involved and the direct users of said information.

2. Theoretical review

2.1 Legacy Systems

Information systems are one of the main management tools in organizations, their level of complexity is related to the product or service offered, and its sophistication directly linked to the interest groups that the company has. An information system:

"It is a formal set of processes that, operating on a data collection structured according to the needs of the company, collect, prepare and selectively distribute the necessary information for the operation of said company and for the corresponding management and control activities, supporting , at least in part, the decision-making processes necessary to perform business functions of the company in accordance with its strategy" (Andreu, 1991).

In the case of "Legacy or legacy" systems, they present challenges for the managers of information systems within the companies, given that it is often necessary to maintain them due to their efficiency, usability and usability; but it is also a limitation when planning new solutions that include using the information that these systems handle. They are named like this because they represent those tools conceived decades previous to the current one, and they are the support of the central operations of many companies, but they have been relegated in time, due to their limitations (Rodríguez, 2015).

Typification of "Legacy or legacy systems"

Transactional systems: Are those, whose objective is to carry out the tasks of the support processes to give value to the organization, such as: personnel, logistics, accounting, finance, sales management, and others. Among them you can also count on ERP systems (Enterprise Resource Planning)[3] that are the integrated systems that consist of all the main modules for large organizations, mostly these systems are sold by large companies such as "People Soft" and SAP (Systems, Applications and Products)[4] , also Peruvian companies such as Novatronic, Sonda, Ofisis, all with their own scheme and to which companies have to adapt, but not the unique systems in which each one has its own forms and working models, with its own formats.
The transactional systems register the day to day of the organizations, the most common are the accounting systems (Muñoz Recuay, 2007).

Automated process systems: are used together with electronic or mechanical equipment; they are mostly made with low level languages such as "Assembler". These systems record data. As measures of time, power, production, heat, fuel level. In the case of motors, they control the operation of the machines by means of predefined and repetitive programs and may or may not store information (Muñoz Recuay, 2007).

Talking about evolution involves several aspects, from correction of failures or problems presented, the customary maintenance every so often, going through an adaptation to new needs, adding new functionalities and processes, ending with the total disposal of the whole system, that is, giving it low and / or replace it with a totally new one.

[3] ERP It is a set of tools that integrate the departments and functions of a company through a single computer system. It works with a single database, allowing different departments to share information and communicate with each other (León, 2008).
[4] SAP. It was founded in 1972 in the City of Mannheim, Germany, by former IBM employees (Claus Wellenreuther, Hans-Werner Hector, Klaus Tschira, Dietmar Hopp and Hasso Plattner) under the name of "SAP Systemanalyse, Anwendungen und Programmentwicklung". The name was taken from the division in which they worked at IBM. The SAP corporation was founded in 1972 and has developed into the fifth largest software company in the world. (RedSinergia, 2017).

On the other hand, from the beginning, SAP (Systems, Applications and Products for Data Processing) was dedicated to business applications. With collaboration with IT business executives (Information Technology)[5], and having partners around the world, SAP developed a unique way to understand the challenges encountered in implementing technology solutions for business users, developing software that can help companies integrate their business processes, helping the entire company work orderly. Today, SAP is the largest software developer for business applications in the world and the fourth largest independent software provider, in absolute terms. More than 7,500 companies (more than 15,000 installations), in more than 90 countries, chose SAP systems to control the processes of finance, manufacturing, sales, distribution and human resources, essential for their operations (Technology and IT, 2015).

With more than 1000 business processes included in the software, SAP can integrate an entire organization. With SAP it is possible to share information in real time between the different sectors of the company, suppliers and distributors, whether a company of 50 or 100,000 employees.

2.1 Automation

Industrial automation is the use of control systems, such as computers or robots, and information technologies to manage different processes and machinery in an industry to replace diverse tasks performed by a human being. Although the term mechanization is often used to refer to the simple substitution of human labor for machines, automation generally implies the integration of machines into a system of self-government (Aguirre & Rodriguez, 2017). The term automation was coined in the automotive industry around 1946 to describe the increase in the use of automatic devices and controls in mechanized production lines.

Automation can be defined as a technology related to the realization of a process through programmed commands, combined with an automatic feedback control to guarantee the correct execution of the instructions. The resulting system is capable of operating without human intervention. The development of this technology has become increasingly dependent on the use of computers and technologies related to computing. As a result, automated systems have become increasingly sophisticated and complex. Advanced systems represent a level of capacity and performance that surpasses in many ways the abilities of humans to perform the same activities (Groover, 2018). Automation technology has matured to the point where other technologies have developed from it so they have achieved recognition and a state of their own. Robotics is one of these technologies; is a specialized branch of automation in which the automatic machine possesses certain anthropomorphic or human characteristics.

2.2 Automation in the automotive industry

The digitalization and automation of services, the internet of things, robots, "cobots"[6], virtual and augmented reality, manufacturing execution systems, software for collaborative networks and the analysis of "Big data"[7]; therefore, they allow optimizing different processes inside and outside factories and making companies more efficient. The integration of these technologies brought, the already well-known concept of Industry 4.0[8], that must be developed in order not to be relegated, as a change in the traditional social order that will bring new niches of employment, because, although automation can affect the work of some sector, someone should develop new systems and robots, which means labor niches for the future.

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[5] Set of tools, processes and methodologies (such as coding / programming, data communications, data conversion, storage and retrieval, systems analysis and design, systems control) and associated teams used to collect, process and present information. In general terms, IT also includes office automation, multimedia and telecommunications (WebFinance Inc., 2018).

[6] The cobots are passive devices whose motors, of low power, could not move the robot by themselves. Your goal is to change the transmission ratio of each joint, but the operator provides all the power for movement. The control is in charge of track tracking and the operator is concerned with directing the manipulator approximately. An analogy of COBOT could be a train and its tracks (Nicolás Store, 2009).

[7] Big data It is the trend in the advancement of technology that has opened the doors to a new approach to understanding and decision making, which is used to describe enormous amounts of data (structured, unstructured and semi-structured) that would take too much time and would be very expensive to load them into a relational database for analysis. In such a way that, the concept of Big Data applies to all that information that can not be processed or analyzed using traditional processes or tools (Barranco Fragoso, 2012).

[8] Industry 4.0. it refers to a new model of organization and control of the value chain through the life cycle of the product and throughout the manufacturing systems supported and made possible by information technologies. The term industry 4.0 is widely used in Europe, although it was coined in Germany. It is also common to refer to this concept with terms such as "Smart Factory" or "Industrial Internet" (Val Román del, 2016).

The final result is that Industry 4.0 is neither a factor that drives the work nor one that destroys it, according to the Institute for the Labor Market and Occupational Research (IAB). Digitization could lead to the loss of thousands of jobs. At the same time, thousands more may arise. However, education and additional training are particularly important to cushion these displacements (Pardinas, 2016).

