NOVA IMS Information Management School

MGI

Mestrado em Gestão de Informação
Master Program in Information Management

Global Mobility Chatbot

Chatbot model to improve mobile employee experience

Tiago André Pimpão Vilela

Dissertation presented as partial requirement for obtaining the Master's degree in Information Management

NOVA Information Management School
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GLOBAL MOBILITY CHATBOT

Chatbot model to improve mobile employee experience

by

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Dissertation presented as the partial requirement for obtaining a Master's degree in Information Management, specialization in Marketing Intelligence

Advisor / Co-supervisor: Vitor Manuel Pereira Durate dos Santos

February 2021

“The ones who are crazy enough to think they can change the world, are the ones who do”

STEVE JOBS

ACKNOWLEDGMENTS

The words written in this section cannot express my gratitude to all the amazing persons, friends, and family, that contributed significantly to the success and execution of this dissertation report. All the patience, care, and unconditional support made this project viable and definitely something I will be proud of for the rest of my life.

An initial paragraph for the Information Management Master's teachers, who were phenomenal in teaching us the essential bases for developing business intelligence oriented corporate strategies, data-driven and marketing analytics methodologies, as well as many other topics, such as Data Mining tools and concepts, insights on digital consumer's behavior, and so many others. For all the dedication, hard work, and patience in teaching large classes of international students, my honest words of gratitude.

Then, would like to direct my kind words to my master colleagues, especially the ones I had the chance to work and collaborate with, in multiple successful projects. Would like to highlight my Business Intelligence class colleagues, which we had the chance to work on building a Datawarehouse and an ETL process. Also, my Data Mining and Analytical Marketing colleagues, where we had the chance to build a Data Mining project using powerful tools such as the SAS Enterprise Miner. And last, to not forget, my "preferred" group, where I had the chance to work on so many fun and challenging projects, like the Pestana challenge, the Zara Try, and others, in several different classes, such as Consumer Behavior Insights, Strategical Marketing, and others.

To *Professor Doutor Vitor Duarte dos Santos*, for being persistent, for never stop believing my capacities and willingness to achieve this goal, and essential for being the best guide and coordinator I could have to embrace this dissertation adventure with me.

To my family, especially my brother, my father, and my mother, who always advised and support me on achieving this master's goal, not just on the dissertation, but during the entire master cycle. This would not be possible without them.

And last, to the love of my life, *Sofia*, who is my shelter, my partner, my other half. All of this is possible because of her. For all the special care, love, words, support, for all the trust, and belief in my capacities to achieve this dream. My true gratitude for all you have done for me and for achieving this prize, which part of it is totally yours.

To all of you who are mentioned here in this section, my honest thanks!

ABSTRACT

The Global Mobility Industry is the area that comprehends the emerging internationalization and growth of companies outside borders. Its overall core essence is to support businesses all over the world in setting up operations, by assigning employees in other cities or countries outside the company's headquarters.

These operations have intrinsically a set of challenges and opportunities that both companies and employees need to face while on move. To face these challenges and accomplish international move tasks and goals, software houses have been developing over the past years platforms and solutions to face each of the international moves phases.

However, it's hard to keep every task, request, event, and everything on track and both accomplishing and managing it can become a struggle when the number of employees on assignment multiplies and grows year after year.

The usage of Chatbots is not new in the tech world, but the technology, features, and capabilities of those have been growing and growing, and those are gaining a significant space and importance in a variety of different businesses and social fields, such as sales, real state, eCommerce, customer support, and even marketing and enterprise bots. Its capacity to work as a true virtual assistant, able to respond and support users 24/7, it’s becoming something more and more desirable for every company and employee.

This dissertation has the goal to, first, make a deeper research and study on the Global Mobility Industry and the Chatbot usage and development. Defining and stating how helpful and valuable a chatbot could be when integrated with a Global Mobility software solution. By concluding this study, 2 built artifacts will result from it, specifically a backlog full of business requirements to accomplish, and a prototype of the chatbot using one of the top Chatbot enablers platforms in the market.

To work and develop the artifacts, this dissertation will follow the design science research methodology, whose evaluation phase will be supported by a user testing session and a structured interview with carefully selected participants, with pre-defined closed and open-ended questions.

Everything resulting from this dissertation will leave open space for future enhancements, by incrementing the value and functionalities of the chatbot, and potential real-world application and integration of it in Global Mobility softwares and platforms.

KEYWORDS

Global Mobility; Chatbots; Requirements Backlog; Artificial Intelligence; Dialogflow; Prototyping.

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LIST OF ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
AIML	Artificial Intelligence Markup Language
A.L.I.C.E	Artificial Linguistic Internet Computer Entity
ASD	Adaptative Software Development
CA	Conversational Agent
COLA	Cost of Living Allowance
DSRM	Design Science Research Methodology
GMI	Global Mobility Industry
IFTTT	If This Then That
LUIS	Language Understanding Intelligent Service
ML	Machine Learning
MVP	Minimum Viable Product
N/A	Not Applicable
NLG	Natural Language Generation
NLP	Natural Language Processing
NLU	Natural Language Understanding
SME	Subject Matter Expert
UI	User Interface
UX	User Experience

1. INTRODUCTION

The Introduction chapter will be split into 3 major parts: Background – to understand the business context under the spoken topic; Motivation – to give more details about where the dissertation idea was born and Objective – to present how the dissertation will be structured and how we will enhance and answer the identified problems and raised questions.

1.1. BACKGROUND

These days, due to improvements in technology and business models, we are seeing an evolution of how companies and employees work, which represents an increase in the investment in internationalization. When this internationalization emerges, employees are being moved to different countries and this represents a challenge to all players evolved: HR Managers, Global Talent representatives, and the employee themselves. The increased dynamism of global business models and context leads the Global Talent Management to emerge over the past years (Tarique & Schuler, 2010).

The internationalization of companies is not the only factor that is positively contributing to the growth of the expatriation factor. Personal factors and multi-cultural behavior changes are also contributing to this growth. According to Calderón (2016), successful expatriation promotes the personal and professional development of the individual employee.

For these multinational companies, the traditional Human Resources Management is no longer only a matter of dealing with recruitment and payroll check, but also a matter of dealing with GTM - Global Talent Management. As Yvonne (2017) said, international employee mobility is a key element of multinational enterprises and expatriates play a central role in the GTM Industry.

Typical Global Mobility Management softwares are packed with basic features to deal with the daily-management: processing expenses in different currencies, calculate taxes, produce accurate cost estimation and compensation reports, among many other scenarios. And for each type of user (relocation coordinators, employees, HR managers, etc), the needed features and tools are significantly different. According to Audra, Lena & Helen (2018), organizations are becoming diverse in the response to the increase of globalization, companies are presented with new challenges and need to come up with solutions to quickly adapt to the market changes.

All the above international challenges, represent opportunities for software houses that want to succeed and provide complete solutions in the Global Mobility industry world. And despite we are seeing a growth of players and complex software solutions to fulfill all these needs, there are still gaps in what refers to the employee experience on assignment. There are still existing pains on having a “guide” able to answer all my questions as an employee, 24/7, on basic things related to my work move (services available, upcoming tasks, etc) or even related to culture and information about my host country.

A Virtual Assistant, based on Artificial Intelligence, Machine Learning, and Dialogue systems can be a tremendous added value to a platform/app that goes along with the employee on the international experience. As Bohouta & Kepuska (2018) said, spoken dialogue systems are intelligent agents that

can help users finish tasks more efficiently, and so, being that important help to guide and keep the employee comfortable about the next steps and move outside borders.

The usage of AI and chatbots are the perfect combination for building an accurate Virtual Assistant for the employees on move. The proliferation and use of chatbots have led to the messaging-as-an-interface user interaction parading (Bezverhny, 2020).

1.2. MOTIVATION/JUSTIFICATION

The Global Mobility industry is already a good market niche for software houses. A lot of different players are competing on having a top place to fulfill all the needs of companies that have employees relocated in different countries. Solutions that support mobility management, assignment costs, allowance calculations, and proper communication between a different range of users: HR Managers, Global Mobility executives, and also the relocated assignees.

These solutions have been evolved over the past years, with complex management systems being created for relocation managers and platforms/apps for the employee on the move. Those are all good tools that help with management and communicating between these different users.

However, there are still gaps in these software solutions. The employee on the move might find it hard and complex to get all the information that the software can provide him, as well as being a guide on the moving experience and helping to finish the upcoming tasks. As expressed in the Forum Expat (2017), in this global mobility environment, the need for an efficient technology platform to manage mobility operations is becoming critical to the growth plans of many international organizations.

It was identified as the major problem for this dissertation, the “how” can international organizations ensure that the employees on assignment, can have the needed support and guidance on things they need to do and worry about. More, how can these companies ensure that their employees will have a 24/7 assistant, ready to help and guide them on issues that are typically asked to their mobility coordinators and administrative assistants?

Tasks management can be hard in the current days, knowing all of them and completed on time can be a hard task for employees. As Silva (2018) said, there is a significant amount of repetitive tasks that require time to accomplish, and the desire for having them organized, at a distance of a click and automated, is becoming a requirement to facilitate employee’s work and life balance.

