



Implementing Robotic Process Automation for Internal Process Optimization

Valeria Kopper
Gabriel Rocha Rodrigues
Madeline Zomb
Franco Zuccolillo

March 6th, 2020

Major Qualifying Project
Advisor: Professor Joseph Sarkis
Worcester Polytechnic Institute

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Abstract

Our project worked to improve and automate the internal processes of Heliotec, a Paraguayan solar and renewable energy company, through the implementation of Robotic Process Automation. We designed a customized robot based on IDEF models developed specifically for Heliotec's processes. We then conducted technical, economic, and organizational feasibility analyses, and determined that the project was feasible. Our recommendation was that Heliotec should implement the RPA developed in the project given the determined benefits.

Introduction

Companies must constantly adapt to the fast-paced business environment by redesigning their processes and improving their efficiency in today's rapidly changing markets. Nevertheless, there remains significant skepticism related to investing in new technologies. This is partly due to the consideration that there is a large risk of not receiving considerable returns on investment; however, these companies need innovative technologies to increase competitiveness, enhance their reputation, and add non-quantitative values to their brands. Without technology many companies have processes being done manually, lacking structured systems and having repetitive, non-value adding tasks. Those issues account for inefficiency, increase in cost and lack of progress.

This project will utilize Business Process Reengineering (BPR) as a method to analyze inefficient processes in order to redesign internal processes and rethink business strategies (Davenport and Perez-Guardado, 1999). BPR can be combined with other methods for continuous improvement, such as lean, and specific techniques to achieve the goal of implementing changes to improve processes (Zellner, 2011). Most of the techniques and methods date back to the late 1990s; therefore, this project will combine these methodologies and tools with Robotic Process Automation (RPA) to achieve a modernized approach. RPA is a software that is trained to "mimic digital data tasks performed by humans" (Rouse, M., Tucci, L. & Rosencrance, L., 2020). It is used to automate repetitive, rule-based tasks by interacting with different applications, just as an employee would.

These principles will be applied at Heliotec, a Paraguayan company founded in 2013 that provides solutions and assistance related to the harnessing of solar power and other renewable energies. The company's target clientele is mostly rural farmers from the Occidental Region (also known as the Chaco) in Paraguay, which is known for its scarce electrical infrastructure. The entire Occidental region, which covers about 60% of the country but only holds 2.6% of the entire population, has a single public electric transmission line to sustain their electrical needs (Ortiz, 2016). Consequently, the population living in these areas, mostly farmers, rely on fuel engines for generating energy. The region has been identified as an area with great potential for solar energy capture due to a favorable climate and high levels of solar radiation throughout the whole year. Heliotec's goal is to supply the people living in the region with a cheaper and more sustainable alternative to producing energy. The company offers a broad range of products that are accompanied by an experienced technical team that is prepared to support and install the systems over the entire country.

The goal of this project was to evaluate the implementation of RPA and lean principles in order to improve and automate Heliotec's internal processes. Heliotec's processes and infrastructure, described later in the report, were assessed to determine which specific process would be analyzed for RPA implementation. The company's management has identified several

flaws and inefficiencies in their current processes and are considering implementing RPA aiming to increase efficiency and reduce costs. This includes an in depth analysis of the project's feasibility as well as a projected timeline for what the project's implementation would look like. There were three main objectives in order to achieve the overarching goal. These included evaluating and assessing current systems and processes at Heliotec, developing an action plan and timeline for what RPA implementation would look like at the company and what changes would be necessary. Additionally, we included recommendations and next steps for the company.

Project Objectives

The overarching goal of the project was to evaluate the implementation of RPA and lean principles in Heliotec to improve and automate their internal processes. The project motivation stemmed from the majority of the internal processes at Heliotec currently being entirely manual and the company being suitable for automation due to the fact that several of their back-office processes follow a specific set of rules. Heliotec was interested in automating repetitive internal processes that are value adding, such as client-oriented tasks. The lack of a structured system, which impacts the company's processes, can be addressed through the implementation of RPA. Overall, RPA has the potential to make specific processes more efficient and cost effective; therefore, the project evaluated the current systems and processes at the company in order to determine which was most suitable for RPA. Once this was determined, an optimization plan and timeline were developed. Baseline measurements were established in order to measure future improved efficiency. This was paired with a feasibility analysis, including economic, technical and organizational feasibility, that evaluated the viability and the costs associated with the project.

Literature Review

Business Process Reengineering (BPR)

It is critical for businesses to continuously adapt and improve by reevaluating their processes in order to keep up with the constantly changing market. This is known as Business Process Reengineering, which aims to rethink business strategies and analyze and shape their processes according to the constant changes (Davenport and Perez-Guardado, 1999). Companies heavily rely on these updates and improvements on their processes to succeed. “Today, firms must seek not fractional, but multiplicative levels of improvement - 10X rather than 10%.” (Davenport, 1993, p.1). The term “‘reengineering’ functionally resembles planned change” (Burton, 2011) and speaks to starting from scratch or a blank slate. Reengineering addresses all aspects of the processes within a business and focuses on re-designing and implementing those changes. Additionally, the competition curve has become increasingly steeper over the years, leading to a higher innovation rate (Aghion, Bloom, Blundell, Griffith, & Howitt, 2005). In other words, the fierce competition makes the need for BPR indispensable for companies to grow their business and stay competitive within the market. By being more innovative, companies will improve the efficiency of their processes and focus their work power towards activities that will add more value to their brand and customers.

BPR encompasses a broad spectrum of business improvement methods. It follows the Deming Cycle, a plan-do-check-act (PCDA) cycle, which focuses on a clear goal – evaluate, redesign and improve (Zellner, 2011). Nonetheless, there are multiple techniques that can be combined with these methodologies to achieve the objective. The choices depend mainly on the business strategy, processes selected and main issue to be tackled (Kettinger, Teng & Guha, 1997). Is the priority to eliminate waste? Is it to gain more profit? Is it to have more value-adding tasks? Therefore, the shape of a BPR project modifies according to the situation in which it is being applied. For this project, Heliotec's internal manual processes were analyzed in order to implement BPR combined with other methodologies and techniques to increase efficiency and potentially reduce costs. Given that BPR was an element of several combined to design a plan for the company, further methodologies evaluated and applied will be additionally discussed.

Business Process Management (BPM) Comparison to RPA

RPA is considered to be a form of Business Process Management, which is understood to be synonymous to Business Process Reengineering. RPA is not meant to replace BPM. Instead, it is intended to compliment it (Santos, Pereira and Braga Vasconcelos, 2019). Table 1 shows a comparison of the two, which clarifies how they can be used concurrently.

Domain	BPM	RPA
Business Goal	Process re-engineering (Forrester, 2014; Lacity et al., 2016)	Automation of existing processes (Lacity et al., 2016)
Application	Creation of a new application (Forrester, 2014; Khramov, 2018; Lacity et al., 2016; Lacity and Willcocks, 2015)	Use of existing applications (Aguirre and Rodriguez, 2017; Lacity et al., 2016)
Integrating Method	Interacts with business logic and data access layers (Khramov, 2018; Lacity et al., 2016; Lacity and Willcocks, 2015)	Interacts with systems through the presentation layer (Aguirre and Rodriguez, 2017; Lacity et al., 2016; Lacity and Willcocks, 2015)
Process Suitability	Best suited for processes requiring IT expertise on high-valued IT investments (Suri et al., 2017)	Suitable for processes that require business and process expertise (Lacity et al., 2016; Suri et al., 2017)
Programming Requirements	Requires programming skills (Cewe et al., 2017; Khramov, 2018; Lacity and Willcocks, 2015)	Does not require programming skills (Aguirre and Rodriguez, 2017; Khramov, 2018; Lacity et al., 2016)
Development Responsibility	Development by programmers (Lacity et al., 2016; Suri et al., 2017)	Development by the business unit (Lacity et al., 2016)
Development Time	Long development times (Mindfields, 2015)	Fast development times – no complex integration required (Mindfields, 2015)

Table 1: BPM vs RPA Table Comparison (Santos, Pereira and Braga Vasconcelos, 2019)

There are six phases of BPM: process identification, discovery, analysis, redesign, implementation, and monitoring. Process identification is done simultaneously with current measurements. Process discovery then documents the current state of each relevant process. This project utilized Integrated Computer Aided Manufacturing Definition (ICAM definition, shortened to IDEF) technique to develop as-is and to-be models for this purpose. During the process analysis stage, any issues with the as-is model are identified, documented, and prioritized. Process redesign utilizes the issues found in the previous stage to identify change measures and create a to-be model. Process implementation covers both organizational change management, which involves any changes required for all participants to be involved in the new process, and automation, or the necessary development of IT systems. The final stage, process monitoring, is a continuous task in order to determine how well the process performs by collecting data on any bottlenecks, errors, and deviations to further improve and perfect the new process. If there are any new issues, the BPM cycle must be repeated (La Rosa & Mendling, 2019).

Robotic Process Automation (RPA)

Robotic Process Automation can be easily confused with physical robots; however, this does not hold true. RPA is a variety of softwares that has the ability to interact with multiple applications in a computer. It can be programmed to complete basic tasks typically performed by an employee. RPA is considered a type of robot, used to automate repetitive tasks. It can automate activities as simple as generating an automatic response for specific emails, to performing financial tasks such as performing bank statement reconciliations. RPA tools perform logic [if, then, else] statements on structured data (data in a predetermined format, such as a configured excel sheet), following an established set of steps. By doing so, it can interact with different computer applications and accomplish activities such as extracting data from a browser and inputting it in a desktop app, clicking or typing where and when indicated, to only name a few (Tornbohm 2017).

RPA is ideal for so-called “swivel chair” processes, in which employees take inputs from a particular system, such as an email or an Enterprise resource planning (ERP) system. Those inputs can then be modified to follow specific rules and can be recorded as outputs into another system. Over the past two decades, RPA has gained increased interest across industries, resulting in dozens of RPA software companies and improved platforms for RPA development. Among the largest and most renowned companies are Automation Anywhere, Blue Prism, and UiPath.

As previously stated, BPR is associated with a wide range of business improvement methods; however, most of its relevant literature is over two decades old.

Due to it being a mature approach, this project will be focusing on combining BPR and RPA to automate internal processes. Overall, contributing to a modernized approach to this process improvement technique. At this time each of the three major RPA vendors and software providers is reviewed. This evaluation will be valuable for later recommendations.

Typical RPA Implementation Timeline

According to the UiPath Business Analyst course for RPA, a typical RPA implementation has six major stages shown in Figure 1. The first focuses on preparing the RPA. In this step, the organization has to prioritize to automate the processes which will provide the best outcome. In order to do so, the organization needs to take metrics or time estimations on their current processes. The following step is to actually design the RPA. For this step, the organization needs developers that can design a proper solution for their process and that can create a test environment where the final project can be tested before it is implemented. The next three steps are to build, test, and stabilize the RPA. During this phase, it is crucial that the test environment assimilates as much as possible to the real-world scenario and that all the possible outcomes are considered when writing the code. By doing so, the developers will be reducing the chances of the RPA failing when implemented. The final stage of the timeline is constant improvement. This step pushes the organization to not only improve the previously implemented system, but to look for new processes to automate and to integrate them together. By doing so, the company would continue to reduce operational costs and it will also spread out the cost of implementing RPA.

In regards to our project, the first step of the timeline has been completed during the Winter Break. Also, the team has a solid design idea for the RPA. The main idea is to automate the selection of pumping systems and sending the budget to the client. Also, it would include automating the creation of a digital database for the company's clients, which will be the company's first step on their transfer from a physical database to a central digitalized one.

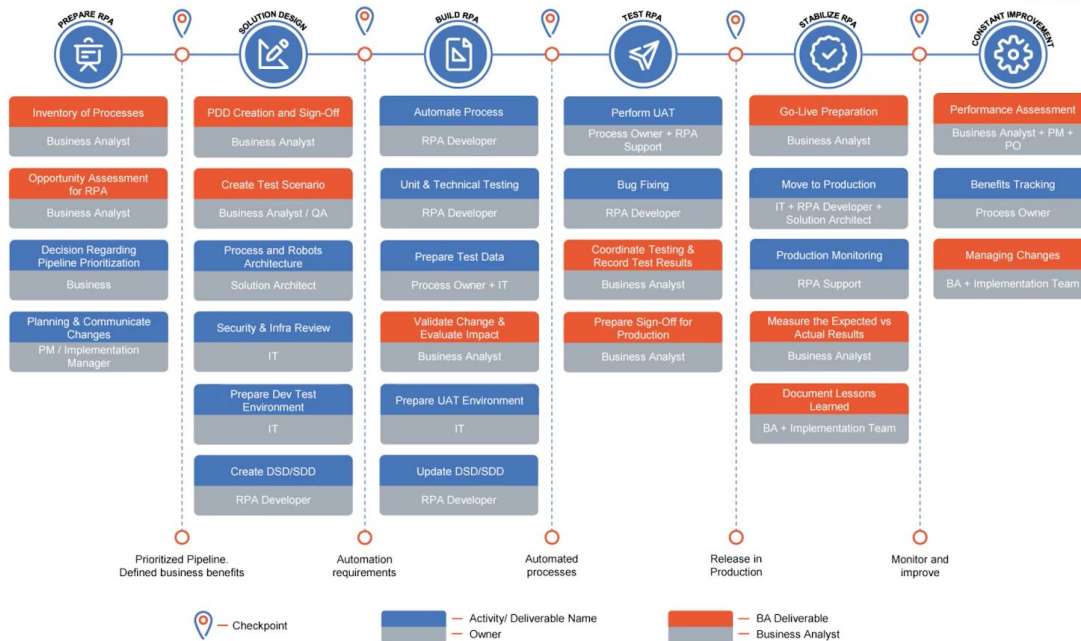


Figure 1: Typical RPA Timeline (UiPath)

Automation Anywhere

Since its foundation in 2003, Automation Anywhere has been providing an enterprise-level RPA platform with built-in cognitive tools and analytics. The software is used by more than 1,000 global organizations to manage and scale-up their business processes faster, with near-zero error rates, while reducing operational costs (Preimesberger, 2019). One of the key features offered to its users is its sophisticated cognitive technology, which aims to make sense of unstructured data to automate complex business processes. Companies such as Dell EMC, KPMG, and PwC rely on this software for automating their business processes. Over the past years, Automation Anywhere has been the largest RPA software vendor along with Blue Prism and UiPath (Medium, 2019). A key difference between Automation Anywhere and its competition is that it is more script-based, while the latter have visual process designers; therefore, more advanced programming skills are needed to use this software.