The automotive industry is the engine of Mexico's national economy; the next step is to develop research and innovation, because new investments will be directed towards the most technologically advanced countries, estimate representatives of the sector and researchers. After Mexico was positioned as the seventh producer and the fourth world exporter of vehicles, Fausto Cuevas, general director of the Mexican Association of the Automotive Industry (AMIA) (Executive, 2017) affirms that it is necessary to have a strong participation in research projects and innovation. Mexico is already preparing, and today there are about 30 research and development centers where the industry and local and federal governments has been given the task of seeking the link between the academy and companies, both terminally as auto parts.

The main challenge is what industries must do to remain within the framework of the industrial revolution 4.0. For example, below, some recent cases are mentioned:

"Ford Motor Company announced that it is already carrying out tests to manufacture auto parts and automotive parts in third-dimensional printers" (Notimex, 2017).

"The German Volkswagen, meanwhile, began to develop vehicles with augmented reality technology in virtual laboratories, which could revolutionize the work of automotive engineers and designers. Not to mention the advances in connectivity, so that, in about three years, all the latest model vehicles will have "WiFi on board", estimated the Telefonica Mexico's B2B Vice President, Mariano Moral." (Ejecutivo R. M., 2017).

"On the other hand, models with the On Star service of General Motors 2018 already include internet connectivity from any remote location where the vehicle is located, with the ability to connect up to seven devices on board and 15 meters range around the unity" (Vivero, 2017).

"Telefónica ventures into the automotive sector to facilitate connectivity in the Cadillac, Buick, Chevrolet and GMC models" (AN, 2017).

Robotization will have an impact on labor costs, with increases in the long term, as a result of which investments will migrate to developed countries, allowing them to develop increasingly sophisticated technological automation platforms. And if there is no reconversion to that status in the industry, there are studies that argue that, in Mexico, 51 percent of manufacturing employment would be at risk (Bensusán, Eichhortst, & Rodríguez , 2017). For Julio César Morales, director of the Engineering Division of the Universidad del Valle de México (UVM) Campus Lomas Verdes. The automotive industry in Mexico has 70% automation in its manufacturing process, for example, in a plant around 80% of the technological base, are robotic arms that collaborate from the assembly, to the painting of a vehicle. As well as programmed logistic controller technologies, integrated business management systems (SIM), an automation process reduces the level of error in the final product by 50% and increases productivity by 40% (Rosagel, 2011).

In the modern computer context refer to the automation of processes causes large oppositions. First, because it is understood as a change of execution in the way companies or businesses conduct themselves. It is clear and key that implementing automatic execution within a company is a change of great impact: technicians and professionals are not sensitized, in an initial stage, although everything changes once the true results of the execution of those processes are appreciated when they are automated.

The study of process automation, establishes that its correct analysis is directly related to the type of business or company that is being automated. If the organization manages a small amount of data it is relatively easy to manage and control information through manual execution. On the other hand, if the volume of data is significant, automation is the indicated way. Automation, is not the execution of processes in parallel.

The automation of processes is a control of data and processes that guarantees quality in the execution and availability of information, reducing errors and taking advantage of each material and human resource of the organization. In this way, programming and execution standards are set, and the logic of business is transparent for any area that is involved in corporate management. It can also be seen as the combination of four fundamental principles: mechanization, continuity of the process, automatic control; and economic, social and technological rationalization (Shimon, Y Nof, 2009).

The expansion of technological capabilities and the reduction of robot costs have increased the use of robots in new activities. The generalization of the use of robots multiplied and everything indicates that it will grow in the following years. The manufacturing industry was the traditional sector of use of robots and it still is, but it has also spread in agriculture, the construction sector for prefabricated buildings and in homes to perform dust extraction, washing clothes and crockery, as auxiliary in cleaning tasks, etc.

2.3 Robotic Process Automation (RPA)

Software robots learn powerful and dynamic process flows; In addition, they can repeat them hundreds of times. So, what exactly does RPA mean and what do these software robots do with their powerful and dynamic process flows? Basically what they do is integrate and automate a flow of data or information that connects one digital system to another (Willcoks, 2015). In simple terms, robots can reproduce the same tasks that a person performs while working with his computer. Repetitive tasks that bore the staff a lot; how to re-type what is on one screen in another or cut and paste from one application to another system, website, web portal, e-mail, etc. In many jobs it is common to consult different web platforms looking for orders, purchase orders, requests, claims and when new items appear, triggering some action in the department, in the company, in the corporate ERP, etc. Processes that, indeed, bore anyone.

The objective is not to replace, but to complement and improve. It is not about replacing the investment in existing technology in the organization. It's about filling gaps, eliminating manual tasks, improving current processes. It is about questioning how they perform things on a day-to-day basis and questioning what tasks are carried out to discover that, many of them, could be done in another way. The RPA technology offers a wide variety of applications, since in areas of work related to the tasks of "back-office" in finance, purchasing or accounting will accelerate data entry, billing management or information on the sale of products (Vector Consultoria, 2017).

2.4 Benefits of using RPA

According to T-Systems International Gmbh (2018), the reduction of costs, allows to achieve large savings directly and indirectly, up to 50%, coupled with the large increase in productivity will achieve investment returns of the order of six to seven times; increase in profitability, in terms of the process efficiency multiplied by 9, a process BPO (Business Process Operations) of insurance coverage is performed in approximately 12 minutes, however, robotic automation manages to complete the process in just 4 minutes, tripling the volume of operations; quality service, greater accuracy and better service to customers, that is, the attention span of robots is unlimited and they do not make mistakes in their calculations, thus eliminating human failure; security, regarding the alignment with the existing network security policies and access rights of the applications; specialization of the workers, referring to the employees who performed those tasks assigned to the RPA can now have a more complex occupation, contributing more value to the company; increase in sales, as a result of the efficiency and speed of the robots, the service offered to real customers is almost immediate, increasing their satisfaction (Vector Consultoria, 2017).

According to the consulting firm Deloitte (2017), the current robotization scale allows processes to be executed:

- **Specific -** technically simple and repetitive transactional tasks that are part of a larger function within the company**;**
- **Multifunctional -** similar processes that run through multiple functions in the organization. The coordination of several robots allows the optimization of current processes**;**
- **Integrals -** complete processes that require the integration of robots in all stages of the same, streamlining and optimizing their management.

The ability of organizations to adapt plays a fundamental role in their competitiveness, solvency and stability. The better the integration of your human and technological infrastructure, the greater the benefit See Figure 4.1 (Deloitte, 2017).