To build a good and stabilized virtual assistant, understanding how artificial intelligence, bots, and natural language understanding becomes crucial. And as more intelligent the computer can be, the better experience will provide to the end-user. As Costa states (2017), the machine is considered intelligent when is talking to a human and he does not understand that is talking to a machine. The study should answer questions like:

- What is needed for building a good and useful software virtual assistant in the Global Mobility context?

- What are the available tools, bots, and APIs in the market that can serve as an example and facilitate/integrate with the development of the virtual assistant?
- What kind of areas, such as tasks, events, upcoming priorities, events, and other relevant services should be available and be useful for the employee on assignment?

With these assumptions, and due to the interest of the author on the Global Mobility Software industry, it becomes the main goals of this dissertation, the creation of a requirements backlog and a chatbot prototype, that could work as theoretical artifacts for a potential development of a new software virtual assistant, that would integrate with a Global Mobility management software, and provide employees on move help and guidance along with the entire period of the relocation experience.

As part of this dissertation project, the followed methodology will be based on the Design Science Research framework, and the built prototype will later be submitted to an evaluation by a carefully selected group of individuals.

1.3. OBJECTIVE

The main goal of this dissertation is to provide a detailed analysis of a new Virtual Assistant, as well as a real chatbot prototype, which can be later integrated and adapted into a Global Mobility Management System, that would provide employee users currently assigned outside the home country, a new virtual assistant that would help them know what tasks or events are coming, what requests does the employee have to fill out, as well as go along with the international experience, suggesting and helping on finding the right services for the mobility needs (housing, schooling, tax and immigration services, between others). Based on Artificial Intelligence, Machine Learning, and the employee's global mobility management data, this new virtual assistant will provide a modern tool for the employees to have a better assignment experience, as well as for the Global Mobility and HR Managers to communicate and provide relevant information for them, via populating correctly the global mobility management database that can be used by the bot. The Virtual Assistant will be backed by logic and language understanding, that will recognize the employee need (by voice or written text) and suggest/help them on accomplishing their goals: task to complete by the end of next week, check approved expenses, or even knowing what services are available in town.

The main question of the dissertation project is: How can employees assigned in different countries/cities have a better experience on things to accomplish and have the entire knowledge in their mobile phones or laptops by only inquiring the management software they already have?

As part of responding to this question, the investigation will be focused on finding the best virtual assistant chatbot enabler platform to answer this need, that will help the employee on things not just directly related to the assignment work, but also with services provided and available on its location. It is planned to be a complete backlog analysis for a software feature that will support a new virtual assistant.

Briefly, the result of the project should culminate in:

- Providing research of the current Global Mobility industry concepts, challenges, and opportunities, and describe how a chatbot feature can improve the user experience for expatriate employees;
- Providing a detailed study and research of the software virtual assistant and chatbot market, what are the available tools, technologies, and artificial intelligence artifacts that can be used or are recommended for developing this new feature;
- Build a backlog of requirements with the set of User Stories needed for developing the chatbot feature, in the context of a global mobility management software that would match the proposal goal: help and guide the employee on its international assignment;
- Build a chatbot prototype that can be used later as guidance and enabler for building a real chatbot that can be adapted for integration in mobility management softwares.

2. LITERATURE REVIEW

To later understand the best ways of approaching the development of the backlog for the Global Mobility Virtual Assistant and to describe the state of art in what concerns the artificial intelligence technology behind automated intelligent assistants, the literature review will be split into 3 bigger topics, that latter will be split into smaller research items: “Global Mobility Industry”, “Chatbots & Virtual Agents” and “Software Requirements”. Those will help understand the scope of the project analysis and get deeper into the global mobility industry and the dissertation problem.

2.1. GLOBAL MOBILITY INDUSTRY

Managing teams has been an issue that most companies in the world have been dealing through history. And as far as the company grows, more and bigger teams emerge. And if we speak about globalization, teams that can be divided and spread in different locations and time zones, more difficult and challenging it becomes.

2.1.1. Concepts & Introduction

The GMI is rising as technology and internationalization are rising. The globalization and spread around the world of virtual mobility teams, in different time-zones and cultures, represent a new way for companies to grow internationally and act in different markets. This lead human resources to travel and spent part of their lives living abroad, as Tiago Condeixa (2010) states, “Nomadism can be seen as a property of global mobility management”.

Relocation Management has a lot of different variables to be treated and managed with simple spreadsheets and decentralized information. Despite is an industry in constant growth and willingness to suffer changes, “budget, geographic constraints, and short-term infrastructure constraints persist as fundamental features of global mobility” (Andreas Schafer, 1997).

Global Mobility and Relocation programs have lots of moving parts, they represent a life-cycle of a mobility employee who needs to deal with different immigration systems, taxes, compensations, social security, cultural training, benefit elections, manage expenses and the list could go on. It is almost prohibited to manage all this information and workflow of tasks with spreadsheets and outlook alerts. And there are several ways of classifying these international assignments. As Duvivier affirms (2019), there are 3 types of international assignments:

1. Long-Term Expatriations;
2. Short-Term Expatriations;
3. Short-Term Inpatriations.

The first type refers to an assignment of an employee who goes on a long-term period (6 months or more) outside his home country. The second one refers to the same ambit, but in shorter periods, and the last, Inpatriations, is the ability to bring foreign employees to the HQ country (Duvivier, 2019).

This classification is just a way of categorizing international assignments based on their duration period and the direction of the assignment (inside or outside the HQ country). Depending on the

international assignment type, company industry, and employee's position, the benefits and costs will also vary accordingly. And the benefits package is an extra motivation for employees considering moving abroad, as Scullion (2005) says, employees might agree on taking unexpected or unattractive tasks if they find they can reap the benefits in the future, such as promotions.

It is a phenomenon that is having an impact on bigger and international companies. As Chew (2004) affirms, as organizations become globalized, there is an increasing challenge to use expatriates for completing international strategic tasks. And not just because it is economically beneficial for the employee and the company, but also because it is starting to represent a new social behavioral trend.

According to Adrian Favell et al. (2012), "Building on this, a new wave of social theory focusing on "mobility" has sought to dissolve the category of "society" itself, celebrating a variety of new forms of social, gendered or transnational "citizenship" beyond the nation-state supposedly enjoyed by mobile and networked populations.", which may be representative that working abroad is not just being seen as something good just for making money but also to achieve a relevant social status.

2.1.2. Challenges & Opportunities

The phenomenon of global mobility and living abroad represents a major challenge, not just for the companies that need to manage and provide support for the mobile employee, but also for the employee itself. It is not easy to leave everything behind in the home country and go on an expatriate adventure.

In a study made by Figueiredo (2015) to a person that lived and worked abroad on 3 different continents, he states 3 different phases of challenges: challenges that belong to the arrival phase, to the staying phase, and also to the departure phase.

In the first cycle, on arrival, mobile employees face challenges like finding the right place to live, getting to know the city, understand and study the host country's culture, and sometimes understanding the language and the best way to communicate while living abroad. While in-assignment, in the staying phase, different challenges will appear, like how to find and fit the society, getting to know new people and friends, getting used to the costumes and the city services, like supermarkets, kids school, and many others. Not as intense as the other two cycles, the departure phase also brings challenges to mobile employees, with concerns like leaving the host home, deciding on bringing or not the bought furniture, saying goodbye to friends and co-works, among others.

In general, being a “work-nomad” brings a lot of different challenges for these mobility persons, and it gets more effective as more different assignments happen. Personality and intra-personal behavior shape to adapt to this way of living. As Butcher said (2009), more challenges associated with being constantly on the move emerge, namely long-distance relationships, discomfort, fragmented identities due to the contact with so many different cultures, etc. It is a challenging and not easy experience, and, as Figueiredo (2015) states, different questions like “What is home for you” or “In which ways do you think it affects who you are and what you do” start to come across your mind and thinking.

But, despite all the above-mentioned challenges are true and needs to be taken into consideration, there are also huge opportunities, for both companies and employees within the global mobility and working abroad. According to McNulty (2016), expatriates accept international assignments usually for career development and personal/family opportunities, due to mobility playing a positive role in the career progression.

As Chew (2004) affirms, there are very good relocation benefits for the employees, and the majority (87%) of the firms offer mutually accepted relocation benefits, such as helping on the house hunting, school registration for dependents, and shipment of personal goods to the host country. In flexible assignment policies, the expatriate employee can negotiate the terms of their benefits, with the possibility and opportunity for asking and selecting the reward that makes more sense to their lives and situations.

The financial gains and opportunities are also important, but not the only reason for considering a move. In Dickmann’s study (2008), there is up to twenty-eight decision factors and the financial improvements do not figure the top ones:

1. Having relevant job-related skills
2. Potential for job skills development
3. Potential for leadership skills development
4. Career progression
5. Perception of career risk
6. Maintaining work networks with the home country
7. Work/life balance
8. Intercultural adaptability to the host culture
9. Professional challenge of working abroad
10. Willingness of spouse to move
11. Children's education needs
12. Interruption in spouse career
13. Loss of partner's income
14. Maintaining personal networks
15. Personal health status
16. Desire to live abroad
17. Successful previous assignment(s)
18. Personal financial impact
19. Position offered on assignment
20. Length of an assignment
21. Potential role(s) available on completion of assignment
22. Language compatibility
23. Security
24. Distance away from home location
25. Host country culture
26. Host country standard of living
27. Pre-departure preparation
28. Repatriation package

TABLE 1 – THE TWENTY-EIGHT DECISION FACTORS

SOURCE: MICHAEL DICKMANN (2008)

We can conclude from the above results, that there are many opportunities and different reasons for considering working abroad, from personal aspects (improve skills, learn new cultures) as well as family aspects (children's education, loss of partner's income, etc) and, obviously, the work labor aspects (desire on a better work/life balance, career progression, between others).