BluePrism

Over the past 12 years, Blue Prism has been developing its own RPA platform. With their motto, “Taking the Robot Out of the Human,” Blue Prism asserts the company’s mission to take mundane and repetitive tasks away from employees, and instead, assign them to jobs where their human skills enhance customer service. Blue

Prism offers a single type of license, which consists of unattended robots- robots that can be run automatically and do not require any human interaction to perform the indicated task. Blue Prism's client architecture, as well as the debugging capabilities, are far superior to those offered in Automation Anywhere or UiPath. However, one key feature that this platform lacks is the capability of recording macros, which makes the development of simple processes easier and more efficient.

UiPath

With very intuitive and straightforward software, UiPath's platform has become the most popular RPA software on the market (Miller, 2019). UiPath's partnership with companies such as ABBYY (AI cognition software) has enhanced the platform's performance and capabilities, granting the ability to read over unstructured PDF files, for example. Contrary to Blue Prism, UiPath offers three types of robot licenses: attended, unattended, and development robots. Furthermore, UiPath has its own academy, where free RPA development and business analysis courses are offered in addition to a free community edition of the platform, intended for educational and training purposes.

For this project, the team relied on UiPath for developing purposes due to personal experience and knowledge using the software. Additionally, UiPath's Academy is a free resource that can be utilized to train Heliotec employees. Potentially this can lead to the company having their own developers, who can advance automation efforts within the company to additional procedures.

IDEF Structured Analysis and Design Technique

The as-is model is a method of portraying the current state of a process used as part of the BPR methodology. This is typically used to establish a baseline, which can then be used as a measure for improvements and changes implemented. It can also serve to identify key components that need to be altered in order to improve the current system (Fosslund, S., & Krogstie, J., 2015).

The as-is model works well in conjunction with structural modeling approach, a graphical modeling method used for analyzing business processes developed specifically for manufacturing (Fosslund, S., & Krogstie, J. 2015). The IDEF model consists of different levels of detail that vary from the most simple overview of the whole process to the most detailed view of one step. For the purpose of this project, the IDEF model was developed until the level A1.1 Below, Figure 2 represents an illustration of an IDEF model at level A0 of a process. The arrow entering the system from the left represents the inputs and the arrow leaving the system on the right represents the outputs of the system. The arrow entering the bottom is the mechanism used in the process and the arrow entering the top is the controls of the process. Each step of the

process may have different inputs, outputs, mechanisms, and controls, but at level A0, all of them are represented with multiple arrows.

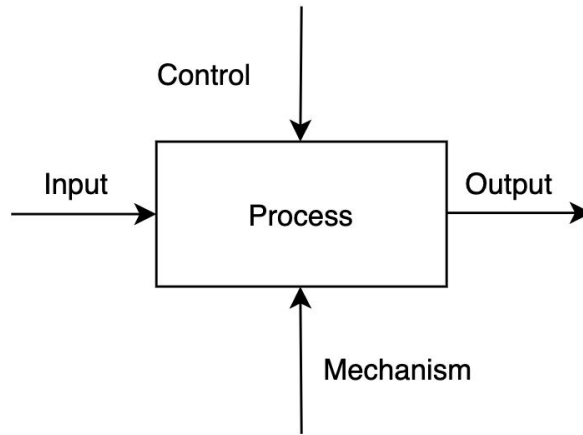


Figure 2: Example of an IDEF As-Is Model A0

Figure 3 illustrates an example of an IDEF model level A1. It follows the same principles as the level A0; however, with more details that depicts the process as a system. The processes are broken down in two, with a number representing the position in the system. This example also shows an interesting connection between two processes, which is an output from one step can be an input for the next step. This connection between processes can happen with all fields - Input, Output, Mechanism, Control.

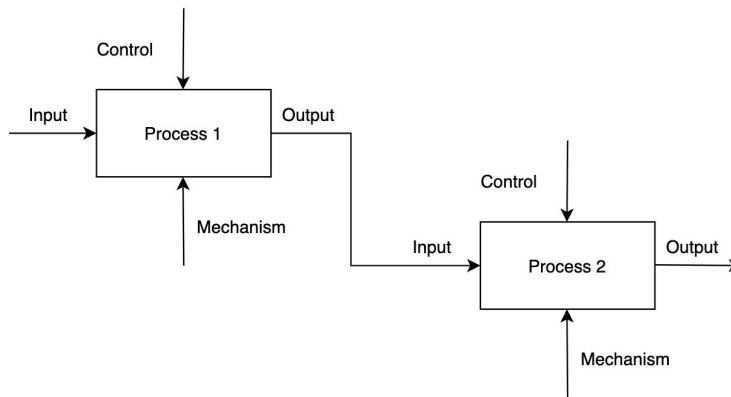


Figure 3: Example of an IDEF As-Is Model A1

Finally, Figure 4 shows an example of a level 1.1 IDEF model for process 1. This level provides deeper details on how the process 1 works. It illustrates two other processes that share

the same control and have a connection between output and input. A complete IDEF model should contain a level 1.1 for all the processes that were established in level 1.

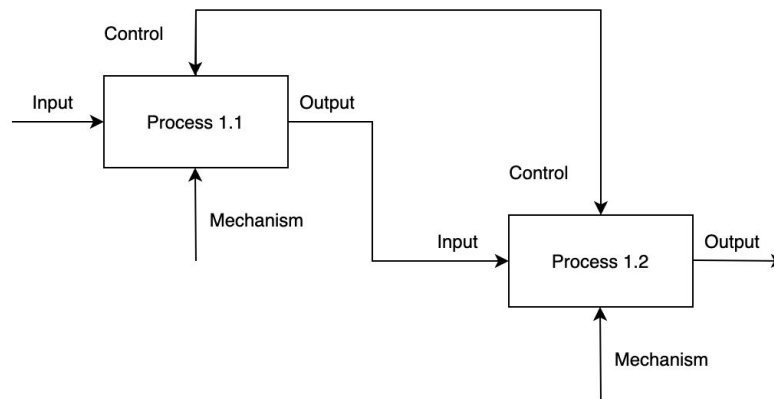


Figure 4: Example of an IDEF As-Is Model A1.1

As-is models are often paired with to-be models, which show what the processes would look like after the improvements are implemented (Fosslund, S., & Krogstie, J.). This can also be helpful in terms of process standardization.

Feasibility Analysis

The feasibility analysis aims to determine whether adopting RPA is beneficial for Heliotec, and evaluates the technical, economic and organizational feasibility.

Technical Feasibility

The technical feasibility analysis is rooted in the question "can we build it?". The analysis can then evaluate whether the proposed project should be pursued. The familiarity with the application in question and the technology being implemented should be evaluated, given that less familiarity comes with a higher risk. The size of the project should be determined and how many people are going to be involved, given that larger projects tend to have a higher risk associated. Part of the analysis will be to ensure that the employees involved post-implementation can operate the new system properly. Lastly, as part of the technical analysis, the compatibility of the technology that will be implemented with the technology already in use should be assessed. Typically, the harder it is to integrate the incoming technology with the existing one, the higher the risk will be (Dennis, Wixom, Roth, 2018).

Economic Feasibility

The economic feasibility analysis addresses the question “should we build it?”. It utilizes a cost-benefit analysis to determine whether the project will be profitable. The initial step in this process is to identify all tangible costs and benefits including both one-time and recurring costs. Values are then assigned to the costs and benefits, which are determined by surveying consumers. The next step is to create a cash flow including the forecast of the costs’ and benefits’ worth over the next three to five years, with growth rates if possible. The final assessment of the project’s economic value is calculated and compared with the costs: the return on investment (ROI) is the rate of return earned on the amount invested on the project, the break-even point (BEP) is the period in which the cumulative benefits exceed the total project costs, and net present value (NPV) is restating all costs and benefits in today’s monetary value (using the appropriate discount rate) and determining whether the total present value of benefits is greater than or less than the total present value of costs. The economic feasibility analysis is a critical process for businesses to complete as it will determine whether or not the project is feasible (Dennis, Wixom, Roth, 2018).

Organizational Feasibility

The main focus of the operational feasibility portion of the analysis relies on "if we build it, will they come?". This addresses how aligned the project is with the developer's business objectives. It should aim for strategic alignment, in which the fit between the project and business strategy is strong. It is expected that the stronger the alignment between these, the less risky the project will be. A stakeholder analysis should also be performed, in which crucial roles are determined and how the project will affect them. This analysis will also determine whether new operational roles will be required post-implementation. This mainly consists of determining who the stakeholders are and what role they will play within the project development as well as post-implementation. The role of Project Champion is usually attributed to a high-level executive. They are usually the project sponsor and the person responsible for requesting it. Their main support for the project comes from giving time, resources and representation, essentially conveying the importance of the project to other organizational managers. Another key role is Organizational Management, a person with knowledge about the project that is responsible for setting up a budget and encouraging the employees. Lastly, the System Users are responsible for making decisions that influence the project, as well as interacting with the outcome. In other words, users determine if the project is successful (Dennis, Wixom, Roth, 2018).

After the feasibility analysis is completed the project can continue, and the next step is to describe and model the processes chosen in terms of requirements, data flow, and entities.

Methodologies

Gantt Chart

An important tool utilized throughout the project was a Gantt chart, which is commonly used in project management. Gantt charts allow teams to break down project activities and milestones, in order to develop a projected timeline for the project. It served as a visual display to keep the team organized and accountable throughout the duration of the course. There was a Gantt chart developed for each stage of the project, divided as: Before the Start of A-Term, A-Term, B-Term, Winter Break, and C-Term. The project timeline broken down in these stages can be seen in Appendix 3, shown in table format.

Semi-Structured Interviews

Semi-structured interviews are a method of gathering qualitative data in which the interviewer asks the participants “a series of predetermined but open-ended questions” (Ayres, 2008, p.810). This type of interview will allow us to have control over the direction of the interviews, while also providing space and opportunity to explore other points that the participants want to bring up, which were not included in our main course of the interview.

First, Heliotec’s owner, Pablo Zuccolillo, was interviewed at the beginning of the project aiming to get an overview of the company, more specifically about the processes that would be targeted. Then, Heliotec’s head secretary, Fatima Samudio, was interviewed. The goal for the interview was to obtain more information on the current processes, technologies and methods used at the company. The insights given by Mrs. Samudio aided in the creation of the workflow of the company. Lastly, it allowed for a more precise evaluation of the expectations on the project.

IDEF Modeling

As previously mentioned in the Literature Review, as-is and to-be models are a great method for visualization of bottlenecks and improvements in the processes represented. Therefore, for this project, as-is and to-be models were created to establish baselines for the processes on focus. IDEF was utilized to develop as-is and to-be models levels A0, A1, A1.1, A2.1, and A3.1. These are shown in Figures 7 to 16, in the analysis section of the report.

Process Analysis and Selection

The selection of the specific process to be automated was done with the help of Heliotec’s management, including an interview shown in Appendix 1 and 2. The first step was for management to describe, in detail, their whole order process from beginning to end. Once the

process was described, the team divided the whole process in different sections, and began to identify the different stakeholders in every step. The next step was to analyze how each step is currently done, and identify the logic behind every step. For instance, what logic determines whether the secretary does one thing or the other? Following UiPath's Business Analyst course's lessons, the team decided to target the "quick wins" or the parts of the process that could be easily automated. Since most of the process steps were done on pen and paper, or required manual labor, the team determined to focus on automating the processes currently done digitally. Specifically, the team determines to automate the selection of the ideal pumping system after the secretary receives a call and fills out a *Ficha del Cliente* (FDC). This particular process followed a very straightforward logic, took a considerable amount of time, and could be done completely digitally. Once these two steps were completed, the team assessed the results and recommendations with the client, who approved the team's decision. The analysis is further discussed and the chosen process is thoroughly described in the as-is model, as mentioned above.

UiPath Coding

Typically, the first step on the RPA development phase is to write a document that describes the process from beginning to end. In this document, all the needed requirements for automation are clearly specified. The document should also include a detailed description of every step of the process, such as explaining how the process is currently done manually and describing the logic of every step, as shown in the as-is model. As a result, the RPA developer understands the process thoroughly in order to program the robot to accomplish it.

In order to do so, the team will prepare IDEF models to show the steps of the manual process (As-Is Model), as well as the different steps of the process after RPA implementation (To-Be Model). Besides showing the order of steps, these models will also describe the involvement of the different actors in the process, whether it's the secretary, the engineer, or even the RPA. Once these models are done, the team should contact Heliotec and get their confirmation that the models are accurate. Once the client signs off the document, he/she is confirming that the models are accurate, and that the process is ready for the development phase.

As previously mentioned, the team relied on UiPath's RPA Timeline when developing this RPA project (Figure 1). In order to do so, all four members of the group completed the UiPath Business Analyst course, which is offered at no cost in the UiPath Academy website. In this course, the different steps of an RPA project are described thoroughly, and recommendations are given on how to approach different types of projects.

Analysis

The analysis of RPA implementation in Heliotec was divided into two main categories: Process and Feasibility. The process analysis portion relates to the break-down and in-depth analysis of the back office process to be automated. Throughout this section, different models are presented that explain the current process and how the process will ideally be after automation. The feasibility analysis, on the other hand, encompasses a larger scope. This section was divided into three parts: technical, economical, and operational feasibility.

Process Analysis

Process Selected

Heliotec focuses on two different product lines. The first line involves pre-set and pre-designed solar systems that include pumping systems and electrical systems for home appliances. The customers that purchase these products are typically farmers who need electricity for their homes or for their ranches. The second product line involves large scale projects under customer specifications. These large projects normally involve government infrastructure projects or large companies whose projects scope are far larger and cannot be covered by the pre-designed systems.


Although only 20% of Heliotec's customers are farmers (who fall under the first product line), these types of orders are a lot more frequent than the larger-scale projects that happen sporadically. Therefore, it was determined that focusing on the pre-designed solar systems that follow the same process and are not dependent on customer specifications was best suited for designing the RPA automation. The product line of pre-set solar panels can be divided into three phases: customer order, system installation, and installation follow-up. Although Heliotec has a standardized step-by-step procedure for the three phases, all of them are currently done manually on paper. The project aimed to digitalize and automate the first stage.