Figure 4.1 Deloitte Global

Fuente: Deloitte Global

The projection in the use of this technology according to Gartner (2017) for the year 2020, 85% of the data management processes will be executed without human intervention. In the same way, the following benefits of the use of automation instead of the execution of manual tasks show considerable performance indicators in several aspects: repetitive tasks are improved by 21%, error rates are reduced in the order of 21 %, improvement in the standardization of business flow processes by 19%, the reliance on multi-systems and screens to complete processes is reduced by 14% and the dependency for the execution of direct processes is reduced by 11%. There are several features of using an RPA, the first software robots are configured to perform tasks or activities with the steps in the same way as a human user, they are also trained or configured, using demonstration steps only once that you will have to execute in subsequent repetitive way, without using programming code, this means that the robots are trained by the people who actually perform the tasks.

The RPA are easy to use and require technical support for their use and once the robot is trained, it will execute the tasks without error rate. Any strategy selected to execute the tasks of the automotive consortium regarding the updating of vehicle prices is the use of RPA. Among the industries that have used the RPA of UI Path in 2017 are NASA, Oracle, Accenture, PWC, Deloitte, Sumitomo, Cognizant, among others and that have helped to save more than 650 thousand hours and project savings by 2019 of 3 million hours and 250 automated users only for the Sumitomo automotive industry, according to (UiPath, 2018).

3. Methodology

The methodology used for the implementation of the case was Lean Six Sigma through the phases like "Define, Measure, Analyze, Improve, Control" (DMAIC) in English language that mean Define, Measure, Analyze, Improve and Control.

Six Sigma is a methodology that provides tools to optimize costs, improve quality or reduce processing times for products or services. Specifically in this case focuses on the reduction of delivery times of services for updating the prices of products of the automotive industry.

To do this, the Six Sigma methodology, based on the DMAIC model, establishes the steps to be able to carry out the improvement:

- Define: Identify the problem that causes decrease in customer satisfaction, the work effort required.
- Measure: Collect information on the current performance of the process.
- Analyze: Study the process to identify the points of pain that you have, such as tasks that do not add value to the client and are not necessary, which are commonly referred to as waste.
- Improve: Corrective actions that are implemented to make the service delivery faster and improve customer satisfaction.

- Control: Validate and monitor that the improvements are sustainable and have a positive effect on service delivery times.

Some of the tools used in this case and also common within the DMAIC model in the Six Sigma methodology are the following:

Table 4.1 Correlation of DMAIC phases in relation to the Lean Six Sigma methodology

Phase	Tool	Description
Definition	Voice of the Client	Document that expresses the client's needs obtained through an interview or petition document.
Measurement	Analysis of differences	Tool used to measure the differences between the expected value (for this case, expected processing time) and the current value of the process
	Control charts	Measures the minimum specifications required by the customer compared to the real ones
Analysis	Root cause analysis	Document that explains in a structured way the causes that cause the pain detected, in this case of study, the processing time longer than expected by the client
Improvement	Brainstorming	Tool used among specialists to determine the best solutions to a detected problem
	SIPOC	Graphical tool that describes the steps to follow to implement the solution avoiding the use of tasks that do not add value, called waste
Control	Measuring boards	Tool to measure the efficiencies achieved before, during and after the execution of the improvement tasks

Source: Prepared based on the working documents of the project, and in accordance with the confidentiality rules of the company

The documents, boards and deliverables; they are not available for the most part in this chapter, derived from the rights that the company restricts, as well as the confidential information of the data that these entail. Each of the phases have a relevant importance to achieve the improvement of the process, however, the critical point lies in the improvement where it is essential to establish the tasks that will make the efficiencies, a reality without losing the focus of the dimensioning of the objective.

Therefore, the most used tool for the identification of these limits is the SIPOC (Suppliers, Inputs, Process, Output, Customers), which has been used since the 80s in the framework of total quality management and its use is included as a tool within the Six Sigma methodology, Lean Manufacturing, Business Process Management and Project Management Institute Project Management, which was used for the development of the definition of the project. This tool provides a quick overview of the process, in some cases, it can be too simplistic to provide better understanding and clarity of the process to be worked on, as well as to identify when and where to stop. In the mentioned case, the defined limits of entry, started from the information given by the department of finance and controlling[9] and they ended up in the information exits to the concessionaires.

This descriptive graphic tool offers a process development based on the client's needs or also called customer's voice. Highlights the need to serve internal customers to satisfy external customers. The graph identifies who receives or is affected by the outputs of the process. In this case the entries are the alterations of prices frequently maintained by the controlling department, which have to be reflected as departures in the vehicle price systems in the concessionaires; this helps to clarify the process including its specific requirements. The next step is to define the entries related to the client's requirements, to be communicated to internal and external suppliers, to drive the process from the client, there is a traceability that links the developed process with the requirements of the client fulfilled.

After analyzing and understanding suppliers, inputs, outputs and customers (including the requirements of each phase), the process is developed, identifying the steps required to convert inputs into outputs in an efficient manner of approach to the customer. SIPOC, however, simplifies the process by providing a structured approach to increase the company's knowledge of all systems, showing the interrelationships and interdependencies between the processes.

[9] Controlling it consists in verifying if everything happens in the confirmations with the adopted plans, the issued instructions and the established principles. Controlling ensures that there is an effective and efficient use of the resources of the organization to achieve the planned objectives. Controlling measures the deviation of the actual performance of the standard performance, discovers the causes of such deviations and helps take corrective action (Juneja, 2018).

Through the structure of the SIPOC method it is understood who serves whom, and the SIPOC chart can significantly improve the design of the processes (Munro, Ramu, & Zrymiak, 2015). Finally, the exposed case demonstrates the utility of software automation for the improvement of business processes, in the context of Industry 4.0.

4. Development (case study)

An automotive company of German origin, currently has implementation of SAP systems with its main modules such as finance, controlling, sales, material handling among others. However, despite the standardization of business processes through SAP, it also has many legacy systems. These legacy systems are those that do not belong to SAP and that due to their origin and seniority are still of use for this automotive company since these functionalities have not been migrated to current systems.

Legacy systems are regularly developed programs tailored through programming languages such as JAVA, .NET, PHP and others that are regularly configured by the consortium in Germany, and do not have the source code in them the different countries to make required adjustments typical of the region.

The automotive company has among one of its legacy systems that of price charges. To be able to update the sale prices, the role of the "controller"[10] you must request the installation of the system on your local computer, as well as the permissions so that your user can update the corresponding fields at prices. As part of the definition phase of the Six Sigma Methodology, information derived from the customer's requirements and pains notebook was gathered, which is called the customer's voice, in which it is indicated that this system has different update options related to the product. , of which 90% of the activities are done manually, according to the requirements notebook delivered by the client; therefore, there is a risk of generating human errors that impact the company's billing process. Likewise, said legacy system, in addition to having to be used through manual operation, that is, there are no mass loading or extraction and execution of programmed data through interfaces, nor does it have physical or digital instructions for its use, so the training must be carried out by the members of the controlling area who have the knowledge to the new collaborators of the structure.