Expatriate employees have the chance to develop themselves as persons and as workers. It is a new world to learn and a new way of living to adapts. Hermans (2020) affirms that global mobility is an opportunity to acquire and develop skills in a new location, which potentially contributes to bigger marketability. Workers with international and/or expatriate experience, are seen in the labor market as assets with more adaptability capacity and with a bigger culture and knowledge of the world. According to McNulty (2016), the importance of "external marketability" is a commodity for the employee because it may ensure lifetime employability.

As Hermans (2020) says also, working abroad is a life-enriching experience, that provides employees an enhancement in cultural literacy, expands their professional and personal networks, and also facilitates the mastery of foreign languages. All opportunities that employees see as truly added value to their background and personality. If we associate all these advantages with the opportunity and joy of traveling, having different experiences, meeting new cultures, is something rich and desirable for the average human being.

General internationalization and growing outside borders for companies is something desired to expand markets and revenues. Big companies act in different markets and countries. There are also opportunities for sending employees to different countries, despite the risk of losing them in the international market. As McNulty said (2016), focused expatriates can be a benefit to organizations, once they might know already the culture and processes of the company, and sometimes it can be

less expensive on recruiting potential external talent. The time saving and training on new external hires usually satisfy and help companies growing faster in different locations.

Despite the visible benefits on both companies and employees sides, expatriation has direct and indirect costs associated with the moving, such as the salary, training costs, travel, and all the relocation expenses (Chew, 2004). And these expenses can vary from simply helping the employee on house hunting, but also things like representative payments, transportation, and moving costs in the host city, among others.

According to Hermans (2020) study, 3 big forces may impact (positively or negatively) the growth of global mobility for companies: Globalization, the Gig Economy, and the Demographic changes. For the first, due to the potential increase in revenues, companies are willing to do more business outside national borders. The market grows, the target expands, and the opportunity of increasing sales is desirable for companies. The Gig Economy also has an important word to say in the internalization. As technology and the digital world grows, it is more common to work abroad or work from home (this last one more visible since the start of the global COVID-19 pandemic). As Hermans (2020) states, the future of work is skill-driven. Companies are much less hierarchical, digital jobs are gaining force and manually, tasked positions are becoming less relevant. This also enters the field of the third force, which is the demographic changes in the workforce. By having four generations in the workforce, as Hermans says, cultural diversity is also increasing across multinational companies, and this is a challenge for working with persons that think and act in a different way than what we used to and having employees prepared and willing to embrace these changes and diversity, it is something that will facilitate later the international growth of companies.

2.2. CHATBOTS & VIRTUAL AGENTS

Chatbots and Virtual Agents are almost a necessity for every online site, service, or shop. Those help customers and providers on finding the best ways to fulfill their goals, by helping on solving an upcoming problem. The fact that those are always available, smart, and capable of delivering the best paths to move forward, is something that is desired by companies from a different variety of industries. As Kidwai et al. (2020) said, Chatbots nowadays have found use in every sphere from commercial use like analytics, communication, customer support, education, entertainment, finance to personal use as food, games, health, shopping, social, sports, travel and utilities.

2.2.1. Concepts & Introduction

Chatbots and their overall goal are not a new trend in the tech industry and the world's needs. Having a 24/7 assistant that can help us achieve our goals and perform tasks is something that the majority of people would like to have. As Dokukina & Gurmanova said (2020), the creation and training of smart conversational agents have long been a dream of the human race and a huge challenge for scientists and programmers.

The utility of chatbots can go over the simple use case of “helping users on finding the desired product in an online shop”. It is coming as a major need for a variety of companies and industries because it replaces the need for a human to be ready to answer, guide, and essentially replying and performing a lot of repetitive tasks. According to Bezverhny et al. (2020), managers of education programs spend 70-80% of the work time on repetitive tasks, such as polls, reminders, answers to the same questions. This is a very good example where a chatbot can intervein and be useful, in the Learning Management Systems. Because in a modern and technological world, repetitive and boring tasks should be done by machines, saving time for people to work, evolve, and be creative in what matters.

The evolution of Chatbots has been quite notorious. From simple pattern recognition and interaction with text to utilizing speech synthesis and visual avatars (Kidway et al., 2020). Those have become much more interesting for companies over the years due to their natural evolution. It can even get to a stage where people do not know if they are talking to humans or a machine, and this is where we start seeing the power of a chatbot: replacing the natural work of an assistant. When Artificial Intelligence gets in the game and the chatbots become smart after each interactive conversation with users, their power becomes almost unlimited.

If we take a deeper look at the Chatbots history, we will see that chatbots are not a new trend but their evolution over times has been quite notorious:

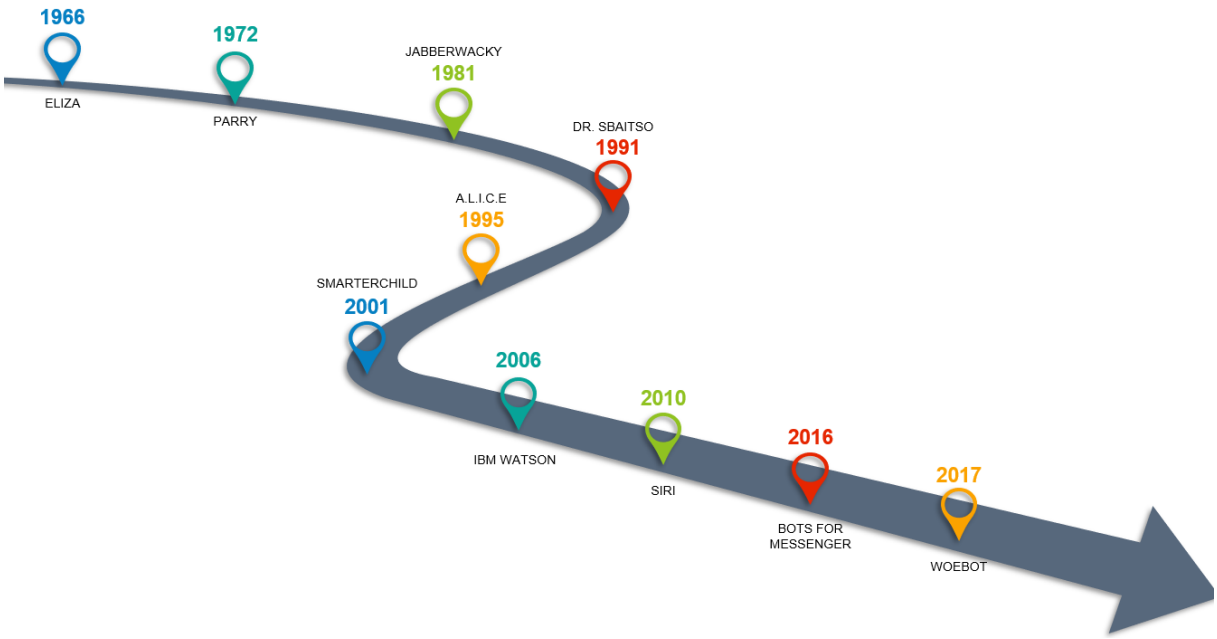


FIGURE 1 – THE HISTORY OF CHATBOTS
SOURCE: ADAPTATION FROM SMARTSHEET BLOG (2020)

The Smartsheet company released an article on their blog (at https://www.smartsheet.com/artificial-intelligence-chatbots), where is visible the evolution of chatbots over time, as well as the characteristics and end goals of each. From the release of Eliza, the first chatbot program released, which was capable of responding to prompts but not learning or contextualizing interaction, passing to specific bots with personalities (Parry as a paranoid schizophrenic robot, Dr. Sbatiso as a psychologist, between others) and reaching to the first bots using Artificial Intelligence, like A.L.I.C.E (in 1995), IBM Watson (2006), or Siri (2010), the growth of technology over time has greatly boosted the Chatbots' power and capability.

Even looking at how Chatbots grew until nowadays, there is still a lot of room to improve and grow, specifically, general chatbots that are programmed to accomplish a set of different tasks. According to Nimavat (2017), using general chatbots turns out to be disappointing since sometimes they do not do what the user expects them to do, in opposition to the narrow ones that do very well. Nimavat states that there are general areas where the chatbots can still grow significantly, like the Context Awareness, the Personality, between others. The future of chatbots is exciting and we will likely see them impacting, even more, every business and personal life.

2.2.2. Types of Chatbots

The chatbots can vary significantly, from the model type, the target, and a set of other different variables, and the business/development teams need to be fully aware of the chatbot category they need to build. The rise of chatbots has been, as we will see in chapter 2.2.5, a trigger for chatbot explosion and contribution to the diversity of roles we see in nowadays chatbots.