Current Process

As previously mentioned, the group focused on phase one of the process, Customer Order. The process begins with a customer calling Heliotec. The call is received by the secretary that has to fill a FDC (Customer Form) manually. The FDC is divided in three parts: Customer Information, Order Specifications and Observations. The first part includes customer name, category (rural, which is related to farmers; urban, which is related to urban customers; infrastructure, which is related to large companies/government; UPS system, which is related to back-up battery systems), corporate name, email and telephone number. The second part includes information based on the product that the customer is selecting, *Sistema de Electrificación* (Electric System) or *Sistema de Bombeo* (Pump System). For *Sistema de*

Figure 5: Ficha del Cliente

After completing the FDC, the secretary sends it to Heliotec's engineer. The engineer analyzes the customer form and chooses the specific system that satisfies all the conditions established by the customer. To determine the correct system, the engineer uses a Product Catalog, an Excel sheet containing all the systems available for purchase with their respective characteristics. The Product Catalog was thoroughly designed by the engineering and management teams in order to simplify the selection of the correct system. Figure 6 is an example of how the catalog illustrates the information on the specific system.

		Brasilia 1994 c/Artigas Asunción - Paraguay		Tel. +595 21 290025 ventas.heliotec@gmail.com www.heliotec.com.py			
				Asunción, 1/9/20			
PRESUPUESTO				Cliente:			
Sistema de bombeo solar para tajarar				Telefono:			
L15.5-025T				E-mail:			
Rendimiento diario medio:	m3	25	19	16	11	8	1
Altura dinámica :	m	5	8	10	13	15	20
Incluye:							
Item	Cant.						
Bomba de agua alemana	1						
Controlador	1						
Paneles solares	1						
Soporte para paneles	1						
Flotador	1						
Cableado bomba	30 m						
Puesta a tierra	global						
Material de instalación	global						
Contado:	G 12,585,929						
Cuotas: 6x	G 2,412,303						
Condiciones comerciales:							
Precio no incluye instalación, ni traslado							
Precio no incluye sistema de distribucion electrica ni de agua							
Validez del presupuesto: 15 días							
Forma de pago: 6 cuotas = cheques diferidos;							
Garantía: 12 meses							
Flete: Gs. 3,500/km recorrido de acuerdo al volumen.							
Mayor a 12 paneles Gs 5.000; mayor a 23 paneles Gs. 7.000							
Instalación: G. 600,000/día a pagar max. 15 días despues de la instalacion*							
*interes moratorio 2% mensual							
+ 1% gasto administrativo							
Servicio de cobrador Gs. 50.000							
Financiacion por banco externo							
Opcional: Sistema Pararay y otros artefactos para prolongar la garantia a 24 meses por Gs. 3.150.000 o financiado a 6 meses por Gs. 580.000							

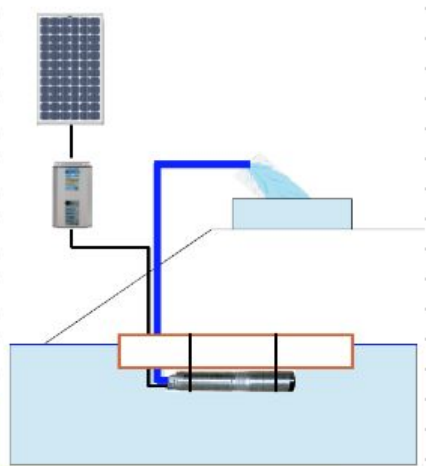


Figure 6: Product Catalog for system L15.5-025T

Figure 6 shows system L15.5-025T, which is a pump system for artificial ponds. The rows highlighted in blue are the most used by the engineer since they are the baseline information necessary to choose what system fits the best given the specifications of the customer. They inform the amount of daily water that the system can generate based on the dynamic height of the pond. The rows highlighted in orange present all the items included in the purchase of this system. The yellow rows give the prices of the system in Guaranis. For this particular product the price is ₡ 12,585,929 (US\$ 1933.49). Lastly, the green rows mention specifications about the product and observations about the purchase of it.

With the specific system chosen, the engineer returns the information to the secretary, whose responsibility is to identify the price of the product in order to create a budget for the customer. The secretary uses the Product Catalog, more precisely, the rows highlighted in orange, to gather the necessary information of the chosen system and sends an email to the customer with the budget of the product. Subsequently, the process can follow two different routes depending on the decision made by the customer. If the customer approves the budget, the secretary will send an additional form to the customer in order to obtain information for the installation of the product. The form is called “Ficha adicional de información para instalación”. After the form is completed, the secretary will send the information of the desired system to the warehouse clerk, who is responsible for collecting the necessary materials for the installation of the system, consequently, starting Phase 2 of the process. On the other hand, if the customer does not approve the budget, the administrator plays the negotiator role in order to secure the purchase. The negotiations can take place by email, telephone conversations or in person. If the renegotiated budget is approved, it follows the same steps until Phase 2 is initiated. However, if the new budget is denied, Phase 1 is terminated and there is no business between Heliotec and the customer.

The current process was broken down into clear steps through the creation of an as-is model using IDEF methodology. The IDEF model has three levels. Level A0 (figure 7) is an overview of the overall process, A1 (figure 8) shows the main steps and A1.1 (figure 9), A2.1 (figure 10) and A3.1 (figure 11) have a detailed view of all steps through the process, seen below.

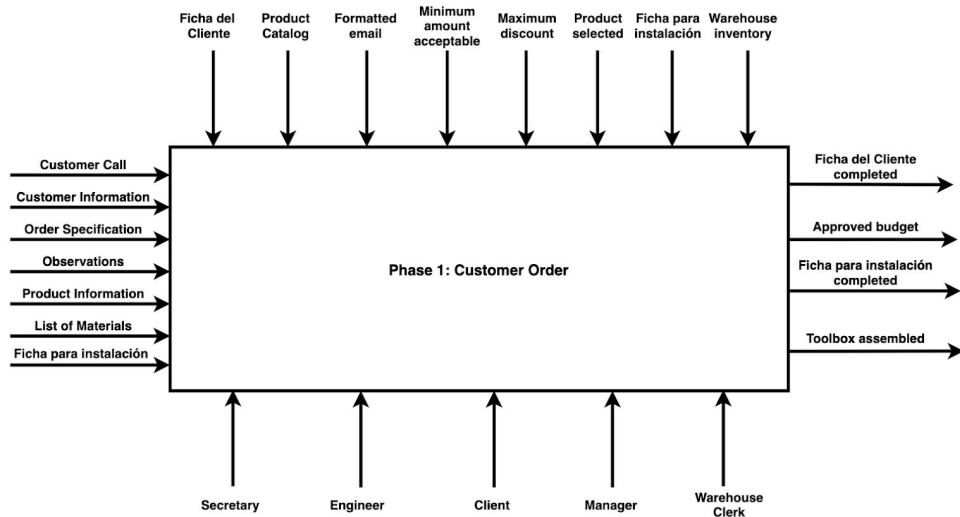


Figure 7: As-Is Model Level A0 Phase 1

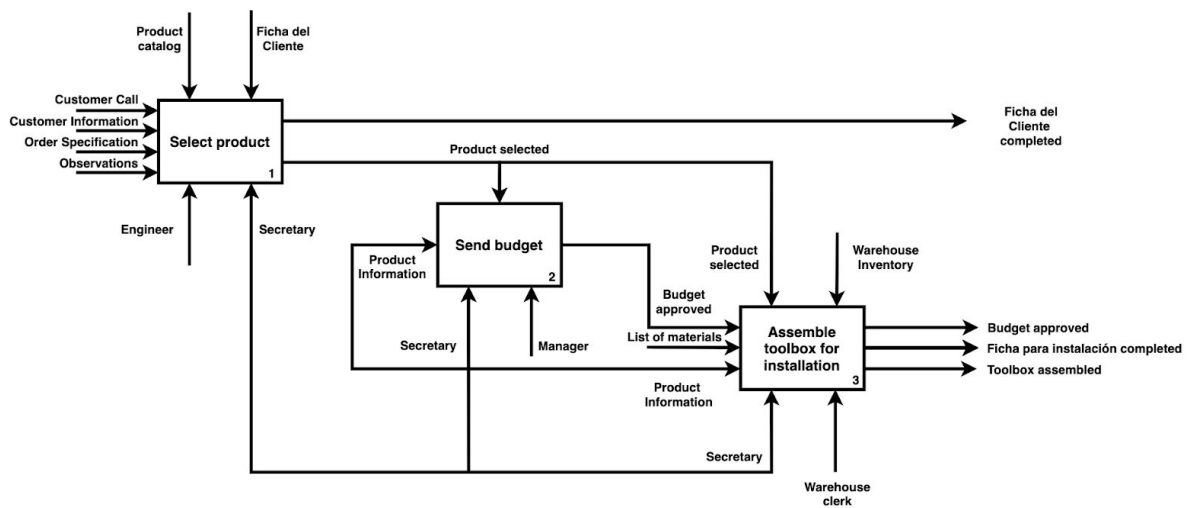


Figure 8: As-Is Model Level A1 Phase 1

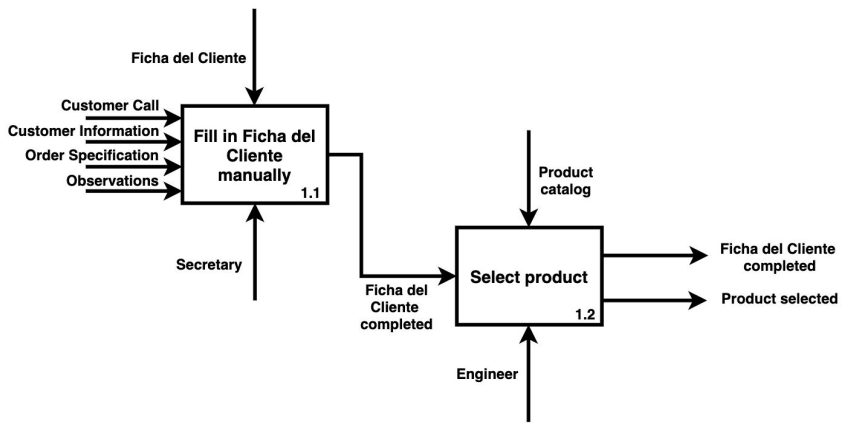


Figure 9: As-Is Model Level A1.1 (Select product) Phase 1

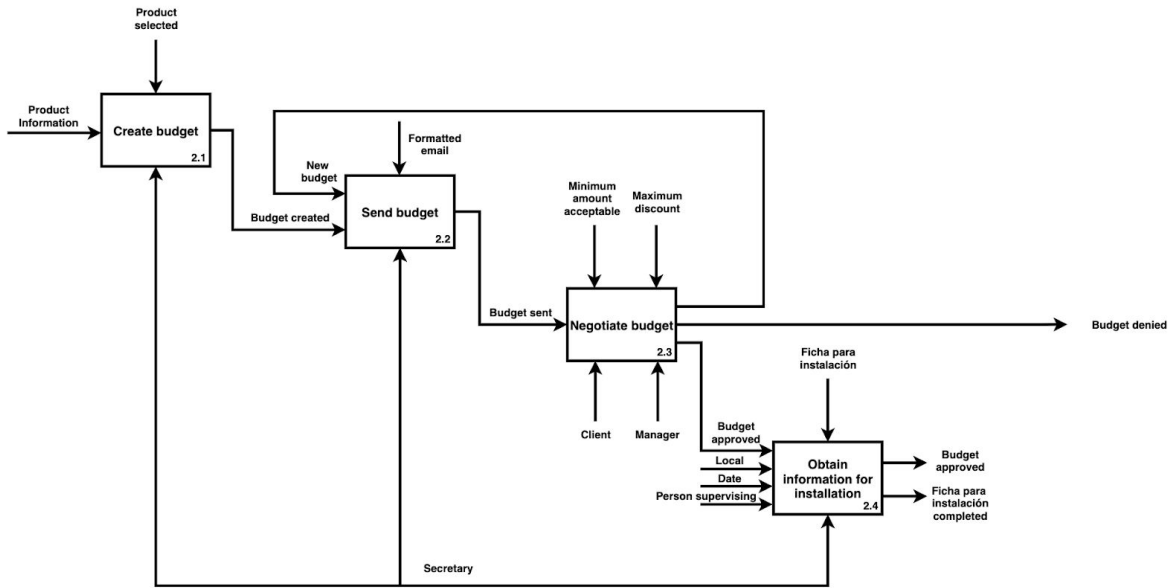


Figure 10: As-Is Model Level A2.1 (Send Budget) Phase 1

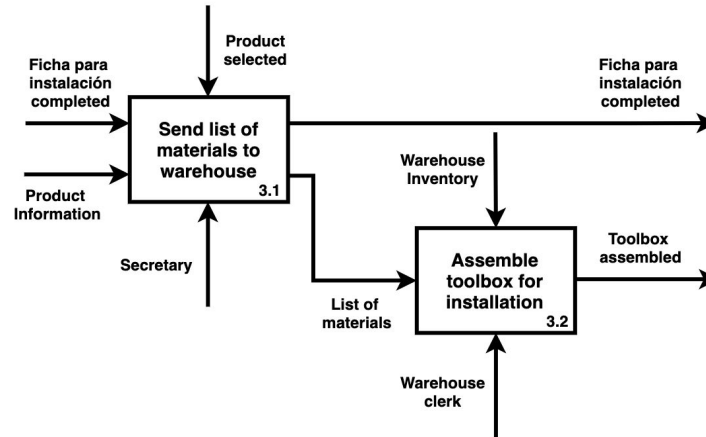


Figure 11: As-Is Model Level A3.1 (Assemble toolbox for installation) Phase 1

By carefully analyzing the as-is model, three steps were identified as bottlenecks: "Select Product", "Create Budget" and "Assemble Toolbox for Installation". The first process is considered a bottleneck due to the large margin of error that exists since the secretary is manually filling the *Ficha del Cliente*. An error in this stage can lead to a customer never receiving a budget, for example. The "Select Product" process was also recognized as a bottleneck because it relies on the knowledge of Heliotec's engineer. It was considered that the engineer is also responsible for other product lines from the company; therefore, the engineer's time is restricted, making the process longer than expected. In addition, the first step is the longest step of the process since it averages around 20 minutes. Finally, the process "Create a Budget" depends on the Secretary receiving back the information from the Engineer, and as mentioned before, sending this information back is not his top priority, prolonging the process time. Besides that, the second step does not have a follow up schedule to contact the customer about the budget approval. In case that the customer doesn't reply to the email, the order is not completed. Thus, the second process was analyzed as a bottleneck.

Taking into consideration the bottlenecks of the as-is model, the proposed process focuses on adding RPA in order to standardize and automate it. The first change would be to substitute the "paper and pencil" *Ficha del Cliente* for a standardized form, which would be digitally filled by the secretary. Next, would be to program RPA to automate both steps - "Select Product" and "Create Budget". This would allow the engineer and the secretary to focus more on value adding activities and would also allow the management team to create a database of the customer's information for control and future marketing strategies. Lastly, RPA would be used to send the list of materials to the warehouse team.