Among the responsibilities of the users of this system are the authorization and updating of vehicle prices in Mexico once they have been approved by the vice president of finance. Other changes are those related to updates of ISAN (New Automobile Tax) and VAT (Valued Added Tax), which is considered critical in the business because they represent revenue also for the brand.

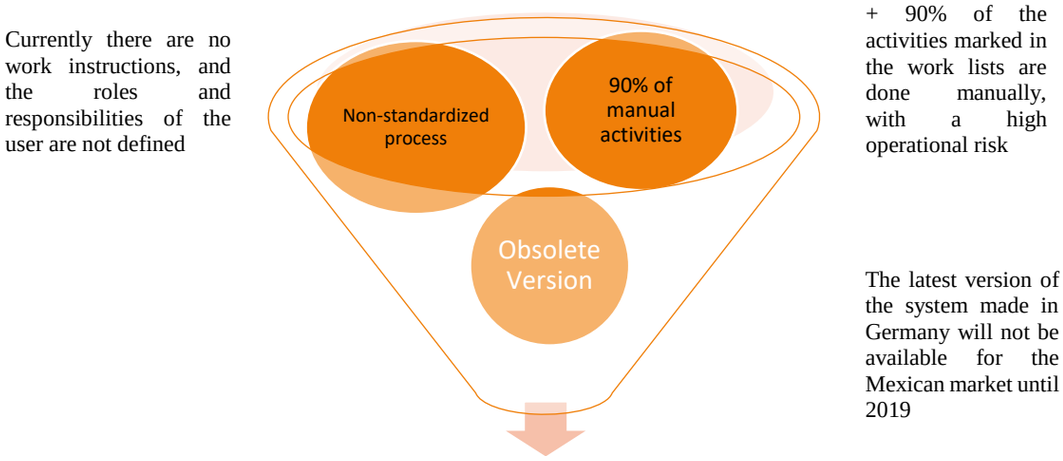
The areas involved in the process of updating vehicle prices are:

- Controlling
- Information Technology Area
- Vehicle brands

The price update, is an activity on demand that is generated whenever new prices are required for new models and versions or suffer changes on existing ones. Because these activities require 90% of manual activities, the company requires an optimization model for its better management. Some of the elements that are considered as points of opportunity for the automotive company are shown in Figure 4. 2

[10] Controller In the business field, it is the figure responsible for the design and general supervision of the management control system. At its highest level of development, that is, based on the senior management staff situation, in general, the controller is in charge of designing the different instruments that help in the management of the other executives of the company. supposed: 1. Design accounting systems (Financial Accounting - Analytical or Cost Accounting) to provide reliable, relevant information at the right time for decision making; once designed, the financial director is responsible for obtaining the financial statements (Rodriguez Martín, 2018).

Figure 4.2 Current business model



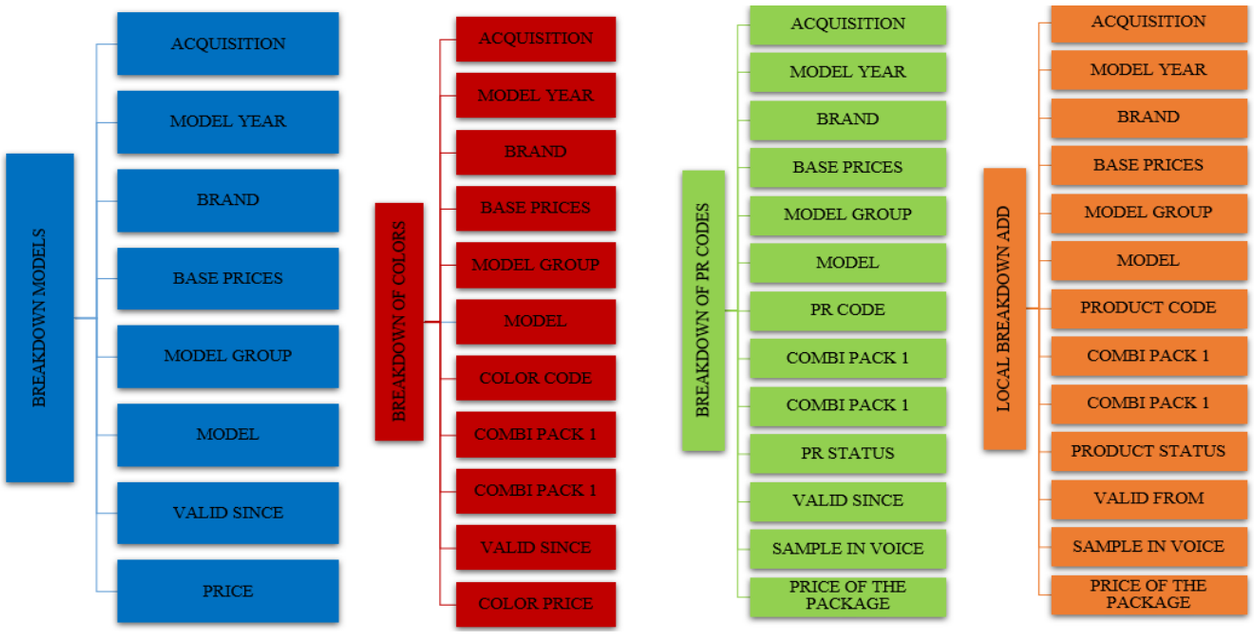
Source: Self Made with company information of the case study

Therefore, the automotive company has requested an update to the system that minimizes operational risks, the processing time of the price update and billing based on current business rules and functionalities. Each vehicle in the system has a differentiated price based on the combination of the following factors:

- Vehicle models (only to mention the current models are more than 50 among all the brands of the consortium)
- Versions (normally on average there are at least 4 versions for each model)
- Colors (with different prices)
- Special equipment (more than 20 different types of configuration)
- Taxes and local charges
- Exchange rates for export vehicles
- Price validity ranges

Therefore, there are more than a thousand combinations of vehicle models, whose prices must be updated in the legacy system in more than 90% of the process. Below is a tree diagram of the possible ways in which you can set the price of a vehicle see Figure 4.3