The classification of chatbots is, for these reasons, a hard task for anyone with intentions of building a chatbot. As we can see in Figure 2, the Chatbots can be categorized into 4 different domains: Knowledge Domain, Service Provided, Goals, and Processing Model.

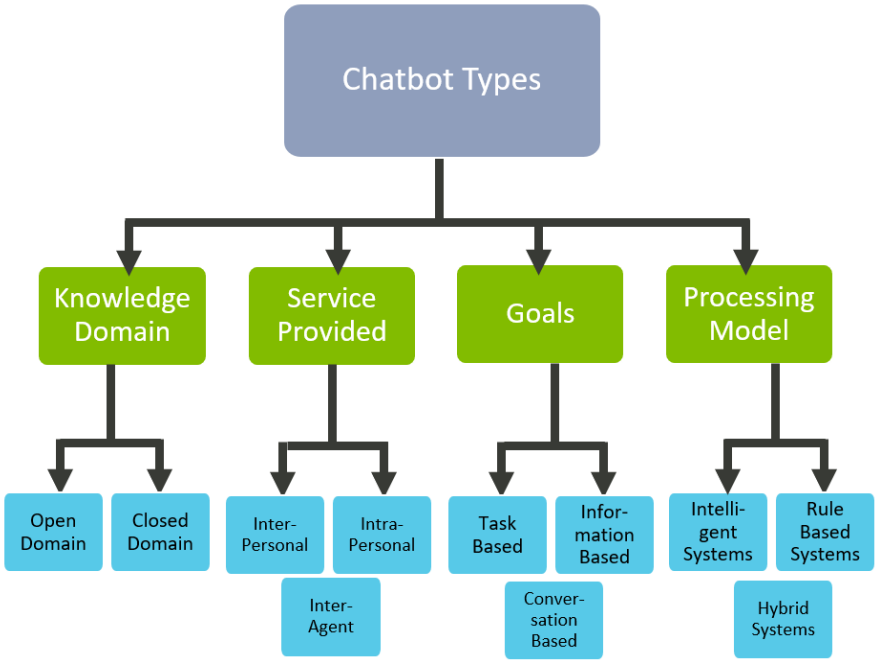


FIGURE 2 – CHATBOTS TYPES & CLASSIFICATION

SOURCE: ADAPTED FROM KETAKEE NIMAVAT (2017)

From the capacity to talk and respond to users about any topic or a particular domain, to the end goal of answering questions or perform any kind of task, chatbots can work and be useful for different industries and different purposes. The most relevant categorization for the purpose of this dissertation relies on the Processing Model: the differentiation between a chatbot based on Fixed Rules or an Intelligent System (with Machine Learning). Traditional rule-based systems, according to Luo et al. (2019), only handle simple inquiries with pre-defined messages. Those are built to respond to specified bot commands and usually just display a fixed level of smartness, they don't learn and don't get smart with time and experience. On a smarter side, Machine Learning based Chatbots are smart and incorporate intelligent systems, which results in understanding language, not just pre-defined commands, and also learning from experience.

But, despite there exist many different characteristics, as Nimavat (2017) said, Bots do not have to exclusively belong to one category or other. Each of the categories and classifications can co-exist in the same bot and, that combination of different tools and capacities is what makes the difference and the bots more powerful. An interesting example of this categories combination is A.L.I.C.E, a bot

built in 1995, and is, as Doshi (2017) said, a rule-based chatbot based on AIML (Artificial Intelligence Markup Language), by having more than 40,000 categories, where each category has a combination of pattern and its response. A.L.I.C.E can fit perfectly in the “Hybrid Systems” classification we see in Figure 2.

All these different categories can be classified as a high-level categorization of Bots. If we get to each of the specific functionalities, we will find different types of bots depending on the purpose and the characteristics. A very good example of it might be the locus of control classification. The dialogue between a real person and a chatbot can vary, and these interactions can be classified as one out of 2: Chatbot-driven dialogue and User-driven dialogue. Once chatbot-driven bots are more rigid in the provided answers (only allowing certain types of paths or questions), the user-driven bots are the ones whose intent is to provide guidance and help for the users to accomplish their goals. As Brandtzaeg (2019) said, User-driven chatbots are set up to enable more flexibility in the possible input users may make, and also to be more responsive to variations depending on the user input. This leads us to conclude that user-driven chatbots are the ones that might be interesting for the purpose of this dissertation, once the interaction with the user must be flexible and provide the needed guidance and help on accomplish the desired tasked within the international mobility experience.

Another low-level dimension that can be helpful to classify bots is the relation. And by relation, we can start building the bridge between chatbots and artificial intelligence. Also as mentioned by Brandtzaeg (2019), human-chatbot relations may, from the service provider point of view, be intended as either short-term or long-term relations. By short-term relations bots, we include the ones in which the goal is simply to provide a one-off answer, without the need on storing any kind of intention or preference. It’s to help the user with its need and that’s it. When we get to long-term relation bots, things can get more complex. The idea around this one is to collect the user preferences on the provided questions and build a user profile model, to learn from that and be more accurate and suggestive in future interaction with the user.

2.2.3. Chatbots Logic & Functionalities

We have seen in the previous chapter the number of ramifications a chatbot might have. From task-based ones to informational chatbots, the number of features each category might supply can be surprising.

When building a chatbot, it's important to narrow and identify the target usage of the chatbot, so feature development can be prioritized according to the importance of it, as Zhang (2020) says, researchers and business analysts can prioritize specific chatbot features that are more relevant to the target population.

FIGURE 3 – PREDICTED USE CASES OF CHATBOTS

SOURCE: REVE CHAT BLOG (2020)

Figure 3 represents a predictive analysis from Patel (2020), which concentrates on the expected usage of chatbots when facing a chatbot. We can see that the top 3 ones are relying on getting quick answers, resolving a complaint, or getting additional explanations. All actions that in the past were answered and supplied by real human assistants. From a different perspective, Figure 4 shows what are the top benefits of Chatbots for customers:

Benefits	%age
24-hour service	64%
Getting an instant response	55%
Getting answers to simple questions	55%
Easy communication	51%
Friendliness and approachability	32%

FIGURE 4 – TOP BENEFITS OF CHATBOTS
SOURCE: INVESP BLOG (2020)

The primary benefit of chatbots seen by users is still the 24/7 service that those provide. In the ramification of customer service, the gains are notorious and this is a major reason why this characteristic is still seen as the major advantage of using chatbots. As Shukairy (2020) affirms, chatbots can speed up response time, answering 80% of routine questions, and save up to 30% in customer support cost. But it does not end here.

Starting from the principle that chatbots have the main goal of interacting with people, chatbots should have at some basis of conversational maturity, by being capable of actively communicating with humans with, likely, emotional intelligence. Tavanapour (2018) affirms in its study, that chatbots should ideally have the same tone, sensitivity, and behavior as people, not forgetting that is expected that chatbots should provide more useful information in less time than humans. It is expected that chatbots interact like they are humans, distancing themselves from a system or a machine, to create a better customer experience for users.

Another important chatbot characteristic nowadays is being present in multiple platforms, know as Omni-capable chatbots. Being present in multiple channels by a one-click integration opens the chatbot's potential adoption due to its capacity of working in the messaging platform that the users might be used to. According to Abdellatif (2020), chatbots are expected to communicate between multiple services and integrate with messengers to make use of already existing Social Network platforms. Choosing a chatbot framework that integrates with multiple already existing communication systems, like Facebook Messenger, Slack, Zoom, Skype, etc, is an advantage that chatbot developers and analysts should consider, not just looking at a solution to live and only be available in the companies' website.

From its history, chatbots have evolved from text-based conversations to speech-based ones. It is quite common to see both ways (written and speech) in chatbots and virtual agents. In the future, as speech recognition technology improves and grows, the usage of virtual assistants will get even deeper into the business workflows (Silva, 2018). Speech-recognition is ultimately connected with one of the core technologies of Artificial Intelligence Chatbots, the NLP – Natural Language Processing, which we will deepen in the next chapter. As Boger (2018) says, one of the central features of each chatbot is the NLU – Natural Language Understanding – component, which is responsible for the definition of intents and entities, the values extracted from the utterance. The

ability to understand and refine what the user intent is, and prompt an accurate answer or action, is ultimately a goal that all chatbots intend to achieve.

An important thing to keep in mind is that each chatbot builder platform has its pros and cons, and each has specific features that have been designed for an end goal. As Araújo (2018) said, depending on the chatbot creation platform, the available features will vary, meaning that a prior analysis should be made to understand what fits better the customer needs. For instance, Dialogflow has a specific feature designed to save contexts during the conversation (Ochoa, 2019). This feature is quite interesting and contributes to a better user experience because the chatbot being context-aware contributes to more rich conversations. If we imagine a case where the user is talking about supermarkets in the region, and at a specific moment makes a question like “Where is the closest one?”, the chatbot, once it has the context of the conversation and previous queries, will ultimately guide the user to the closest supermarket, without the need on specifying what are they talking about.