Consequently, the As-Is model was transformed into a To-Be model incorporating RPA. It can be observed in Figures 12 to 16 and shows the modified actions. In "Select Product", RPA was used after the secretary filled the *Ficha del Cliente* in order to store the information in a

database. Then, RPA substitutes the engineer, selecting the correct product for the customer based on their needs. Lastly, in “Send Budget”, RPA replaced the Secretary when creating the budget and sending it through an email to the customer. The mechanisms involved previously are all still part of the process but with the addition of automated actions.

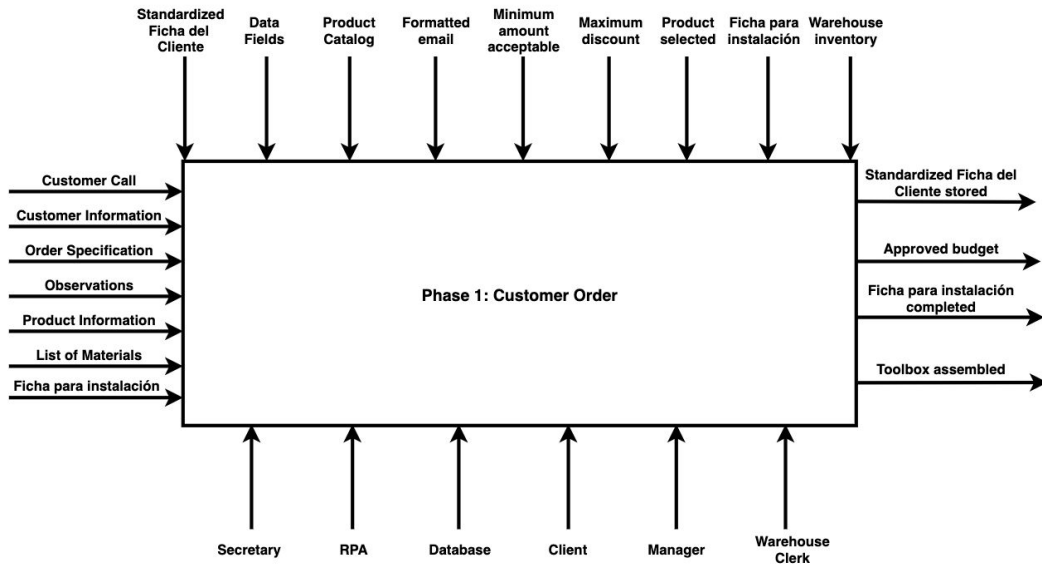


Figure 12: To-Be Model Level A0 Phase 1

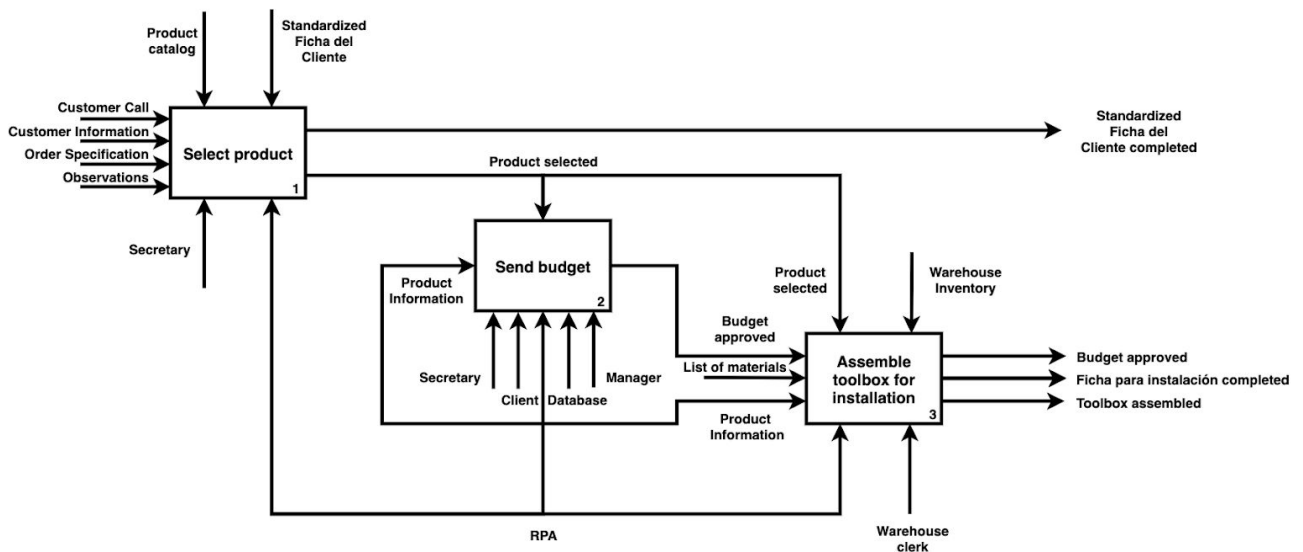


Figure 13: To-Be Model Level A1 Phase 1

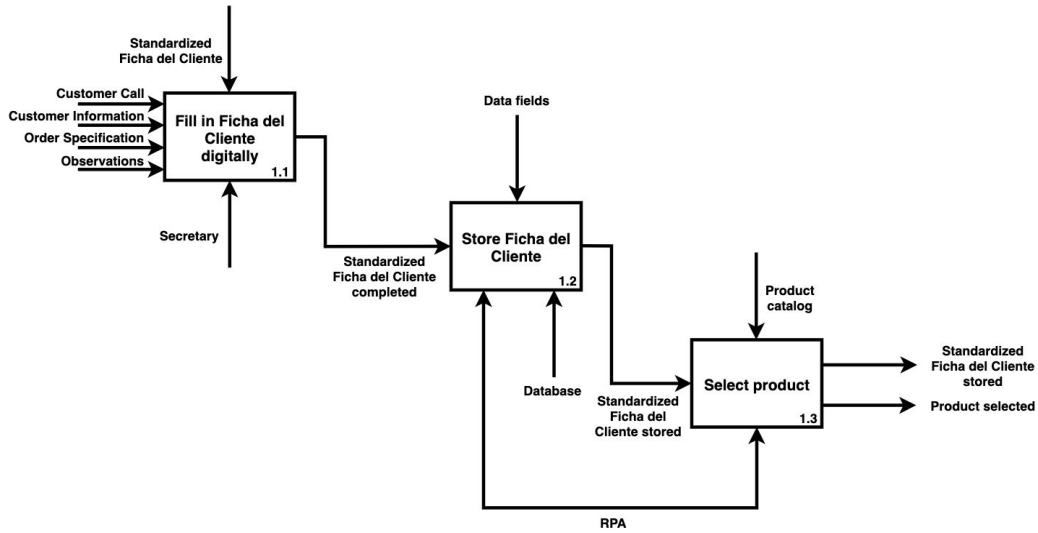


Figure 14: To-Be Model Level A1.1 Phase 1

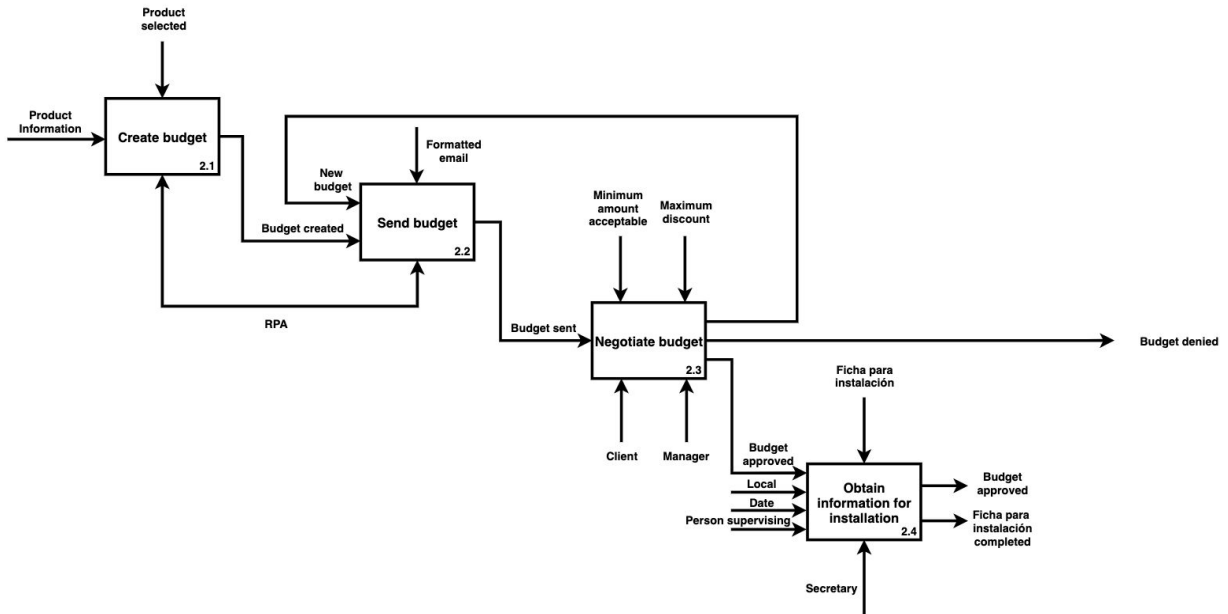


Figure 15: To-Be Model Level A2.1 Phase 1

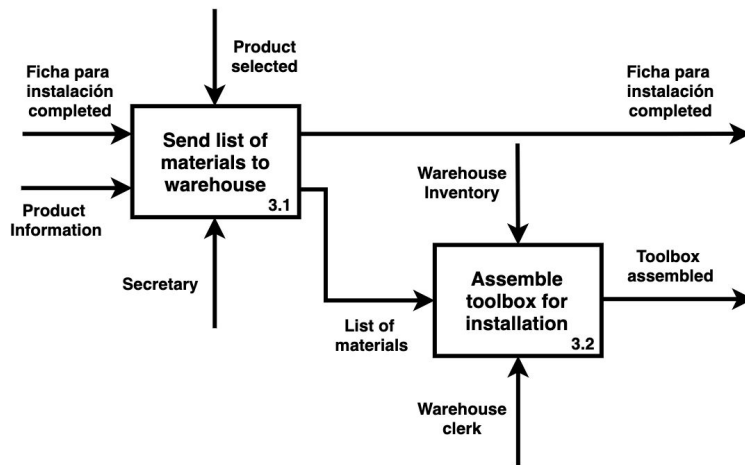


Figure 16: To-Be Model Level A3.1 Phase 1

Measurements

During a client site visit, baseline measurements of the different steps in the process were obtained from interviewing two of the company’s employees. They have been working at the company for more than four years and have been involved in these processes ever since. According to them, the first step is when a client calls and the FDC is filled out, and it takes about 15-20 minutes. This takes so long because most of the time the client takes a considerable amount of time asking about different solutions and respective price estimations. The following step is to determine the proper system for the client based on the client’s specifications and then sending the budget to the client. This particular step usually takes around 10-15 minutes (13 minutes on average) when considering a pumping system, but it can take around 25-30 minutes (28 minutes on average) when considering an electrification system, given that those systems are not standardized and the engineers need to take a closer look to determine the proper system.

The process step 2.3 has two different outcomes: either the client approves the budget or denies it. When asked about how long the clients take to respond to the email with the budget, the secretary said the following: “The client’s time of response may vary. Some might answer on the same day, while another might take a few days or even more than a week. It really depends on how much they need or want the system”. If the budget is approved, moving from step 2.3 to step 2.4, the secretary calls the client and asks for additional information to consider. During this call, the client is expected to provide the exact address of their farm as well as approximated dates for installing the system. If the budget is denied by the client in step 2.3, the secretary sends the FDC to someone in Heliotec’s management and they contact the client directly in order to renegotiate the offer. This step has more in-depth detail and another level of IDEF would be required; therefore, we considered it outside of our IDEF scope. There’s no estimation on how long this renegotiation can take. It really depends on how big the system is, and how important it

is for Heliotec's management to secure that purchase. For instance, if it was a very basic pumping system, then the company's management might not be willing to spend much time on renegotiation.

The following step considering that the budget was approved and the system was paid is to prepare the order. In order to do so, the secretary takes a piece of paper that contains the system number to the warehouse (located 15-20 meters from her office). There, she hands the paper to the warehouse clerk. With the system number, the clerk looks in a folder for the materials list for that particular system and starts collecting all the needed items for the installation and starts loading them into a truck. Usually, the clerk fills out the truck the night before a team leaves for installation. This way, the team can arrive at dawn and leave for the installation. The time it takes for installation might vary significantly depending on several factors such as location (of the farm), the size of the system being installed, and the weather conditions. Nevertheless, the company usually tries to "group" different installation orders that are close to each other in the same week. This way, the truck leaves Asuncion only once with all the materials it needs for these installations and makes several installations before coming back.

One of the major "bottlenecks" identified by the company occurs when the installation team comes back to Asuncion, making it outside of the project scope. Whenever a team leaves for installation, they always take more materials than they need for installation. They do this to make sure that if something breaks or gets lost, they can still install the whole system properly. Theoretically, as soon as they arrive back from installation they need to unload the truck with the help of the warehouse clerk and write down all the materials they brought back with them. Then, they give this piece of paper to the secretary who calculates the difference between the items they took and the ones they brought back and makes the final "installation" bill for the client. This installation bill includes not only the extra materials used during the installation (that were not included in the initial budget), but also includes the gas mileage and a fee for the number of days that the installation took. The problem with this step is that the installer team usually takes way too long to do it. They arrive back to Asuncion tired, so they want to rest before starting to unload the truck and make an inventory of what they brought back. What should be a step that would take at most an hour or two, usually ends up taking half a day or even more than a day. This then delays the secretary's job of sending the installation budget, which then delays the actual payment for the installation. Once the secretary receives this inventory, she calculates the final installation cost, and sends the budget to the client. After this step, the only thing that is left to do is to make a check-up call with the client after a couple of weeks to make sure that everything is working properly.

Software Selected

UiPath was chosen over other automation platforms for multiple reasons, including that the team has experience working with UiPath. Additionally, the availability of UiPath's

Community Edition offers significant automation capabilities for free. With the Community Edition, the company will have 3 robots available for use. The license also grants the download of two studios for designing automation. This was helpful, considering that the team’s developer was able to download one studio, and Heliotec’s process manager will be able to download the other. According to UiPath’s Terms of Use, the Community Edition is available at no cost for all Small-to-Medium (SMB) businesses that have less than 250 employees and less than, or the equivalent, of USD 5 million in annual revenue (UiPath Inc, 2019). Heliotec can use the Community Edition to try out process automation, and if the need arises, could upgrade to the Enterprise Edition in the future.