Figure 4.3 Tree of price configuration combinations



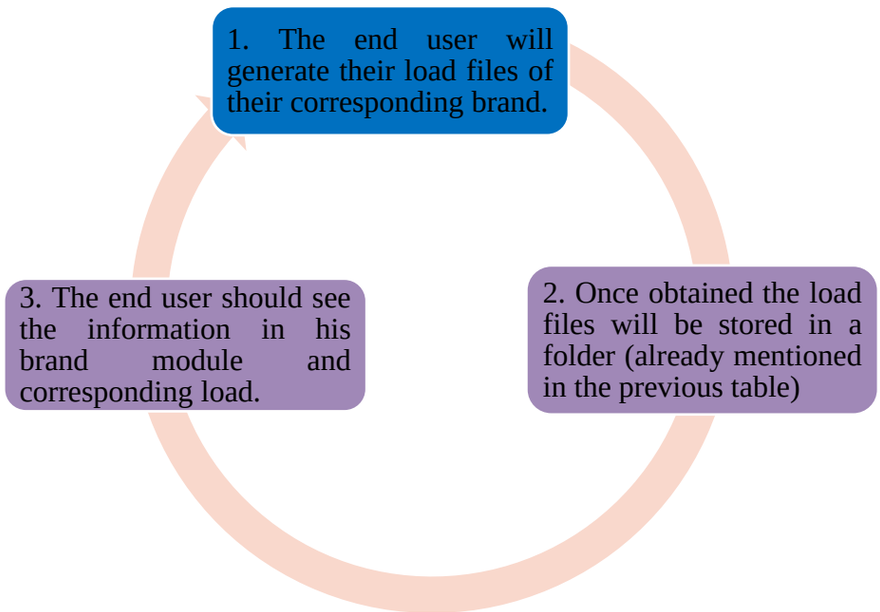
Source: Self Made with company information of the case study

Derived from the types of changes that were handled prior to 2016, the updates were made three to four times a year. However, due to the volatility of the peso against the dollar as of this same year and date, these updates are required in the consortium at least twice a month, representing at least twenty-four annual changes. This has required an increase in personnel in the IT department and controlling, exclusively to perform this task that carries a high risk to be most of the update manually. The intention that the consortium seeks, since the prices are passed through the controlling area in Excel files and captured manually in the legacy system, is that the transfer of information is done automatically without the intervention of the collaborators of IT, given that this generates an effort of around 500 hours for each update that, when carried out at least 24 times a year, represents more than 12,000 hours of human effort per year, which also have a human error rate of 2% which impacts in the financial part of the business.

As part of the measurement phase, a difference analysis was carried out to obtain the real value prior to implementation, equivalent to 500 monthly hours per update of all vehicles, which is equivalent to 30 minutes per each of them.

The value expected by the automotive company is to decrease to less than 3 minutes each update that would give as monthly time 50 hours. Likewise, to carry out the follow-up the company carried out measurements through control charts, to assess the efficiencies reached before and after the implementation. Due to the above information and derived from the long processing time specified, the analysis phase was followed through the root cause document that describes the high working times of IT collaborators for the price update, causing human error rates in around of 2% of the more than one thousand models that are updated at least twice a month, without having support automation tools to solve this task. Figure 4.4 shows the general level process of the desired solution:

Figure 4.4 Desired process



Source: Self Made with company information of the case study

The box at the top of the diagram represents the update of the Excel file that the controlling department performs and its accommodation in a folder that is on a shared route (step 1); from there they are recovered (step 2); and automatically updated in the legacy system (step 3). Given the volume of information that must be handled manually, we proceeded with the improvement phase through the technical brainstorming to find solutions and tools so that the information can be processed autonomously.

The most recommended information technology solution in this case is the use of Automated Robotic Processes or RPA for its acronym in English (Robotic Process Automation).

Selection of tool use for the creation of software robots using RPA

Identified the problem of a high manual activity in the price update, which has an impact on the increase of working hours with consequent update times and financial impacts due to human errors, it was established that the use of a computer robot is the best way to solve the problem.

This means that one or more robots will do the tasks currently performed by the IT area employees to update the prices; thus the time of these employees will be engaged in tasks of development of new systems or support of the mimes. The next step was the selection of the tool that can help the generation of software robots, for which once the ideas for improvement were established, an analysis of those that better execute the needs required by the consortium was required..

Initially, there are two types of automation tools cataloged by their function that are described below:

- **Automation tools for infrastructure work:** these are programs aimed at automating the monitoring of the current capacity of the system disks that automatically free space, also for the monitoring of the space occupied by databases, as well as the capacity of the processor . Among the most common are; Hewlett Packard, HPSA (HP Server Automation) and HPOO (HP Operations Orchestration); there are from IBM and other brands; however, they are oriented to the infrastructure rather than to the application layer of the business process, so all those that belong to the infrastructure area are discarded.
- **Application automation tools:** the automation tools for infrastructure work are vital for the proper functioning of the machine where the applications operate, but they are not sufficient to operate in the operational layer. There is another set of tools for these functions that support end users with repetitive business tasks: spreadsheets, automated emails, SAP systems automation, legacy systems, among others. In this layer are the tools that will help the company to make use of the RPA.

Within the brainstorming session, a comparison was made of the best tools that are being used as best automation practices for the management of RPA and the following were found as the main ones:

- Genexus
- UI Path

It was found that both can be used for the automation of tasks within the SAP system, as well as administrative tasks of the system, such as programming the execution of a program at a specific time, turning off the computer, enabling or disabling system components.
But specifically the facilities of Genexus (Genexus, 2018) are the following:

- Easy use for managing custom applications, which must interact with connections to or from SAP.
- Contains already available connectors to enterprise resource planning systems (ERP, for its acronym in English, Enterprise Resource Planning)
- Agile development for customized solutions within SAP

As previously mentioned, the solution required is for a legacy system and Genexus, despite being a powerful tool in the market, is more oriented to have expeditious connectivity with ERP systems, which, although it is common in the world of systems, for the requirement of this case, does not represent great help.

The UI Path tool (Uipath, 2017) has the following specific characteristics:

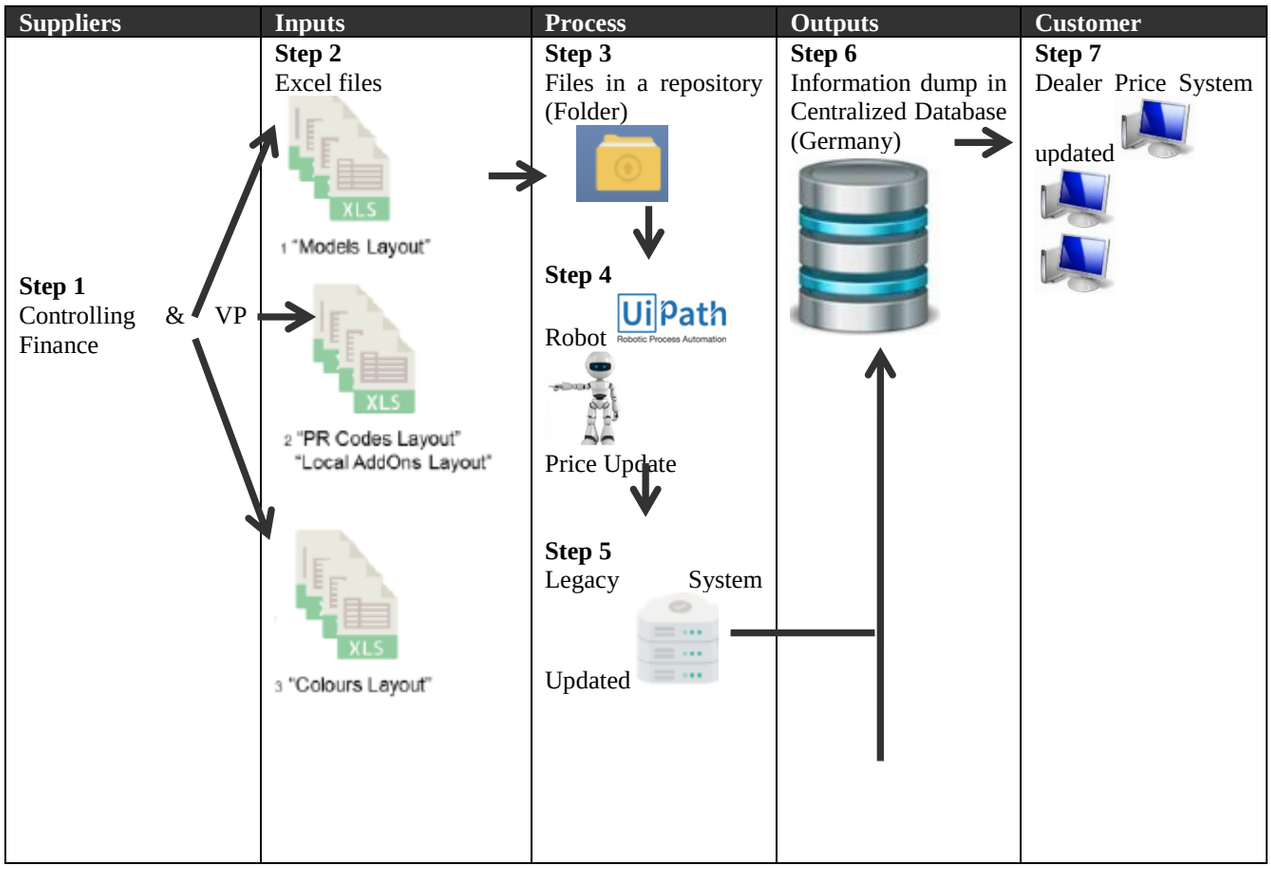
- Solution created for the RPA application
- Express execution of repetitive tasks that have similar results
- Reduction of human error rates
- Assurance of the execution of tasks 7x24 (7 days 24 hours)
- Use for tasks in SAP, legacy systems, web pages, emails and any activity that an end user performs recurrently

Due to the above, UI Path was the software tool selected at the end of the technical brainstorming session; it is the one that best adapts to the needs of the use case of the automotive consortium.

Development and proposal of solution of the use case for the price update automation

Once the scope of the proposal has been reviewed, this section details the solution that allows automation of prices per vehicle to be executed. Then; and making use of a diagram of suppliers, inputs, process, output and customers (SIPOC) still within the improvement phase, the implemented solution design is detailed, see Figure 4.5.

Figure 4.5 SIPOC of the business process of price update. New solution design. Improvement Phase



Source: Self Made with company information from the case study

Step 1. Controlling and authorization of vice-presidency of finances: As already mentioned, step one corresponds to the generation of price updates by the con trolling department. Once these have validated the new exchange rates in the market they make a dispersion of the prices, which are sent to the vice president of finance to do the validation of the same, which culminates with an official authorization.

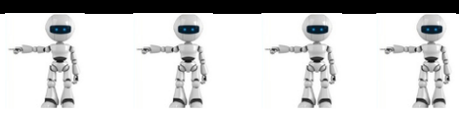
Step 2. Excel Files: The generated Excel files, correspond among others, to the price update for the following categories, where each of the elements of the list corresponds to a file that will be the source of information that is entered into the legacy system : layout of models, brands, base price, model group, colors, equipment (for example: automatic or standard, diesel or gasoline, etc.) and special features (for example: wheel size, sunroof, etc.). The entry of these files is on demand, to the request of price changes derived from the exchange rates.

Step 3. Files in a repository (folder): When the files are generated, they are stored in a shared system folder, which prior to the incorporation of the solution, were opened by the employees of the IT department to initiate the price update of manually, which required an average annual effort of 12,000 hours, in addition to the human errors that implied financial impacts for the consortium and delays in deliveries for the new prices to the concessionaires. Under the new solution scheme, the files are saved in the same system folder, which the robot is monitoring every minute and as soon as it finds a file, it will be the trigger to start the automated work in the legacy system update.

Step 4. Execution of the robot. Price update: Once one or more files are found in the system folder, an RPA orchestrator validates that there is not a robot previously executing and updating the price values in the legacy system, otherwise, the Orchestrator launches a robot, which will start with the price update. When another file is placed at the same time, the orchestrator will ensure that the update in the legacy system is not executed, but until the previous settings have been processed correctly, this in order not to generate inconsistencies in the legacy system, nor in the price update in the database. The following diagram shows the interaction between the orchestrator and the robots that run the price update in the system, see Figure 4.6.

Figure 4.6 Automation process diagram

Orchestrator

If a robot is executing the update of a file, the orchestrator guarantees that until the end of its execution, the activity of the second or subsequent robot begins.
Robots

Once a robot is called to perform the execution it starts to do the update in the Legacy system
Legacy System Update

The legacy system is updated with the new price values, based on the new and existing models, equipment, exchange rate, among other factors
Dump to Database

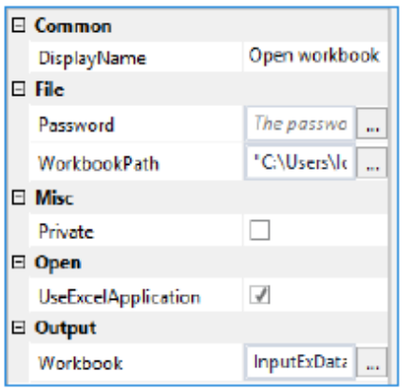
When the information is updated in the legacy system, it executes the dump of information to the database that concentrates the new prices and displays the information in the network of concessionaires

Source: self made with company information from the case study

When a robot is called by the orchestrator to execute the price update from a file placed in the common folder, the actions that are executed are as follows:

- Opening of the corresponding Excel book for which the file name must always be the same depending on the type of file to be updated, that is, depending on whether it corresponds to a file of equipment, special features, models, etc. To do this, the fixed routes where the file will be searched must be specified in the tool: The following Figure 4.7 corresponds to the configuration made in the UI Path tool

Figure 4.7 Excel File Configuration

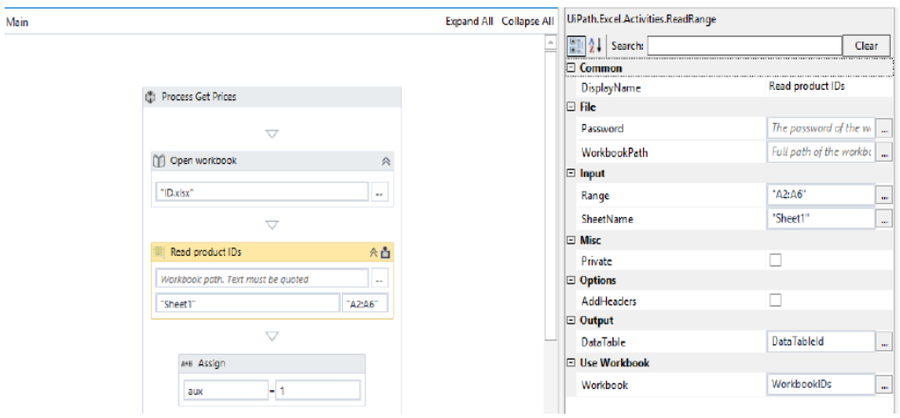


Source: Taken from the UI Path system

The special considerations to take into account are:

- Have MS Office Excel installed
- Have the folder with file sharing properties
- Visible in real time for changes
- Reading of the Excel file: The read ranges of the file are defined and the rungs of the information headers are defined.

Figure 4.8 Worksheet configuration



Source: Taken from the UI Path system

Step 5. Legacy System Updated: As the robot reads each of the records, access the legacy system by executing an identification with a specific user and password for the robot, then enter the option to update prices as shown on the system screen. See Figure 4.9.

Figure 4.9 Main menu of price update system

Source: Company information system taken

Then select the type of file that is being updated, for example, the alternative models, as shown on the screen, this being one of the options that can be modified see Figure 4.10

Figure 4.10 Model options menu

Source: Company information system taken

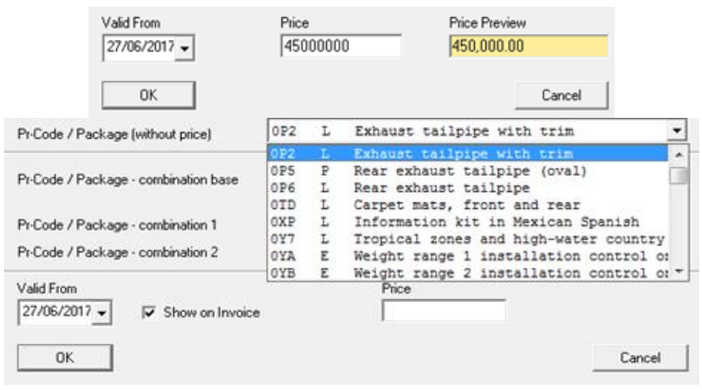
Proceed with updating the prices in the legacy system see Figure 4.11

Figure 4.11 Auto model selection

Source: Company information system taken

The robot, during its execution, begins to perform the price update, based on the special characteristics of the vehicle, see Figure 4.12.

Figure 4.12 Prices and validity of part codes



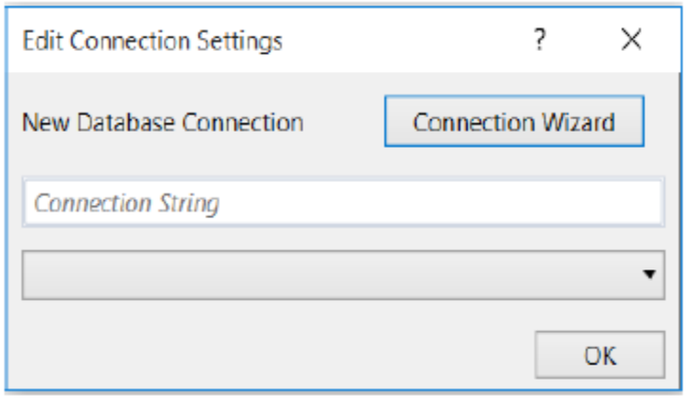
Source: Company information system taken

Step 6. Information dump in centralized database (Germany):

When the information in the system is updated by the robot, the orchestrator sends another robot to call to start updating the data in the centralized database. For this the robot executes the following functions:

- Make a connection to the database see Figure 4.13.

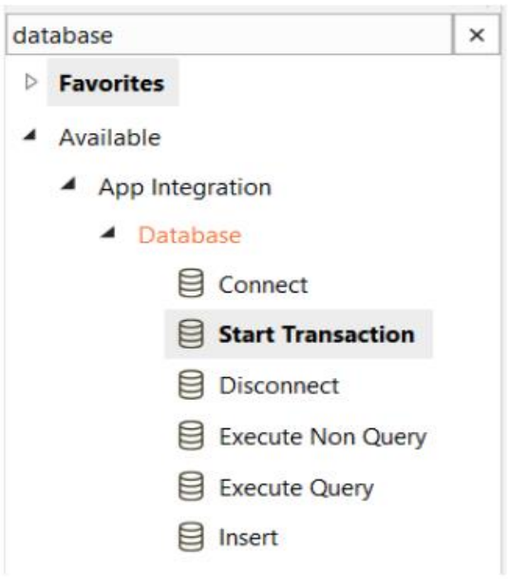
Figure 4.13 Connection to database configuration



Source: Company information system taken

- Open the connection, act on the same database and insert new information if it is a new model or update for existing models see Figure 4.14