More than the general core features that all chatbots have, each will have its needs for specific actions depending on the context or industry inserted. For instance, as Vaz (2019) affirms, Cortana (the Microsoft Virtual Agent), supports a variety of user commands including phone call actions, scheduling events and reminders, making reservations, handling device settings, searching the internet, among many others. Depending on the end goal and the specific needs of each chatbot, the chatbot builder platforms are flexible to allow developers to configure and create specific features that work and serve purposes for each business. Multi-language bots, rich messages, integration with CRM, analytics, perform tasks, inform. All outstanding attributes and features that make chatbots a desirable tool by a lot of different companies and industries.

2.2.4. Artificial Intelligence

Artificial Intelligence is not a new concept in the computer science world. It can be defined as the general idea of building systems capable of performing tasks that usually required some sort of human action and human intelligence. As Haugeland (1989) said, Artificial Intelligence can be seen as the exciting effort to make a computer think and act. Within the wide field of Artificial Intelligence, we can get deeper into specific ramifications such as NPL (Natural Language Processing), Machine Learning, Deep Learning, among others.

Artificial Intelligence is commonly used in a wide range of fields, companies, and industries, such as health-care, manufacturing, e-commerce, CRM, and obviously, chatbots. An AI chatbot has different capacities and power to go further and accomplish the chatbot end-goals, as Zhang (2020) said, Chatbots empowered by artificial intelligence can increasingly engage in natural conversations and build relationships with users. A Chatbot powered by AI, can not just quickly find the best patterns to respond to the users' questions, but also can learn from those conversations.

2.2.4.1. Machine Learning

AI and Machine Learning are technologies intrinsically linked when it gets to build chatbots, one can live without the other but the result of the built chatbot will be weak and missing critical core features to work properly as expected. According to Le (2019), AI is the human-like capabilities that people want to add to the machine, and ML is the data analysis' method that automates tasks and trains the machine to learn and adjust their answers with the conversation experience. It's fair to conclude that AI and ML are galvanizing chatbots and are creating the desire and need on companies to have those as part of their internal processes, helping with customer services, supporting organizational workflows, between others. ML describes the process of learning, a neural network offers the underlying concept of how the machine actually deals with the given data (Boger, 2018).

Machine Learning is not a new technology science and its concept, interest, and capabilities have been growing over the years. In its essence, as Vaz (2019) says, is the study of automatic performance improvement algorithms. Algorithms that learn from experience and practical application on data, becoming more accurate over time to accomplish certain goals and perform tasks for users when needed. Briefly, it is the study of algorithms and scientific models that a computer system can use to ensure learning a task without any explicit instructions by only relying on patterns and inferences instead (Kidwai, 2020). And this concept is very important in the chatbot type definition. We can build and consider more simplistic rule-based chatbots, that are only prepared to reply and perform pre-defined tasks, or instead, we can build more sophisticated bots that learn and have their architecture based on AI and ML processes and algorithms.

The ML concept can be categorized into two specific types: Supervised and Unsupervised Learning. Supervised learning is the most popular type of ML, due to its capacity of mapping the data and label it into a set of values. According to Vaz (2019), Supervised Learning is the way labels are put into specific training sets of data, and the goal is to take that set, analyze it, and build the mapping between these labels and examples. It is similar to Predictive Model science, due to its capacity of making decisions and predictions by analyzing labeled data. It means that the machine is taught or trained using data that is already labeled and comes up with a mapping function between the input and the output (Kidwai, 2020).

From a different perspective, Unsupervised learning makes usage of non-labeled data lean. As Boger (2018) affirms, Unsupervised learning can be compared to a descriptive model, since it does not rely on existing previous and known results, instead, it tries to output the most accurate answer based on what is correct. It looks at data like clusters and based on proximity, it will try to outcome the most accurate answer (which might not be the correct one).

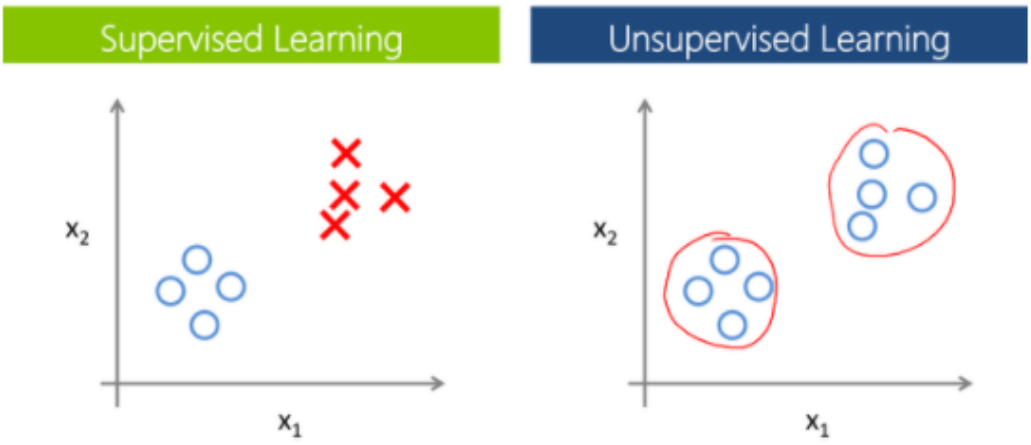


FIGURE 5 – SUPERVISED VS UNSUPERVISED LEARNING
SOURCE: LAKSHAYSURI BLOG (2017)

As we can conclude from Figure 5, in Supervised Learning, we have a set of categorized data, which will make the ML output be decided by what is more common/patterned given the data characteristics. On Unsupervised Learning, there are no labels, so the ML output will be decided based on what is closest to the existing clusters. Both have pros and cons, depending on the context and the scenarios that might be chosen. Lakshaysuri (2017) shows on his blog different examples for those 2 techniques to be applied, such as Supervised ML to predict the stock market (based on past events and existing data), and Unsupervised ML to discover market segments given a database of customer data.

These two different forms are by far the most common types of ML, but in between, there is still room for Semi-supervised learning, which has, according to (Boger, 2018), both labeled and unlabeled data. This approach might be good for creating predictions with not just labeled data, but also based on common characteristics and cluster proximity.

Building chatbots need to be intrinsically connected with machine learning and machine learning technology, due to its need for language processing, recognition, and analysis. As Silva (2018) affirms, machine learning has the function of recognizing the intention of the user so that the proposed solution and answer can be accurate and act in agreement. Bots take advantage of these capabilities. If not, those will be too simplistic for the proposed goals and final objectives. Modern chatbots like Amazon's Alexa, use machine learning techniques because they need to take advantage of providing advanced information retrieval processes, in which the responses are generated based on analysis of the results of data sets (Cahn, 2017).

2.2.4.2. Natural-Language Processing

But it is not just Machine Learning (including the specific foundations of Deep Learning, etc) that compose an AI Chatbot. An AI Chatbot is essentially built taking into consideration 2 specific components: The Machine Learning part and the NLP (Natural-Language Processing) part. If the first one is what will be responsible to process and learn the inputs received by the user, the second one is the other part of the bot responsible for synthesizing human language and output it into an understandable human conversation. NLP technology brings the capacity for chatbots to understand requests from the users and act or respond in accordance with it. As Luo (2019) said, chatbots that are backed by speech recognition and natural-language-processing tools, are capable of understanding dialogs and address users' needs and requests with depth, accuracy, and compassion.

Within the NLP world, we can get deeper and specify it into two different major components: NLU (Natural Language Understanding), responsible for receiving the inputs and decode it into a language that the system understands, and also the NLG (Natural Language Generation), which can be seen as the piece responsible for generating the output, translated to something understandable in a humans' conversation.

NLU is a hard process and has been a big challenge over the years in the Artificial Intelligence world. As Bird says (2009), getting a system to understand what is being required (by text or voice), involves a range of language processing tasks, that can include information extraction, inference, and summarization, and this is a hard task. Lucky for us, the technology has evolved and there are out there platforms that are much prepared to perform this task, which could take a lot of time and money to build from scratch.

On a different hand, NLG is the process that will supply a response to the users' queries, by rendering what the systems output into language. The "generator", as Indurkhya (2010) affirms, starts with the initial intention to communicate and determine what content will be provided, organizing the words and the grammar to make sense for the end-user. As much as the user doesn't get that is talking to a machine, the bot is working according to its essence: conversation as a human being.

All these technological pieces together form what is the basis of an Artificial Intelligence chatbot: Artificial Intelligence as the basis of a smart machine capable to communicate with users as another human, Machine Learning for the capacity on receiving inputs, searching patterns, analyzing, saving, and learning for future conversations, and also Natural Language Processing for the capacity on receiving user inputs as text or voice language, understanding it, processing and replying or guide or perform a task also in a natural language for the user.

2.2.5. Market Analysis & Available Platforms

2.2.5.1. Chatbot Market Insights

The Chatbots market has had incredible growth over the past years due to the progress in the tech industry, as well as the growth of customer needs on having a full-time assistant ready to guide how to accomplish their goals. A very straight-forward example of this growth is, as Nimavat (2017) states, the Facebook bots have grown from 34,000 in November 2016 to 100,000 bots in April 2017. In less than one year, the number of Facebook bots grows significantly, which means companies are requiring these third-party systems, to provide a more complete service to their customers.