Another important reason behind the selection of UiPath was the free access to UiPath training courses via UiPath Academy. This was an important point to consider since it will facilitate the continuation of RPA implementation for the client. Heliotec will be able to use UiPath Academy to train its own developers for maintenance and growth purposes. These developers will potentially be in charge of the efficient execution of their RPA processes, as well as developing future automation projects for the company.

Design of RPA

UiPath – Robot logic structure

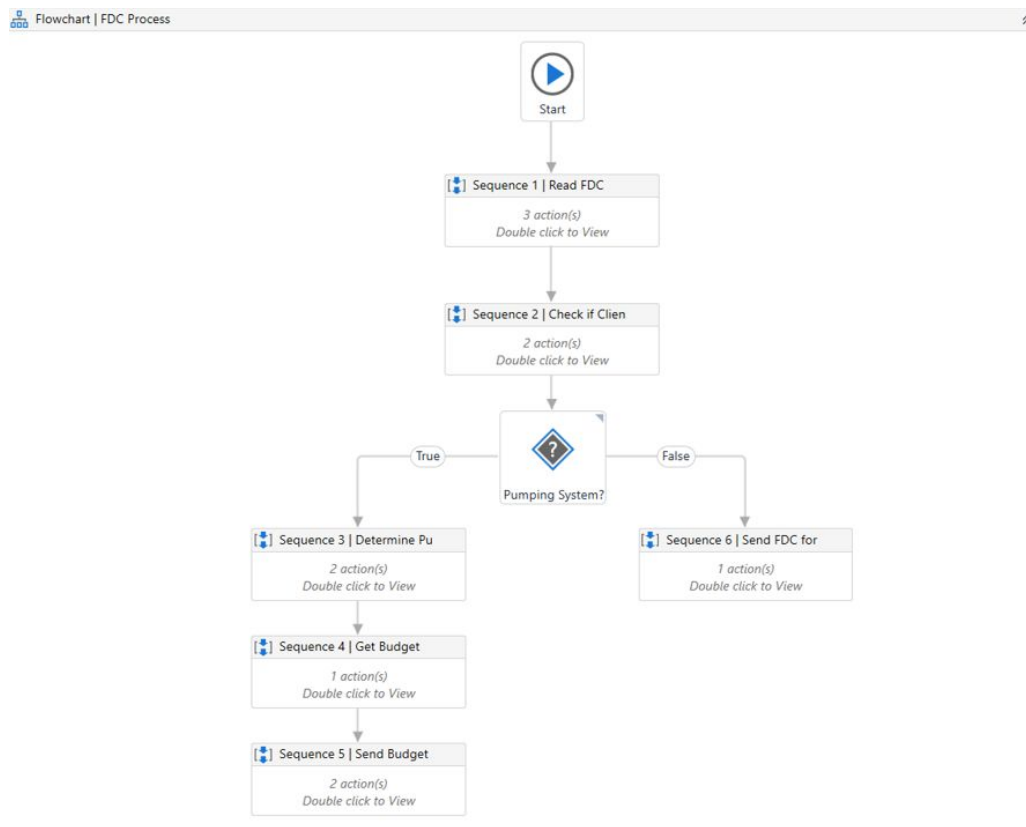


Figure 17: Robot Logic Structure of the “To-Be” process

The robot’s logic structure is shown above in Figure 17. This structure consists of six different sequences which represent the six main steps of the whole business process being automated. Inside each sequence, one can find numerous activities that the robot completes in order to read the FDC, select the ideal system, and then send a budget to the client. Additionally, the robot checks whether the client is a new client or a recurring one, and based on that saves the files (FDC and system budget) into the existing folder or creates a new one. In the case that the client is new, the robot also adds the corresponding information to a MS Access database, which will serve as a general client database for Heliotec.

Sequence 1: Read FDC

The first sequence the robot goes through is simple. In it, the robot looks for files in a specific directory where the new FDCs should be stored after receiving a call from a client. The robot is programmed to read over the files using a For Each Loop, where it looks over the files from the following directory: C:\Users\zucco\Desktop\Clients\Unprocessed FDC. Each file that the robot finds is automatically stored as the file’s entire path. For instance, the file inside the previous directory might be named “Robot”, but the robot stores it as “C:\Users\zucco\Desktop\Clients\Unprocessed FDC\Robot.xlsx”. It is important to note that there must be at least one file in this directory, otherwise an error will occur, and the robot stops since it will not have anywhere to extract data from. In the case that the robot finds more than one file in this directory, the robot will go through the same activities for each file, rewriting the variables every time. Therefore, only the information of the last file will be stored in the variables and only that file will go through the entire RPA process.

After finding a file, the robot opens the excel file using the “Excel Application Scope” activity using the file path. Inside this activity, one can find several “Read Cell” activities. In each one of these activities, the robot is programmed to read specific cells in the FDC and store the data retrieved in different variables, as shown in Figure 18. The variables extracted from the FDC are the following: var_SecretaryName, var_ClientName, var_TaxID, var_CellPhoneNumber, var_ClientEmail, var_SystemType, var_TankType, var_TankHeight, var_DynamicHeight, var_Flow. All of these variables are stored as strings (Text-type variable) except for var_TankHeight and var_DynamicHeight, which are stored as doubles (numeric variable) considering that they have to be summed up to get the total height needed for the system.

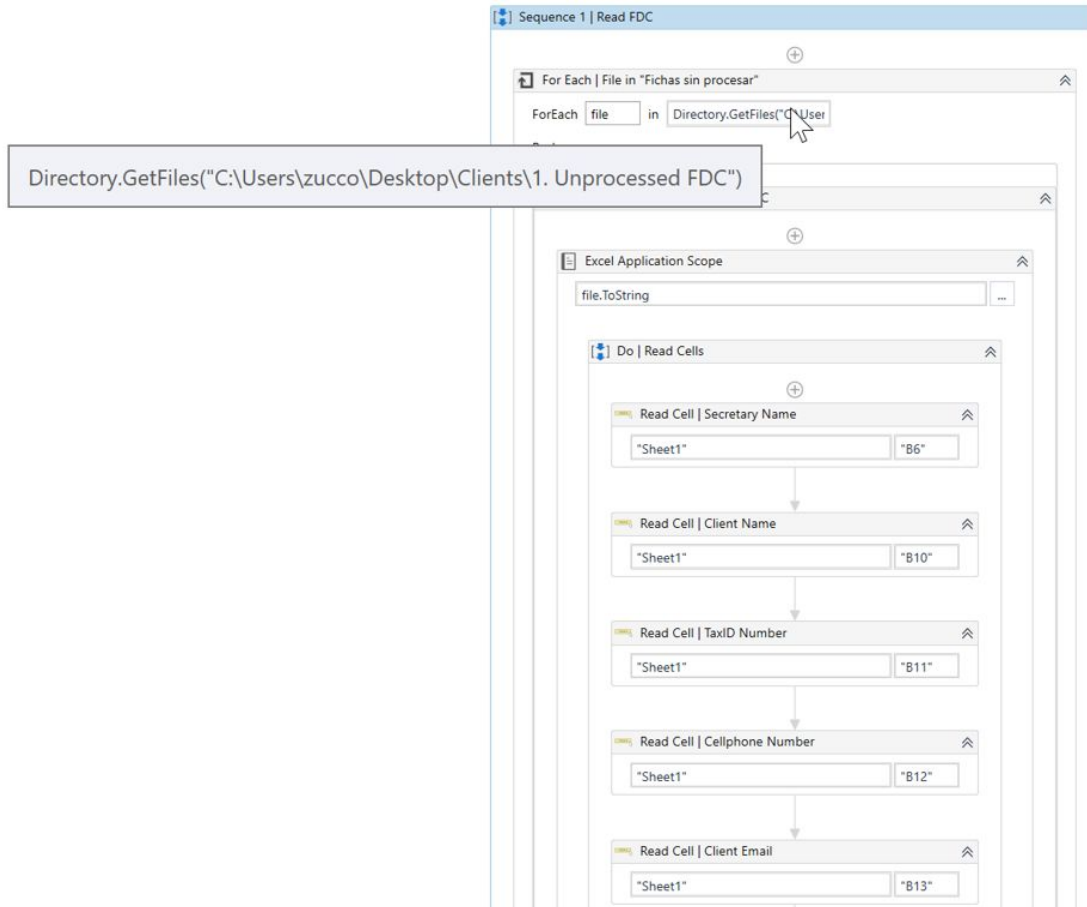


Figure 18: Sequence 1- The robot reads the FDC.

Sequence 2: Check if Client Exists in System

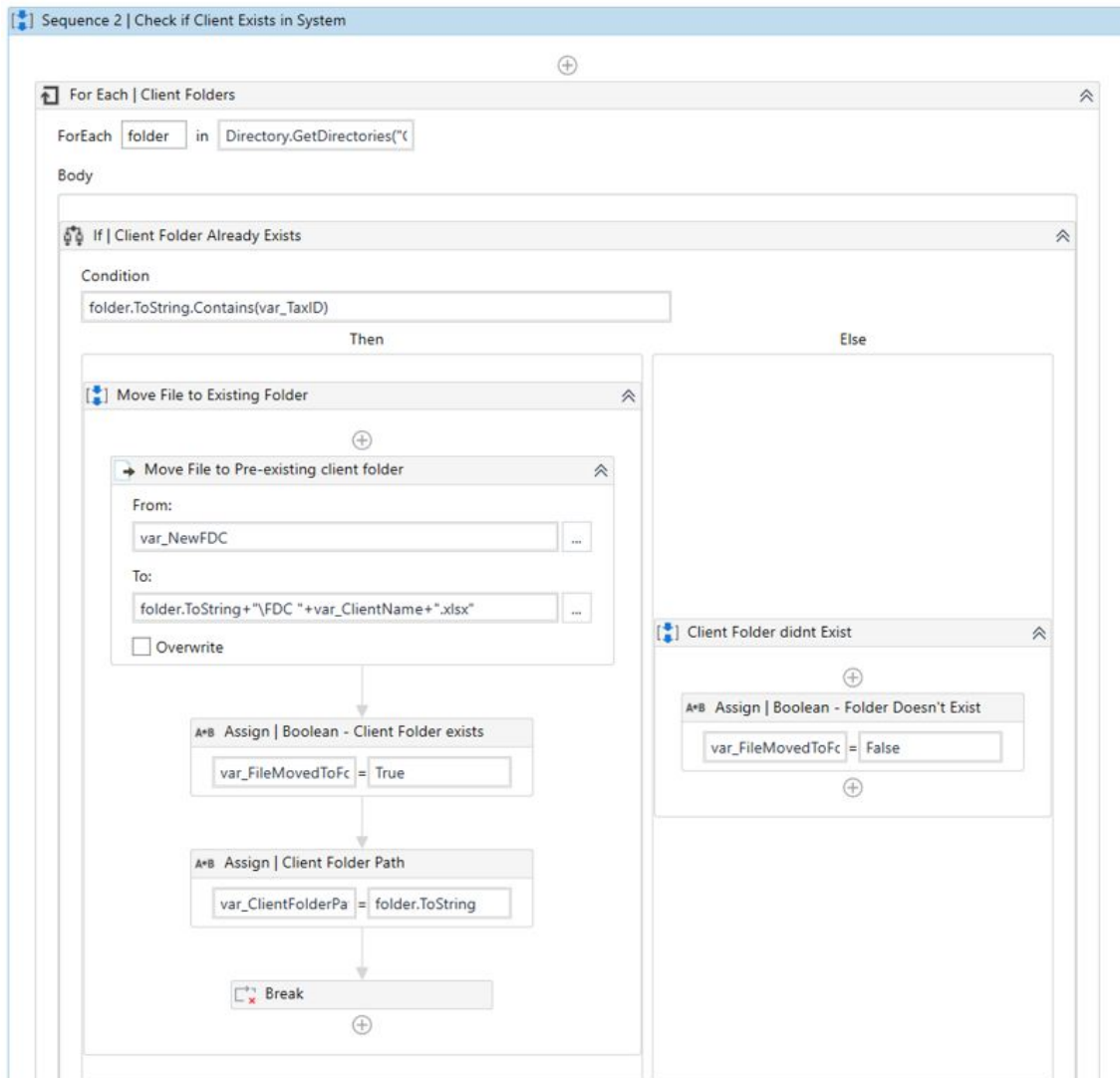


Figure 19: Sequence 2- Robot checks if client exists in the database.

In the following sequence, shown in Figure 19, the robot checks whether the client in the FDC is a new client. In order to do so, the robot enters a For Each loop where it looks over all the folders in the “Client Folders” directory. In this directory, all the client folders are saved under a name that contains the client’s Tax ID followed by the client's name. For instance, if the client’s Tax ID was 1234567 and his name was Mark Connors, his folder’s name would be named “1234567 Mark Connors”. By using an “If” activity, the robot checks if any of the folders’ names in this directory contains the Tax ID that appears in the client’s FDC. If it does, then the robot moves the FDC to this client’s folder and saves it under the name “FDC” and the clients name (Following the previous example, Mark Connor’s FDC would be saved as “FDC

Mark Connors”). Additionally, a Boolean variable named “var_FileMovedToFolder” is assigned as “True”, and the robot exits the For Each loop using a “Break” activity. In case the client folder did not exist, the same Boolean value would be assigned a value of “False”.