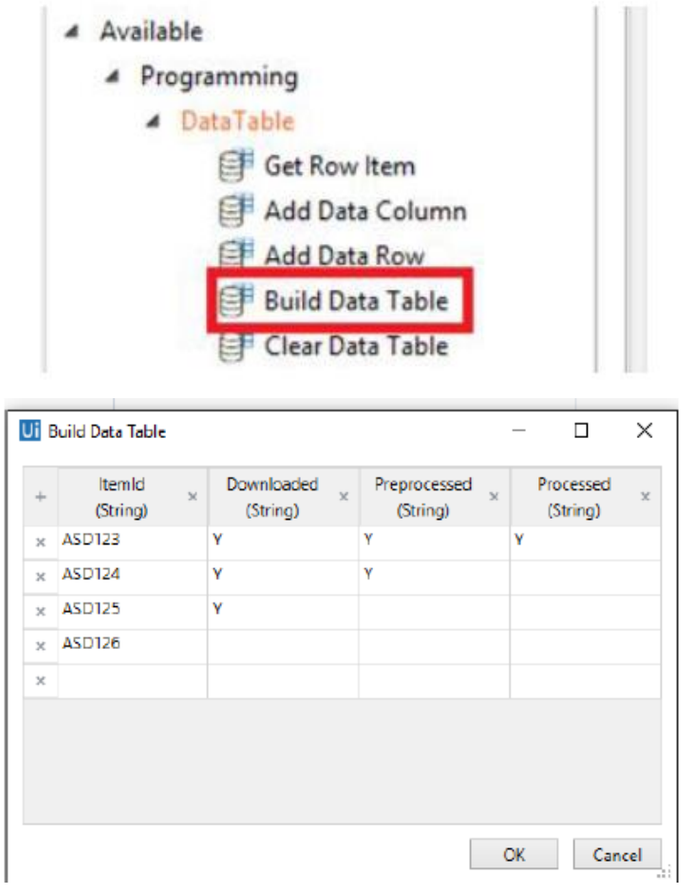
Figure 4.14 Connection to central database instance



Source: Company information system taken.

- This is done directly on the tables that have the price information see Figure 4.15.

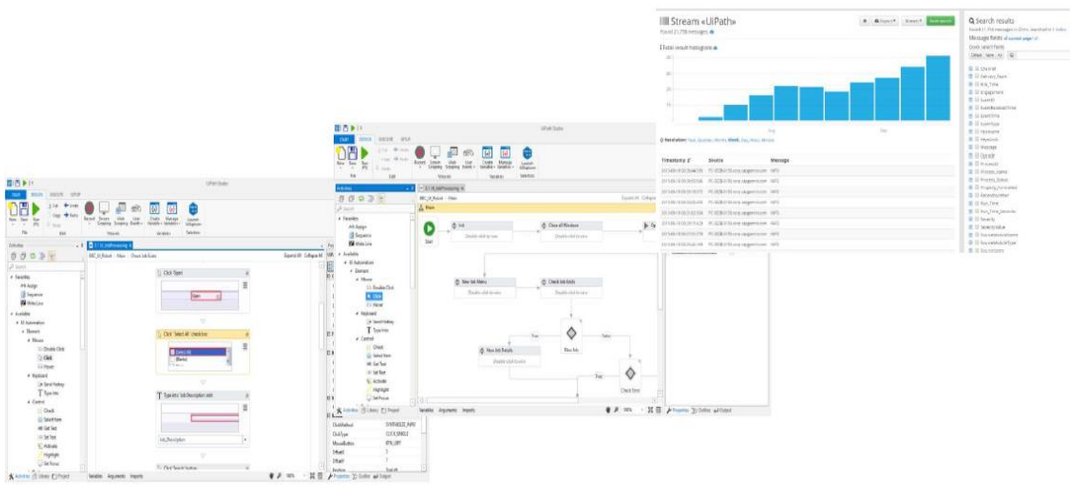
Figure 4.15 Configuration for access to tables in the database



Source: Taken from the UI Path system

The orchestrator keeps a detailed control of how many files have been updated historically, controls the flow of information so that there is no data inconsistency and guarantees the quality of the information. The following image shows a series of indicators and controls of the orchestrator; see figure 4.16.

Figure 4.16 View of the orchestrator working on the execution of robots in real time



Sourcee: UiPath Software

Step 7. Dealer Price System updated

Finally, the price system can be accessed in the view of dealers in a correct and timely manner.

Due to the new solution, and thanks to the measurement boards used by the company in the control phase, it is shown that updating the price of a vehicle after the solution is implemented, takes between 45 to 90 seconds, in addition to the error rate low to 0%. Due to the above, the annual execution times decreased from 12 thousand hours of work of the IT collaborators to less than 400 hours per execution of robot tasks autonomously, reaching the pre-established objective in the measurement phase that indicated having a time for below 500 hours and zero failures as operating error rate.

Prior to the new design of the solution, the update of a specific model through the manual activities took around 30 minutes for the updating of the different modules in the legacy system, as well as the double or triple verification to try to mitigate the risks in the entry of erroneous prices for erroneous captures, such as omission of decimal points, prices entered in wrong characteristics, taking into account that the list exceeds 500 records, and updating in a table with more than 40 columns complicates the correct visibility. All the above caused a rate of errors greater than 2%. Due to the new solution the price update of a vehicle takes between 45 to 90 seconds, plus the error rate dropped to 0%.

Below is the table of comparative summary of previous results, proposed or objectives and achieved after the implementation of the RPA:

Description	Previous	Objective	Reached
Human error rate	2% (20 for every 1000 price updates)	0%	0%
Annual processing times in hours	12000	500	400

5. Conclusions

The automotive industries, historically pioneers in the automation of the manufacturing process, have turned to see the IT departments to assess which points can apply thinner processes, and identifying repetitive tasks that can be done better and faster with the use of the automation. In this case of real study, it is shown that the parameters of decrease of error rate, and of execution times; They can be ambitious but achievable thanks to the implementation of software robots. Based on the success achieved in the automation of the price update process, IT management is analyzing other tasks where it is feasible to implement the RPA through the DMAIC methodology.

The use of RPA tools to automate IT work scenarios based on a methodology, structured for continuous improvement, such as Lean Six Sigma and its DMAIC approach; they demonstrate that defining, analyzing and weighing problems make it possible to select cases to be automated more efficiently, starting with those that generate the most problems in the chain of business processes and that will ultimately have a greater impact.

One of the main fears of those involved in a process that must be automated, is that their tasks are reduced and their work positions are at risk; however, the primary objective is contrary to this, since it means that employees focus on the strategic layer where their work is reoriented to decision making, where they can be the important differentiators of the business. Undoubtedly the implementation of RPAs, involves major challenges from the technological point of view. To achieve that the specific characteristics of the use case are reached, requires that on automation technologies there is the skill of programming to fine-tune even the smallest feature required by the business.

It is recommended that each time you want to implement an automation case, the design of the solution is validated very well, starting from a "Lean" analysis to thin the process, eliminate the tasks that do not add value, normally called waste, which minimize those that do not add value, but those that add value to the business process are necessary and finally are automated. The task of automating IT tasks requires an interdisciplinary collaboration between the owners of the process that are those who know the requirements, the software programmers that will implement the robots and a technical coordinator who is recommended to know both the tasks of the programmer and of the business process that you want to automate.

The use of price automation is the first to be developed and implemented in productive environments for the automotive company in Mexico, which leaves precedents for future cases where manual and repetitive tasks can be automated.

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