These days, companies and sites are seeing in chatbots integration a truly added value, by its way of improving both automation and user experience. And the market grows with it. According to Daniel (2020), the global chatbot market is projected to reach 2 billion dollars by 2024, growing at a compound annual growth rate of 29.7%. A very representative value for a recent technology trend. The successful results and variety of ranges and industries where the chatbots make sense and can be implemented contribute to the high numbers we are seeing.

In chapter 2.2.2, we have talked about chatbot types and their high-level classification depending on the output desired. On a low-level category, if we get deeper into the chatbot development, we can find different ways on how to go from an “idea” to the implementation of the bot on a website. And for that development, companies can decide on “how” they will build the bot. And we can see three different types of bots depending on the way they will be developed: non-programming platform bots, conversation-oriented bots, and platforms by tech giants bots.

If we take a deeper look at the last type, tech giants already saw this emerging trend and are already taking advantage of their experience, tech know-how, and resources to provide other “small” companies the service of bots. And these giants are always the same in the tech world: Google, Facebook, Amazon, Microsoft, and so on. Zhang affirms (2020) that, in 2019, Amazon Alexa had more than 100,000 programs and Facebook Messenger has more than 300,000 active chatbots, and even the World Health Organization has deployed a chatbot in Facebook Messenger, in order to avoid and combat the misinformation that is being spread about the current COVID-19 pandemic. The truth is that these giants that have open platforms and frameworks for chatbot development are boosting the chatbots and artificial intelligence market to a whole new level.

These larger companies already found the chatbot standard model that fits the majority of the other companies, and they use essentially 2 different variables: Intents and Context. As Rahman said (2017), Intents create relationships between what the user said and what action should be taken, and context is used as the string values which will allow the system to differentiate between what the user is requesting, and what will the bot answer. And this is pretty much the essence of a successful bot, determine what is the main intention of the user, what is he or she asking to the system, understand and read those questions under a specific context (it can be product categories if we are in an online shop, it can be related books or contents if we are on a learning system, etc), and reply the most accurate answer and guidance for the user to accomplish their goal, which can be anything: automate a task, approve a request, or simply see some information about the closest grocery store. Chatbots are ready to provide a solution for all these different needs.

Building a chatbot from scratch might be a very hard and costly goal even for software development teams and companies. The complexity around the intelligence that supports it, the integration of technologies and concepts like Natural Language Processing, makes it much more complex than the typical code development for software features. But luckily, there are in the market, available frameworks that support the development of new chatbots, by facilitating and providing the necessary tools for a solid basis.

Chatbots.org is a web resource that lists over 1,350 chatbot platforms used around the world, for many different categories and desired end-goals (at https://www.chatbots.org/). For each category and chatbot overall end usage, like real state chatbots, AI, Customer Support, Enterprise Chatbots, or even Chatbot Builders, there are different types of chatbot platforms available for all tastes and purposes.

Each has its pros and cons, and choosing the right one to build the chatbot on top might not be easy. There are a set of questions that the builder should consider before choosing the right platform: What kind of tools/technologies will the chatbot need to have (NLP, NLU, machine learning, automating tasks, etc)? What price are we willing to invest in it, if any? Do we have any developer resources or we will need to choose no-code platforms? Among many other different questions, this analysis will help to narrow the available solutions and choose the best one to support the implementation of new chatbots.

2.2.5.2. Dialogflow

One of the most trendy and powerful chatbots in the market is DialogFlow, from Google. Acquired to API.ai in 2016, this platform, as Vaz (2019) mentions, is very powerful due to the usage of Pre-built agents (knowledge base and structured data ready to be used, such as grammar, common verbs, context types, currency convertors, between others) and features like Small Talk (customizable modules like “About the agent”, “Emotions”, that give life to the chatbot).

The DialogFlow platform has on the core of its process a set of different agents or stakeholders that work together as a group: User, Platform, Agent, Intent, and, in some cases, the Fulfillment. According to Valente (2020), the user is the human being that writes or speaks to the bot, the Platform, in this case, is the DialogFlow, the Agent is responsible for integrating the NLP, to clarify the message and decide on an action, the Intent is responsible for categorizing the user intention, so it can prepare for a proper answer-back. For cases where purely static responses are not enough, Fulfillment is required to handle dynamic intents and responses.

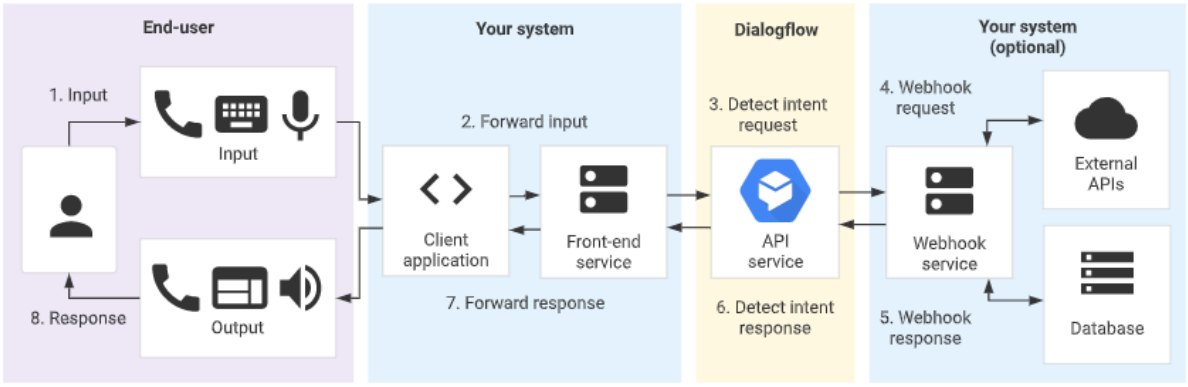


FIGURE 6 – DIALOGFLOW WORKFLOW
SOURCE: DIALOGFLOW CX DOCUMENTATION (2020)

As we can see in Figure 6, the Dialogflow platform starts on a user's interaction, by voice or typing, on an existing app/software/website, forwards the input to the agent Dialogflow, which detects the intent on the user request. When simple and the intent matches a parameter or a static answer, the response is produced and sent back to the system, but when it is not, it needs to call a webhook, which will search for the answer on an external API or in a different database. The webhook service collects the needed information, prepares and builds the response, which will be sent back to Dialogflow, and this agent will send an intent response to the system again. The system will show the response, in audio or text, to the end-user.

All these pieces combined give form to the DialogFlow chatbot process. One different advantage of the usage of this framework is that it is quite configurable. Alves states (2019) that the Match Mode, Machine Learning Threshold, Training Set, and Validation Set, are some of the key configurations that provide flexibility to the usage of the Bot, by defining if the technology used will be only ML or a combination between ML and rules, the possibility to add, remove, or repeat phrases to the agent, so it can learn more accurately the average goal of the bot.

2.2.5.3. LUIS

Another trendy AI Chatbot Platform is LUIS (Language Understanding Intelligent Service), a machine learning-based system from Microsoft, that allows companies to build chatbots with natural language into their apps and IoT devices. Microsoft LUIS is an available platform within Microsoft Azure, which can be a deciding factor for companies that already have their systems and databases built into it.

The LUIS workflow is similar to what we have seen on Dialogflow, as Bavishi (2019) states, LUIS detects the user's query in terms of intents and entities, and sends back the response to the service code where those queries are examined based on the confidence score. The utterances are examined, labeled, re-trained, the chatbot knowledge grows with this active deep learning capability before sending back the response to the user.

Microsoft LUIS is a tool capable of understanding natural language and transform it into customizable intents and entities. Those, according to Silva (2018), are passed as expressions, which is the first triage in building the most accurate response. Intents can be seen as the desire from the user

(intention) and entities are the relevant data that will help define the context, like the recognition of the user's location for suggesting the closest pharmacy.

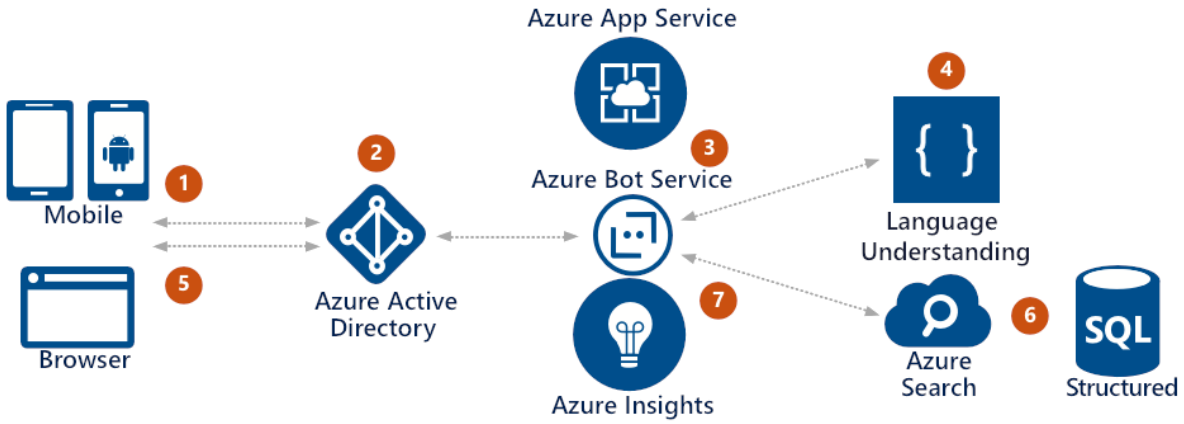


FIGURE 7 – LUIS WORKFLOW

SOURCE: MICROSOFT AZURE LUIS DOCUMENTATION (2020)

As seen in Figure 7, the logic behind the LUIS chatbot process starts with the user, by interaction, the Azure Bot Service receive the expressions (intents and entities), work with Language Understanding and QnA Maker (if the answer is patterned), or search relevant information to retrieve the return answer. The major difference from Dialogflow, where the intents and actions are mapped, is that, as Boger (2018) says, LUIS leave the execution part up to the developer, where he can decide if the action taken from a request is in natural language or a real action, like turning on a television.