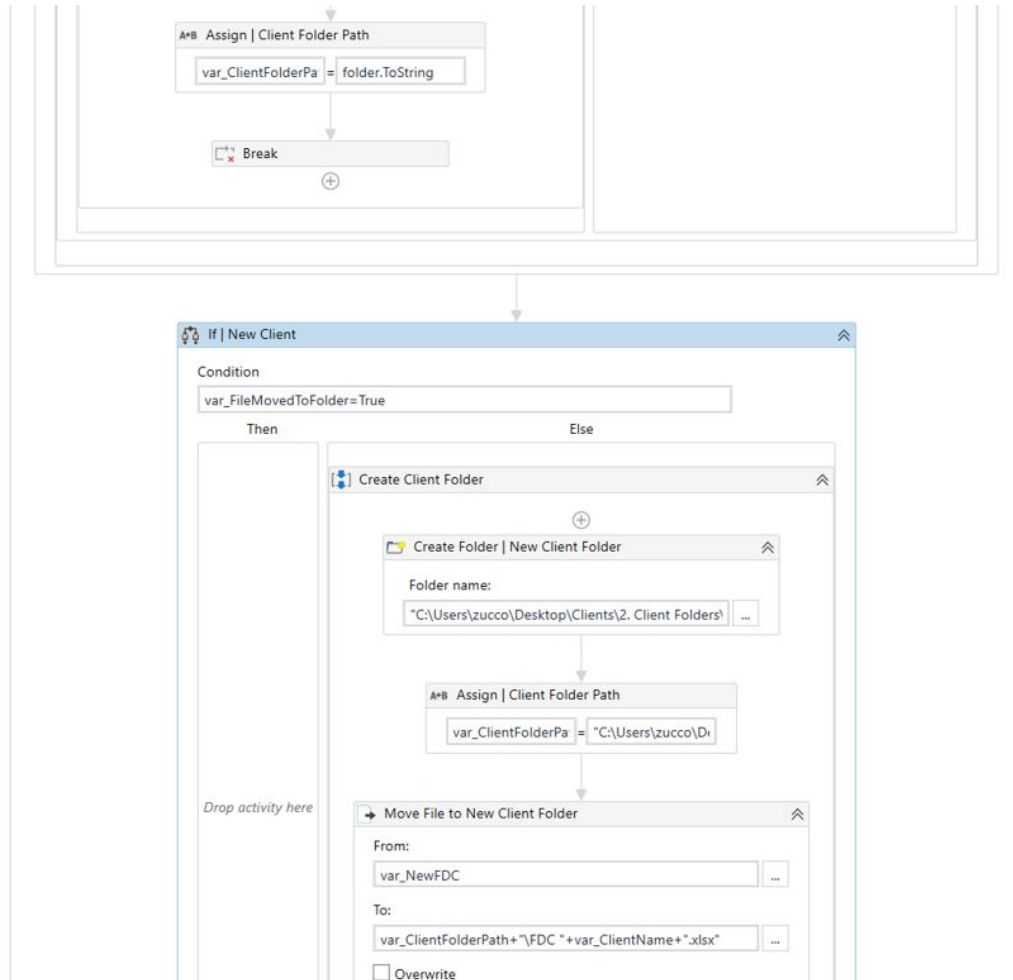


Figure 20: Creating folder for new client in Sequence 2

The following step of the sequence serves to create a new folder for new clients. In order to do so, the Boolean value created previously is used with an “If” activity. If the value was assigned as “True” then the robot does not do anything because the file was already moved to the existing client folder; however, if the client is a new client and the Boolean variable was assigned the value of “False” then the robot goes on to create a new client folder in the “Client Folders” directory, shown in Figure 20. Then, the robot continues to move the FDC to the newly created folder.

Decision Node

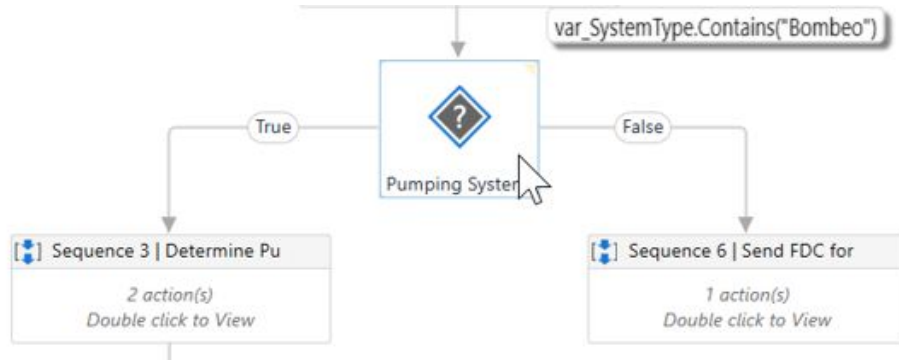


Figure 21: Decision node for pumping system

The next step of the robot's logic sequence is not a sequence, but a decision node, in which the robot checks whether the client inquired about a pumping system or an electrification system. If the client inquired about a pumping system, the robot continues to Sequence 3. Otherwise, it proceeds to Sequence 6, as shown in Figure 21.

Sequence 3: Determine Pumping System

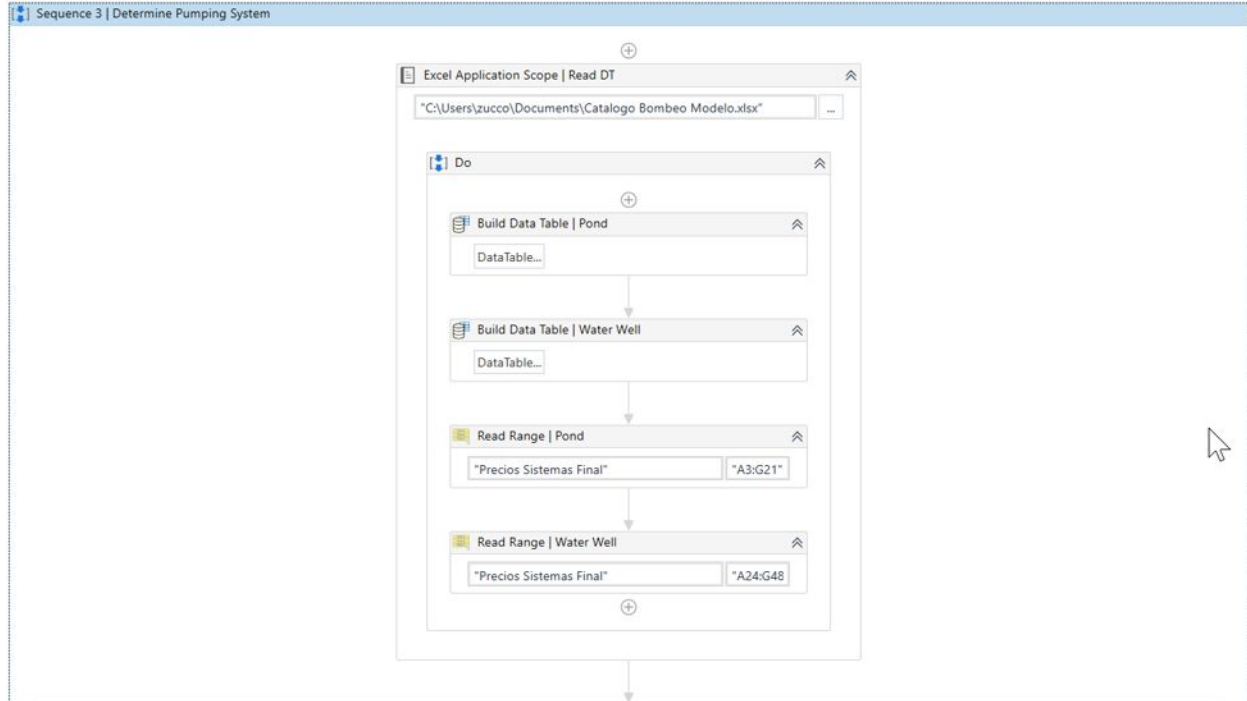


Figure 22: Reading DT in Sequence 3

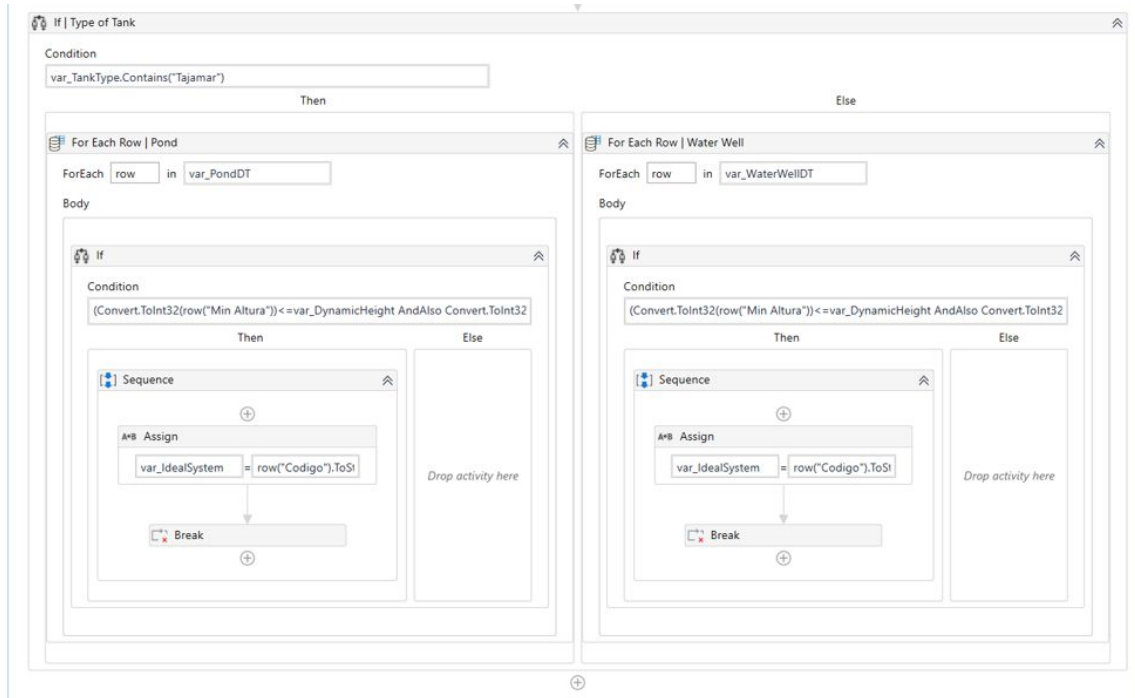


Figure 23: “If” statement in Sequence 3

Figures 22 and 23 shown above show the activities within Sequence 3. In this particular sequence, the robot starts by creating a separate data table for each of the two types of tanks: ponds and water wells. These data tables are extracted from an excel sheet that contains all the pre-made systems with their respective measurements and prices. After reading the excel file and creating a data table for the two different types of tanks, the robot enters an “If” activity which checks for the type of tank needed by the client.

As you can see above in Figure 23, the activities in both the “Then” and “Else” paths are essentially the same. They both start with a “For Each Row” activity where the robot iterates over each row of a data table. The only difference between both paths is that the “For Each Row” activity in the “Then” path goes over the pond systems data table while the other goes over the water well systems data table. Inside the “For Each Row” activity, the Robot again enters an “If” activity. This time, the condition in the “If” activity serves to find the ideal system for the client based on the measurements in the FDC. The robot iterates over each row that represents a single pre-designed pumping system with its specific measurements. The robot checks if the client’s required dynamic height (extracted from the FDC) is greater than or equal to that particular system’s minimum height and is less than or equal to that particular system’s maximum height capacity. The robot also checks that the required flow (again, extracted from the FDC) is greater than or equal to the system’s minimum flow requirement and is less than or equal to the system’s maximum flow capacity (The previously described inequality statements can be seen in Figure 24 below). If the robot finds a system that fulfills these requirements, it assigns this system’s name to the variable “var_IdealSystem” and then it exits the For Each loop using a “Break”

activity. With the ideal system determined, the robot continues to Sequence 4, where it gets the budget for the ideal system.

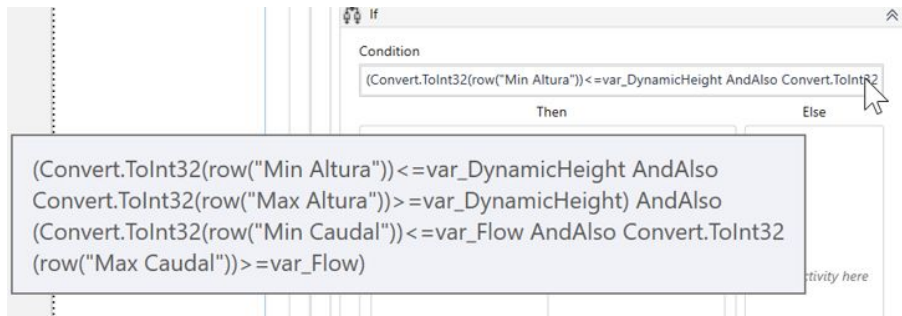


Figure 24: Equation to determine ideal system in Sequence 3

Sequence 4: Retrieve Budget for Client

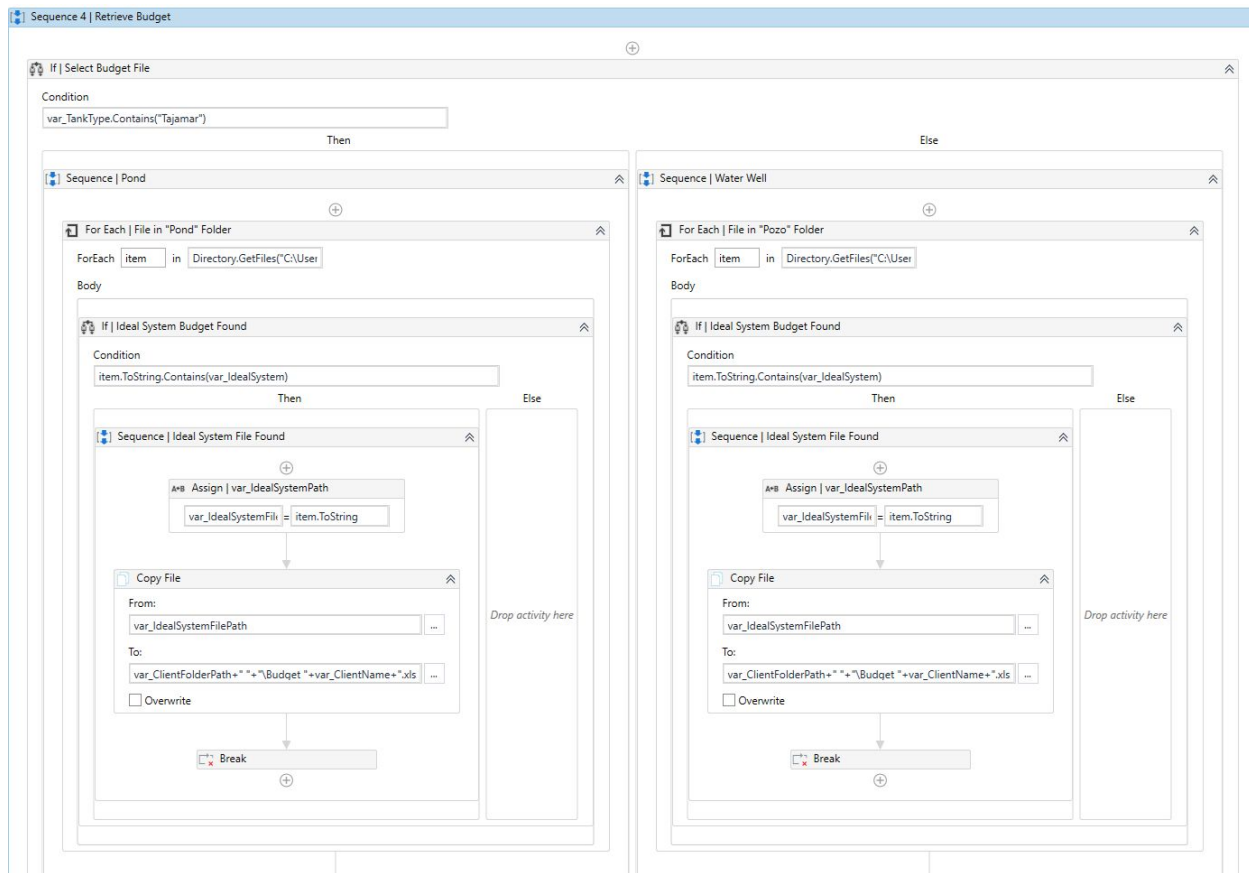


Figure 25: Retrieving budget in Sequence 4

The fourth sequence starts with an “If” activity which only serves to separate the systems based on the tank type. If the client is asking for a pond system, the robot enters the “Then” path. There, it enters a loop where it iterates over the different documents in the folder that contains all

the budgets for the pond systems and it looks for the budget for the selected ideal system. Once the robot finds the correct budget, it copies that budget's file and saves it into the client's folder, changing its name to "Budget [Client Name]", and then exits the loop.