2.2.5.4. IBM Watson

IBM Watson, as the previously described chatbot enablers, is a system capable of communicating with users and answer questions in natural language, developed by the tech giant IBM. The workflow is pretty similar: Receiving users' input, processing, and generate the response. One of the pros behind Watson chatbot, is its incredible NLP capacity, with a question-answer-based architecture. As Cahn (2017) affirms, on processing the relevant answers, IBM Watson uses NLP techniques that include shallow parsing, deep parsing, semantic role labeling, conference relations, named-entity recognition, and these techniques involve transforming any input sentence into tokenization and segmentation.

Watson's workflow bases a significant part of its process by using a lot of different techniques to treat and manage the received information. This capacity allows it to generate a set of different hypotheses, that are validated against the data-sources and ranked according to their importance and relation to the provided answer, as we can see in Figure 8.

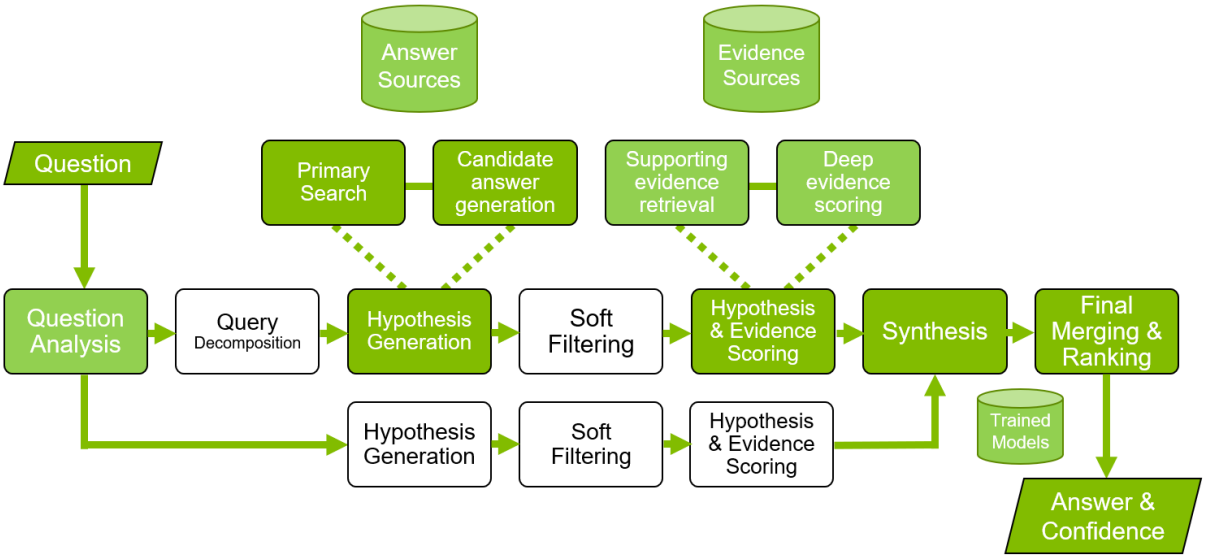


FIGURE 8 – IBM WATSON WORKFLOW

SOURCE: ADAPTED FROM WLODEK ZADROZNY (2015)

If the first phase (query analyzing) is a significant part of Watson's procedure, the second one is not less relevant. According to Cahn (2017), it uses searching and generation techniques, text search engines, knowledge base search, document search, and all these processes together contribute to the generation of relevant hypotheses. After hypotheses are generated, those will be ranked and scored, so the given response has the needed confidence to be accurate for the end-user.

There are hundreds of chatbot builders out there in the market, each one has its purpose, end-goals, pros, and cons. From Ecommerce Chatbots to Real Estate Chatbots, Enterprise Chatbots, SMS, and Marketing Bots, there are available bot platforms for every use case and industry type. ActiveChat.ai, SnatchBot, Pandorabots, Flow XO, Chatfuel, are just some other examples of existing chatbot platforms. This last one, Chatfuel, is known for its simplicity on configuration since it is a full non-programming chatbot builder. As Nimavat (2017) affirms, the most attractive point of it is that is extremely simple to build, a rule-based chatbot with its drag and drop interface, and with the capacity of integration with external services such as email and IFTTT. However, due to its non-code flexibility, it is quite rigid regarding the conversation flows that companies might want to build with it.

2.3. SOFTWARE REQUIREMENTS

2.3.1. Concepts

Software evolution can be materialized in the evolution of its system architecture, user experience & and user interface, but also the evolution of the emerging needs of the business requirements. The evolution process of the software architecture can be defined as a set of life cycle steps: development, project, building, and maintaining, which in each step, new expectations are generated to satisfy customer's needs (Pontes, 2012).

A software requirement is generally driven by a business need or an innovation purpose. In the software industry, once a requirement is ready and planned can originate a work-item ready to go to a backlog of a developer team. As Pedroso (2015) said, we can define a software requirement as a property that aims to solve a problem in the world and those can be functional requirements or non-functional requirements.

The difference between both is quite obvious. A functional requirement can be seen as a new feature, something that might solve a pain in a company process – approve an expense, generate a specific report, etc. A non-functional requirement tends to represent other problems not directly related to the usage of software but instead related to topics like performance or user experience.

The requirements should represent the solution, technical and functional, that would be addressed as a software feature. According to Silva (2012), the requirements represent the capacity and the conditions that the system, in a high-level solution should attend. The requirements play a highly important role in the software development process.

All those requirements and process necessities should be discussed and analyzed between a product development team and the feature stakeholders. Those stakeholders can be internal, anyone with any role inside the company, or external, like clients, which might have inputs into what the real need is and what should be done to address properly that need.

Pedroso (2015) affirms that any software product should have a set of requirements that address a process need and serve as a guide for the development. Those should be the basis of a product feature development. He also states that those requirements should be clear and transparent between the stakeholders and the development team, through a process and a strategy that could ensure quality and validation of those requirements.

Effective communication between the interested stakeholders and the development team usually is ensured by a product business analyst, a project manager, or even sometimes a product owner. Either one that has that responsibility has to ensure the business requirements are well represented and can later be addressed into small work-items that will live on the product development team backlog.

Chatbot development is no exception in the way they are built, and it is important to state the functional and non-functional requirements, according to the intended end-goal and usage of the bot, before starting any active development on it. As Silva (2018) analyzed in his article, functional requirements of tech giants bots (Amazon, Facebook, and Microsoft) can be, for example, user identity recognition and context understanding. From a different perspective, non-functional

requirements can be things like the ease of interaction, the confidence degree in the results, or even the bot's performance.

On a different example, Valente (2020), on building an analysis for its development project, defined, with the stakeholders, that the functional requirements would be things like the chatbot being capable of providing relevant information to solve problems with the usage of bikes, provide the assistance contact when need it or even storage the conversation history for training the bot in the future. The non-functional ones are related to the perception of the brand, the usability of it, the performance, among others. Within this differentiation, requirements can also vary from its structure, being categorized in usability requirements (for example, with potential one-click integration with multiple platforms), UX & UI design requirements (the look and feel), technical requirements (NPL technology support, for example), and others that might fit to deserve its own category.

The functional requirements tend to associate with the effective expected functionality from the bot, its capacity to receive the user’s inputs (and how it knows which user is providing it), analyze it, by understanding the relevant context of the conversation/questions, and provide the most accurate result and output. Non-functional ones are most abstract in terms of the end-usage of it, but no less important to the success of the bot.

2.3.2. Requirements Analysis

It is important to think of software as a full life cycle, with the same amount of importance for each of the development and implementation phases. From the development and deployment initial status, the software will pass the adaptation phasis until reaching its full potential. According to González Muñoz et al. (2015), after the early period, the "capabilities of the software should increase with time, until reaching eventually its full potential, providing a reliable performance and meeting the business requirements". Also, "the capabilities of an application may be changing through time, due to external conditions, obsolescence risk or the request of new features from the business", which represents and justify the new approaches that software companies are using for its development cycles: Scrum and Agile methodologies.

Agile development makes use of an artifact called Backlog. A Product Backlog is a "bucket" of different split work-items, that together represent the minimum viable product to achieve a releasable feature. "A prioritized set of user stories is designated as the "product backlog" at the beginning of the first sprint, and the product backlog is updated after each sprint as new requirements are identified" (Bolloju et al. 2017).