Sequence 5: Sending Budget to Client

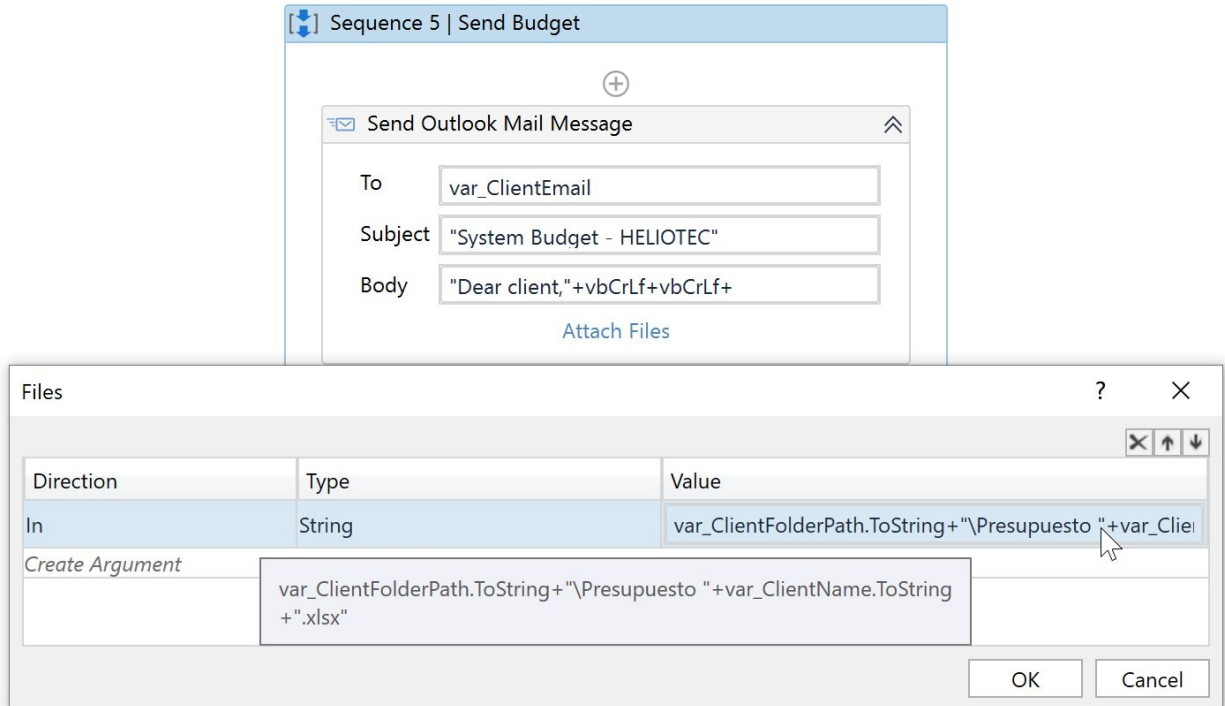


Figure 26: Sending budget to client in Sequence 5

In the fifth and final step of the process, the robot sends the budget to the client. In order to do so, it attaches the ideal budget obtained in the previous sequence (seen above in Figure 26). The robot is designed to send the budget to the client email written down in the FDC, assigned as a variable named "var_ClientEmail". The email's subject and body are a pre-established generalized text that would serve for any client.

Sequence 6: Send FDC for Review

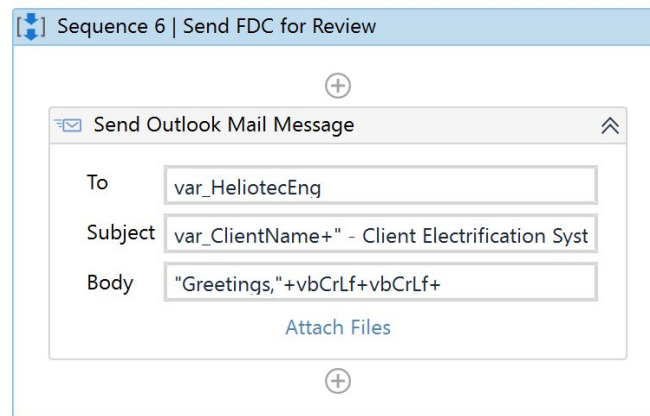


Figure 27: Sending FDC to Heliotec Engineer in Sequence 6

The sixth sequence in the robot’s workflow is actually the second alternative for the decision node. As previously explained before, if the client was inquiring about a pumping system in his FDC, the robot would go to Sequence 3. However, if the client was inquiring about an electrification system, the robot would enter Sequence 6. Since electrification systems are more complex than pumping systems, Heliotec does not have pre-designed electrification systems. If a client is interested in one, the company’s engineer designs the system specifically for that client based on his/her needs. As shown above in Figure 27, the only activity inside Sequence 6 is a “Send Outlook Email Message” activity. The purpose of this activity is to automatically send an email with the client’s FDC to Heliotec’s engineer. This way, the engineer can take a look at the client’s needs and design a proper system for him/her.

Feasibility Analysis

Technical Feasibility

The technical feasibility allows us to answer the question “Can we build it?”. The analysis is based on the capability of the company to support the technology necessary for the implementation of the project. With that said, Heliotec is considered a partially computerized company. The company owns the old versions of Microsoft Office, which can be a problem in the future due to updates in the application. Despite that, the company has the equipment necessary for the implementation of the project; however, they do not utilize the technology in its full capacity. The reason behind it is because management believes that it is difficult to train their employees to accomplish the tasks digitally; therefore, they prefer that the employees manually complete the process. This suggests that the company’s employees may have less familiarity with systems and computers. It might take a small period of time for the employees to adapt to both application and technology. On the other hand, the only system that has to be integrated with the RPA is Microsoft Office, making the compatibility of the new system with the old essential. The table below summarizes the familiarity and risks at Heliotec. Low familiarity means no basic knowledge, medium familiarity somewhat knowledge and high familiarity good knowledge.

	Familiarity	Risk
Application	Low	Medium
Technology	Medium	Low
Compatibility	High	Low

Table 2: Technical feasibility risk table

In conclusion, Heliotec is compatible with the size and technology required for the new system to be implemented. We would advise Heliotec to upgrade their Microsoft Office Software to a new version to avoid future issues related to updates on the RPA software.

Economic Feasibility

As previously mentioned in the literature review, economic feasibility aims to answer the question “should we build it?”. This was mainly done through a cost benefit analysis in which the costs of implementing RPA at Heliotec for the previously discussed process are weighed against the benefits of doing so. This was achieved by determining the costs and assigning values

to the benefits. Calculations are shown in Appendix 4. The cash flow and net present value were calculated. Through this analysis it was concluded that the project is economically feasible.

Costs

Two main types of costs were taken into account, development costs and operational costs. Development costs included were: development team salaries, development training, hardware and software, and vendor installation. There are initial fixed costs that are necessary, followed by variable costs. The time used to develop the RPA by our team was used as a basis for the development team salaries. The time estimated was three full 8-hours shifts of work (total of 24 hours). For the development training, it was estimated that a 2-hour training on how to operate the RPA is sufficient. Therefore, the costs for the training were based on the Secretary’s and Developer’s salary. Operational costs (both fixed and variable costs) taken into account were: software upgrades, software licensing fee, hardware repairs, hardware upgrades, and user training. Costs for each category are shown in table 4 and table 5.

There are two main types of robots utilized by UiPath: Attended and Unattended. Attended robots work alongside the user to speed up tasks that require human involvement, such as contacting center activities (UiPath). On the other hand, unattended robots do not need human interaction to operate in order to automate various back office tasks (UiPath). The attended robot was determined to be appropriate for this project. Table 5 shows the cost breakdown between these two robots for UiPath, which is considered a recurring fixed cost. This falls under developmental costs and is considered the hardware and software cost.

Developmental costs, shown below in table 4, are fixed costs incurred at the start of the project. The development team salaries were estimated based on the hours used to program the robot and the average salary of a RPA developer. The same method was used to calculate the development training, considering the level of difficulty of operating the software. For Hardware and Software, we used the prices of UiPath’s robots.

Developmental Costs	
Development Team Salaries	\$500.00
Development Training	\$50.00
Hardware And Software	\$1,500.00
Vendor Installation	\$0.00
Total Developmental Costs	\$2,050.00

Table 3: Developmental Costs

Operational costs, shown below in table 5, are variable costs that will fluctuate depending on circumstances that will come up. For example, maintenance will be on a need-basis that will vary. The initial prices used are based on Heliotec’s estimation about software and hardware upgrades, as well as equipment maintenance the average prices of upgrades and maintenance in South America.

Operational Costs	
Software Upgrades	\$250.00
Hardware Upgrades	\$120.00
Maintenance	\$50.00
Total Operational Costs	\$420.00

Table 4: Operational Cost

Robot Type	Recurring Cost
Attended	\$1,200.00 - \$1,800.00 annually
Unattended	\$8,000.00 annually

Table 5: UiPath Robot Cost

The software would be the only necessary update within the company before beginning the implementation of the project. Operational costs are low given that UiPath is an open source software. It is important to note that if the company grows past 250 employees or has a revenue higher than \$5 million per year there would be an additional software licensing fee (Inc, UiPath). UiPath may also change its open source policy in the future with the growth of RPA. The total cost for the first year for the project is \$3,970, a sum of the aforementioned costs. This includes the initial fixed costs and the variable costs for one year.

Benefits

Tangible and intangible benefits were taken into account, which were broken down into increased time for value added tasks and the creation and utilization of the Access database. An improved time allocation for the staff will permit an increased focus on value adding tasks. Although the employees’ salaries will not change nor will there be a reduction of staff, the company will spend less money on repetitive, non-value adding activities such as basic data entry and gathering product information for the customer. The database can be used to improve

customer retention, serve as a marketing tool to increase sales, decrease non-value time spent searching for past records due to lack of organization and digitalization, decrease materials used for manual record keeping such as paper and ink, and added intangible benefit of increased sustainability and eco-friendliness.

The average employee working on back office processes in Heliotec receives a base salary of 3,500,000G (around \$540) on a monthly basis, with a chance of receiving bonuses based on sales. According to Heliotec’s management, these employees end up making around 4,000,000G (around \$615) a month, after sales bonuses. In comparison, a back office or “general secretary” salary in Asuncion ranges between 3,200,000G (around \$490) and 5,500,000G (around \$845) on a monthly basis (WageIndicator, 2020), an average of \$668 per month. On the other hand, the electrical engineer in Heliotec is currently making 9,000,000G (around \$1,383) per month. The monthly hours for these salaries are 160. This information is useful in order to calculate a monetary value for the benefits resulting from this project.

There are between 8 and 10 FDC per day filled out; therefore, on average there are 180 filled out per month. For each one the secretary spends 20 minutes working on it (0.33 hours) and the engineer takes 10 minutes on it (0.17 hour). The secretary makes \$4.18 per hour and the engineer makes \$8.63 per hour. This means that the secretary spends an average of 60 hours per month working on FDCs and the engineer spends about 30. When this is multiplied by their salary, the value of the time spent on this for the secretary is \$250.80 and \$258.90 for the engineer. That is a total cost of \$509.70 per month spent on FDC currently. On the other hand, the robot can do this in 10 seconds (0.00277 hour). The equivalent of the robot's salary was determined by finding a weighted average between the secretary's and the engineer's salaries in order to estimate a value for the benefits (despite the robot costs being fixed as previously mentioned). This resulted in \$5.66 per hour, which means that the cost of the robot to the company for the completion of the same process is \$2.83. This amounts to a total savings of \$506.87 per month. The total benefit value for the project is \$6,082.44 for a year in addition to the intangible benefits. The total benefit value does not take into account potential wage increases nor incurred inflation costs, given that it would not be an accurate estimation. The intangible benefits considered were the cease of paper and ink for the FDC, availability of space since the FDCs are not being physically stored anymore and creation of a marketing list using the information of the new database.

Net Present Value

The net present value was found by subtracting the total costs from the total benefits.

	Year 0	Year 1	Year 2	Year 3
Total Benefits	\$0.00	\$6,082.44	\$6,082.44	\$6,082.44

Total Costs	\$3,970.00	\$1,920.00	\$1,920.00	\$1,920.00
Net Benefits	-\$3,970.00	\$4,162.44	\$4,162.44	\$4,162.44
Cumulative Net Cash Flow	-\$3,970.00	\$192.44	\$4,354.88	\$8,517.32

Table 6: Cash Flow Table

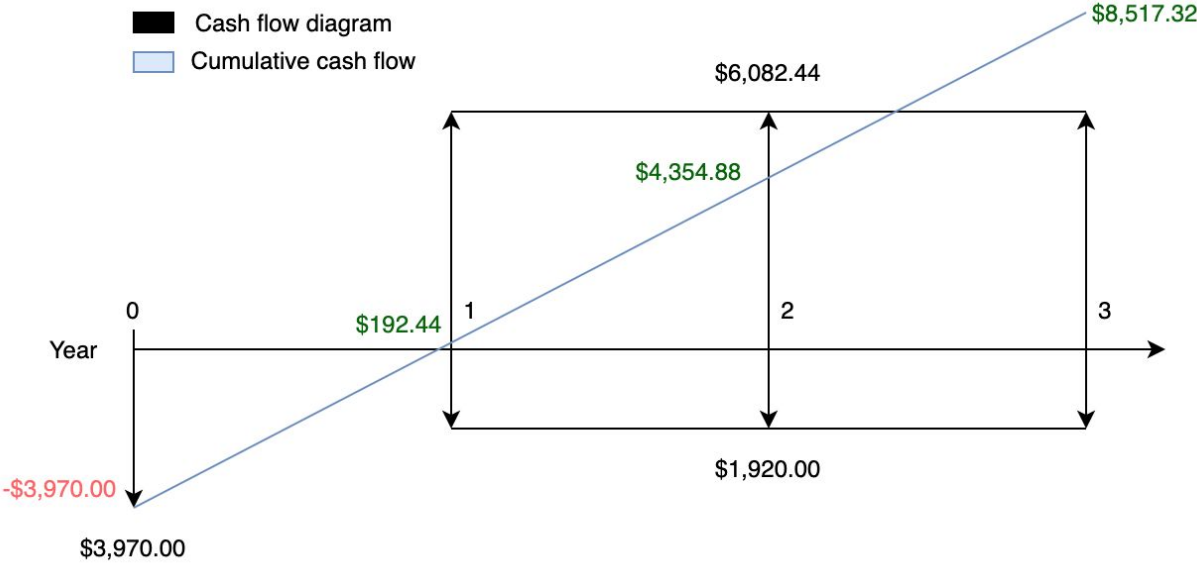


Figure 28: Cash Flow Graph

Operational Feasibility

Operational feasibility addresses whether or not RPA is feasible within the company’s structure, culture, and business objectives. This analysis answers the question "if we build it, will they come?". Below, Table 7 better illustrates the stakeholder analysis of the project.

Stakeholder Analysis		
Stakeholder	Estimated Project Impact	Limitations
Company	Processes are more efficient, data can be utilized to increase customer retention and profits	Full automation is limited because of company culture

Secretary/ Engineers/Other employees	Increased time for value added work	Adjustment to new process may cause less productivity during transition period
Customers	Better customer experience/satisfaction, less wait time	None

Table 7: Stakeholder Analysis

Part of the company’s culture is its close and personal relationship with the customers. First part of the order process is the initial contact by phone between the Secretary and the Customer, since it brings a “human touch” to the business. During the process selection, it was determined that automating the first part of the process was not feasible since it was against the company’s culture. Another limitation found was that the productivity may vary during the transition period of implementation, since the employees are being trained and are getting used to the application. On the other hand, it was identified that management and the secretary will be the users of the application most of the time. Having less people to manage the application decreases the issues that the company could have with its implementation. In addition, the application can be considered fairly easy to use, since its commands are simple and direct. In conclusion, the implementation of RPA is feasible for the company when analyzing its operational side. Even though there are limitations related to company culture and adaptability, the RPA system can be totally shaped to match these constraints.

Conclusion and Recommendations

The project evaluated the necessary steps and feasibility of implementing Robotic Process Automation at Heliotec, a solar panel retail company in Paraguay. It proposed RPA as a method that combined with Business Process Reengineering, would offer a modernized approach to decrease process inefficiencies. The process that was selected for this project consisted of inputting client information, determining the appropriate system for the client's needs, and sending the client the budget for it. The successful implementation of RPA for automating repetitive internal processes at Heliotec would improve efficiency, cost efficiency, and increase time dedicated to value adding tasks. Using UiPath, this selected process was automated and it is able to successfully complete the whole process in about 10 seconds.

To determine the feasibility of implementing RPA in Heliotec, the team started by meeting with company representatives to get a better understanding of the different processes in the company. The team identified the different factors and players involved in every step of each process in order to be able to determine if they were suitable for automation. Once the process was selected, the next step was to begin developing the RPA. The final step was to test the RPA to see if it worked as expected. After testing, the robot performed as it should, and the client was pleased with it.

Through the analysis performed, the team found that implementing RPA would in fact lead to improving efficiency, cost efficiency, and increase time dedicated to value adding tasks. It was determined that it is feasible to implement, and would significantly reduce yearly costs. After the completion of the project, the following recommendations can be made:

- Heliotec should implement the RPA developed in the project for the selected process, given it was determined to be feasible.
- The implementation of the Access database should be used as a tool to digitize and automate data collection and storage.
- Customer retention should be increased through rewards and promotions through the utilization of customer data.
- Further automation by planning to automate other suitable internal processes in the future.

It is important to consider what future steps can and should be taken. If the company chooses to go through with the implementation it will need to prepare and plan as its first step, including updating its system and training its employees. That would then typically be followed by the design of the RPA and building the RPA, which has already been completed as part of this project. The RPA would then need to be tested and stabilized. Finally, constant improvement should be a priority and steps necessary to do this should be taken as well. This should include repeating the process for other internal processes suitable for automation. Additionally, as the

company grows the process might change as well as other aspects of the company; therefore, the company should be prepared to adapt and change the RPA alongside the changes that come up.

Project Reflection

The major outcome of our project was the redesign of an existing back-office process with the implementation of RPA. Our sponsor was experiencing high process times for a process that should only take a few minutes. This was due to an inefficient design of the process, as well as the involvement of unnecessary players that were delaying it even more. Once the team defined and illustrated the whole process using the IDEF methodology, the team redesigned the process incorporating the use of RPA in it. The RPA served to automate specific steps in the process, reducing the overall process time drastically. With the implementation of RPA, those unnecessary players were also discarded from the process. The final outcome of the project was a UiPath software robot designed to automate the particular back-office process, as well as a new, highly efficient process that reduced the total process time from about 15-20 minutes to only 10 seconds. The implementation of the bot will allow the employees that used to be involved in the process to focus on higher value-added tasks that will be more beneficial for the company.

During the design of this project, the group faced mostly economic and social constraints. As mentioned before, Heliotec is a small company with a limited budget and personnel. Therefore, when designing the RPA, the group used a free version of UiPath software in order to adapt to Heliotec's financial situation. However, this has not influenced the design of the RPA since the free license has all the tools necessary for the design. The social constraints related to our design were mainly focused on the business cultural differences. In Paraguay, a large and crucial part of the business is focused on the human aspects. There are plenty of 1-on-1 interactions between businesses and customers. The ideal design of this project would be to automate the whole Customer Order process, including the initial contact with the customer. However, due to the cultural differences, the group had to work around the fact that the management of Heliotec demanded that the initial contact with the customer had to be made by an employee and not the RPA software.

Naturally, a significant amount of research went into thoroughly understanding new concepts and all of the nuances that are part of RPA. Knowledge acquired through WPI coursework was applied and consulted. For instance, the code used for programming the robot was in VBA, taught in OIE3600: Scripting for Process Improvement. In addition to that, feasibility analysis skills were learned in MIS4720: System Analysis and Design. The feasibility analysis. Additionally, our team completed the Business Analyst course online at UiPath Academy, which served as an excellent basis to understand what elements and steps go into the process of implementing RPA into a company. This was complemented by expert knowledge provided through a group member's coworkers from a technical consulting firm, as well as the knowledge gained through that co-operative education experience.

Early on in the project, the team determined each member's strengths and utilized this information to optimize the group's productivity. Our team worked well together and the group

dynamic was very effective in achieving our overall goal for this project. Over the course of the year, each team member participated in the project as a leader throughout different phases of the project. Through the use of the Gantt chart, we achieved clear organization and distribution of work and met all of our set objectives and goals. Overall, our project was successful due to our group dynamic and compatibility, as well as our ability to work efficiently together through the use of our individual strengths.

Appendix

Appendix 1: Interview Questions

Questions about the company and industry

1. Could you explain, briefly, what your company does?
2. What are your company's goals and vision?
3. Who are your main customers? And why do you think this is?
4. How many employees does the company have?
5. How many employees are specifically working on back-office processes in the company?

Questions about the processes

1. What are your major processes in your company?
 - a. Any that are more difficult (bottleneck)?
2. Do you have specific processes that you want to target?
3. Could you walk through these processes with us?
 - a. How would an employee do this task?
 - b. How important is this process for the company?
 - c. How many people are involved in this process?
 - d. On average, how much time does your employee take to do this process?
 - e. How often does he do this process?
 - f. What is the main problem with the process right now?
4. How are these processes managed/controlled? (Excel, web-based applications, etc? Digital tools or paper-based?)
5. Is the process selected properly documented and fully optimized?
 - a. If not, why isn't it?

Questions about RPA

1. What are you aiming to achieve with the implementation of RPA in your company?
2. Do you have an organization-wide, business-driven vision defined for the implementation of RPA or similar technologies in your company?
3. Are there specific reasons why you want to automate these processes, in particular?
4. Should RPA be used as a business re-engineering tool?
 - a. (Is RPA good for business documentation?)

Other Questions

1. Is there anyone else we could speak to gather more information?

Appendix 2: Interview Answers

Questions about the company and industry

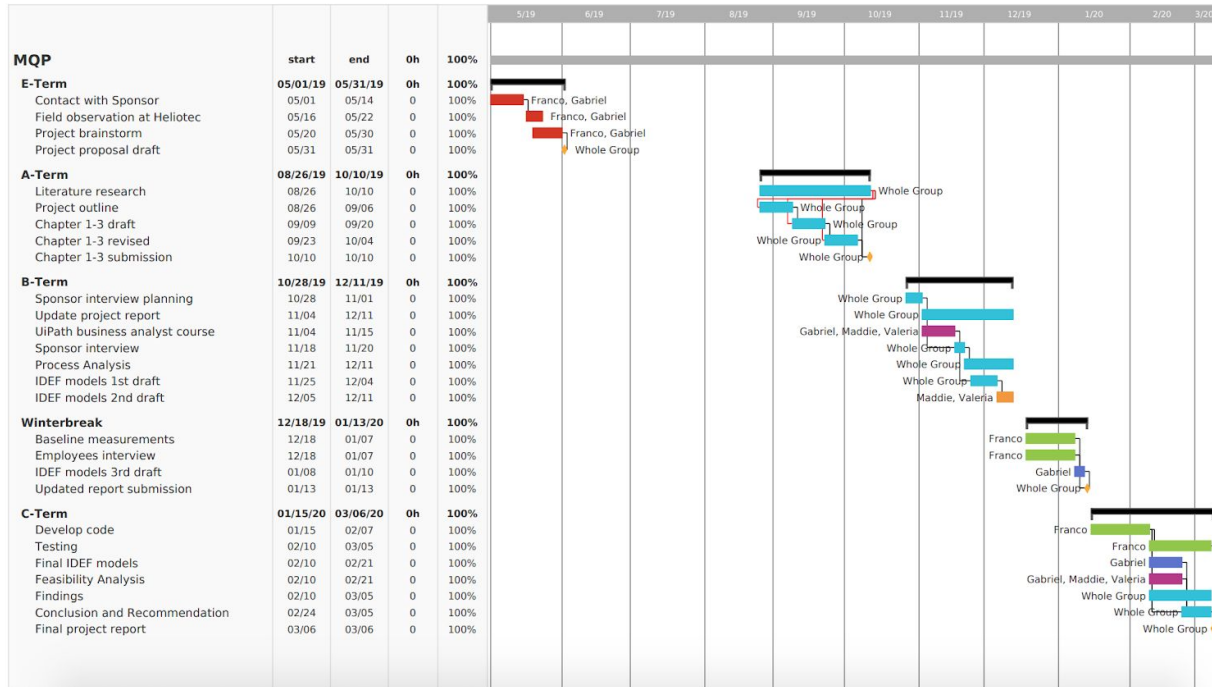
1. “The company is dedicated to two different product lines. The first focuses on pre-set, pre-designed solar systems for farming for water pumps and for fridges and lights to work to be able to have the basic needs in farms. We also do a second line of work which are projects made under clients specifications to be able to reach the demand the client needs.”
2. “The company’s goal is to spread the use of solar panels in Paraguay and we hope to one day be able to install solar panels in every house in Paraguay.”
3. “Farmers in the Chaco. Mainly because there is no electricity and the only other solution is diesel generators to get energy.”
4. “We currently have seven employees.”
5. “Three.”

Questions about the processes

1. The client calls the company, and we have to spend about half an hour explaining to the client how the solar panel works, what they want, and if it can help solve the problem they’re having. Once this conversation is over, we send a quotation to the client depending on the type of system they want/need. Later on, if the client approves the quotation, we go to install the solar system. Once the project is approved, the list of products and materials to be used for the installation is sent to the warehouse for the person in charge of the installation to place inside the truck and take it to the farm. Then, he has to do the installation. Afterwards, he has to take some pictures and measurements of the system to make sure that everything is working well. Later, when he returns to the city, he has to make a letter with all the details destined to the client with the products, amounts of materials used, miles used in the car to get to the farm, and time spent doing the work for the client to be billed.

Appendix 3: Project Gantt Chart

The following figure illustrates the Gantt Chart that was used as a base for our deadlines while completing this design project.



Appendix 4: Economic Feasibility Calculations

The following image shows the formulas used in the excel sheet used in the economic feasibility portion of the analysis section. The second image shows the results achieved from these calculations.

Benefit Analysis	Secretary	Engineer	Robot	Weighted Salary for Robot	
				Hours	Weighted Salary
Hours to complete Ficha del Cliente	=20/60	=10/60	=10/60/60		
# of ficha del cliente per month	180	180	180	Secretary	=20/30
Hours spent completing ficha del cliente per month	=C5*C6	=D5*D6	=E5*E6	Engineer	=C5
Salary	4.18	8.63	=H9		=H6*C8
Cost of monthly ficha del cliente	=C8*C7	=D5*D6*D8	=E5*E6*E8	Sum (Robot)	=I7+I6
Amount Spent (cost)	=C9+D9				
Amount Saved	=C9+D9-E9				

Benefit Analysis	Secretary	Engineer	Robot	Weighted Salary for Robot	
				Hours	Weighted Salary
Hours to complete Ficha del Cliente	0.33	0.17	0.00		
# of ficha del cliente per month	180.00	180.00	180.00	Secretary	0.67
Hours spent completing ficha del cliente per month	60.00	30.00	0.50	Engineer	0.33
Salary	4.18	8.63	5.66		2.79
Cost of monthly ficha del cliente	250.80	258.90	2.83	Sum (Robot)	5.66
Amount Spent (cost)	509.70				
Amount Saved	506.87				

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