FIGURE 9 – PROCESS FOR USER REQUIREMENTS ANALYSIS
SOURCE: ADAPTED FROM MARTIN MAGUIRE (2002)

The Requirements Analysis is not a new trendy scientific process and its ramifications are quite simplistic. As we can see from Figure 9, it can be defined by a process that starts in Information Gathering, passing on needs identification, evaluation, and culminating in the requirements creation and specification.

As Maguire (2002) says, the analysis process starts with collecting information and inputs from relevant stakeholders, usually, users or SME's that can influence or be impacted by the system. This is not always an easy task and requires communication, expertise, and know-how to make the stakeholders express loud and clearly what is the current pain or enhancement need in the software, and once we get to this point, we are in the needs identification phase already. Also Valente (2020), in her dissertation, says that all the requirements for its chatbot development project were gathered in meetings and focus groups with the stakeholders, as viable criteria for fulfilling the needs and provide better support and service for its customers.

Envisioning and Evaluation is the part of the process where we should know already what are we supposed to build, theoretically. It may roll-back to the user need's identification if something needs to be clarified or adapted to fit the intended goal. Mylopoulos (2001) suggests that this evaluation can be done through a selection of leaf goals, that collectively satisfy all given goals.

This iteration that is visible in the picture from the user needs identification and evaluation, is something common in modern software development approaches, not just in the requirement analysis phase, but also during the development cycles. These approaches tend to lead to more accurate product development and customer happiness. A good example is explained in Kidwai's (2020) paper, where he states that, in the Diagnostic Chatbot development proposal, in regular utilization of CAs, the client satisfaction can extend well beyond the requirements to a more socially fun interaction. When development and analysis teams can go behind what is expected and can model the requirements to a better end-goal, things tend to work better and the result can be better than it was predicted.

The entire flow will culminate in identifying and writing up the business requirement, which is when the analysis process reaches its end. As Emam (2000) says, specifying software requirements is when we determine and analyze requirements of the software components and document them in a software requirement specification. Is the moment where we have enough material to start building the backlog with user stories to fulfill the demand of those requirements.

2.3.3. Requirements Management

Requirements represent the general concept behind a need, and, after its analysis, it becomes critical to manage and follow the life-cycle from the is identification to the actual feature. Elicitation and specification of requirements representing the functionality to be incorporated into an information system to be developed is a challenging task (Bolloju, 2017). Specifically, the management of requirements can be represented and handled in a couple of steps, even that there is no scientific and mandatory process for doing that. According to Beatty (2013), requirement management includes all activities that maintain the integrity, accuracy, and currency of requirements agreements throughout the process.

This management process can be split into 3 major phases, as Parviainen (2003) said:

1. Requirements Identification;
2. Requirements Traceability;
3. Requirements Validation and Planning.

Phase number 1, relies mostly on the identification of those business needs and gaps and it is the most important phase in what relates to stakeholders' communication and engagement. Also as Parviainen (2003) said, the Requirements identification practices focus on the assignment of a unique identifier for each requirement. According to Beatty (2013), this identification process should state who has the authority to adjust those requirements through the entire process.

The second phase of the project relies on the traceability for those requirements. How can companies track and continuously follow the major pains and gains of the gap and feature solution. As Gotel (1995) affirms, this step refers to the ability to describe and follow the entire life-cycle of a requirement, including the interactions, changes, and relations that may exist with other development artifacts. The last step is pure validation and final iterations to deliver the business requirements into split work-items to be addressed by a product development team, planned and estimated effort for each of those, according to sum software development methodologies.

Aligned with this framework of phases, Filho (2000), affirms that to properly manage the requirements in each of its phases, 3 activities must occur to ensure: the requirements should suffer a revision from the stakeholders and the development teams, the requirements must be used as the basis of planning for each individual work-item, and the if the requirements are changed during the project, those changes should be validated by the interest groups of stakeholders. These activities ensure that the project is well executed and everyone involved is on the same page regarding what is being built.

Passing from defined requirements into actual features, we enter the field of software development. A lot of books and studies talk about different software development methodologies and, given the truth that requirements are becoming more challenging over time, traditional methodologies are becoming deprecated. As Pestana (2019) says, the traditional method of project management, which is Waterfall, has led to ineffective developments, and new methodologies, like Agile, are becoming more appropriate to respond to complex and dynamic requirements.

Agile philosophy bases its principles on building software fast, more accurate, more testable, and essentially in shorter periods. As Leau (2012) affirms, Agile development is based on the idea of incremental and iterative development, in which the phases within a development life cycle are revisited over and over again. This methodology gains fans in the entire software development industry, especially due to its capacity for adaptation and early and constant customer involvement.

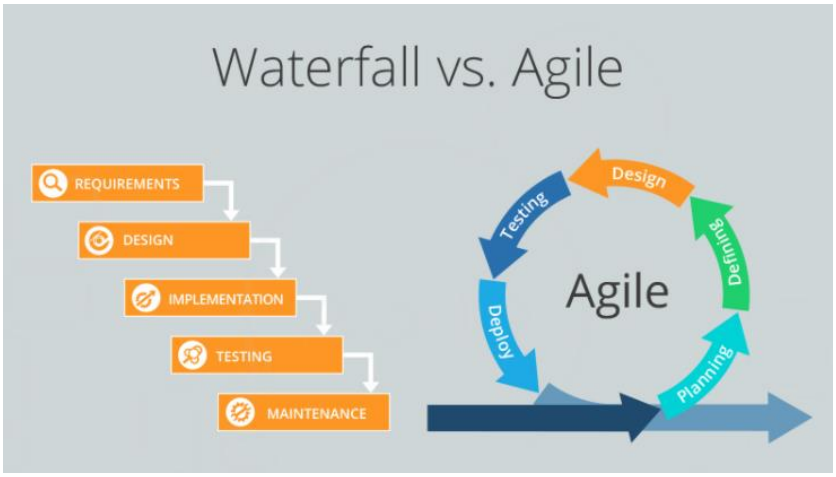


FIGURE 10 – WATERFALL VS AGILE METHODOLOGY
SOURCE: DIGITÉ BLOG (2019)

As we can see in Figure 10, one of the main principles of Agile methodologies relies on iterative work. Constantly asking for feedback, re-designing, adapt, and build faster, doing more deliveries rather than the big largest ones. Dias (2010) affirms that ASD not just offers the structure and orientation to avoid projects becoming chaotic, but also encourages iterative and incremental development as part of its philosophy. This more modern approach of software development allows constant improvement of software features and delivers more value to the customers faster, keeping the creativity alive without the typical pressure on building major releases with big features.

3. METHODOLOGY

The chosen methodology for the study in this dissertation proposal is the DSR - Design Science Research - for being the most appropriate to the problem studied and the built prototype in case.

3.1. DESIGN SCIENCE RESEARCH

The Design Science Research can be considered as a methodology appropriated for approaching and validating features or systems. It can be defined as a methodology product-oriented. Rothenberger (2008) states that Design Science Research creates and evaluates product features and IT artifacts with the primary goal of solving organizational and real-world problems.

The DSR, as the "name" states, is important in between two major fields: the design and the actual research itself. As Petter (2019) affirms, the Design Science Research is a set of synthetic and analytical techniques for performing research, and it typically can follow-up on the creation of a design theory. From problem definition to final evaluation of the built prototype, the DSR approach seems to fit well into the goals of building the chatbot model to support the expatriation of global mobility employees.

Since the purpose and overall goals of this dissertation are to provide a detailed research, a set of backlog requirements, as well as built a draft prototype that can support better the author's idea, DSR phasis fit perfectly within what we are trying to achieve.

To understand and define a DSRM process for a new software feature, the following Design Science Research flowchart, as an adaption from the article of Rothenberger (2008), can represent how this development lifecycle could be structured:

FIGURE 11 - ADAPTED DESIGN SCIENCE RESEARCH MODEL
SOURCE: ADAPTATION OF ROTHENBERGER (2008)

The DSR lifecycle places its 1st step on the Problem Identification & Motivation, the very first moment where the problem is identified and studied, either by a customer or either by one or a group of stakeholders. In its essence, as Henver (2010) said, defines the specific research problem and justifies the value for a solution. Each gap should be communicated effectively and the motivation about finding and thinking already on the best solution that will feed the need. The problems and use cases should be identified in order to build more precise and detailed requirements.

As a 2nd step of the process, the objectives and overall goals can be defined, and the proposed potential solutions should address partially or entirely the problems identified in the prior step.

In the 3rd phase, Requirements Gathering and Definition, Design & Develop, all the requirements can be listed as the high-level backlog of user stories to be worked on. An MVP – Minimum Viable Product – method can be stated and defined for the chatbot to have defined its minimal requirements to be considered as a "shippable" product. After it, the product feature itself takes the

lead. The proposed solution in steps 1 and 2 should now be built to deliver added value for the product and its customers. In the matter of this dissertation, the prototype should be constructed and presented in a way that it can fit into existing global mobility software solutions. In real-world developments, this work is usually delivered to a product development team (that can be composed of multiple roles and elements: developers, quality assurance, business analyst, scrum master, UX designer, software architect, among others) that will have the goal of making it possible. As Boger (2018) affirms, the gathered goals and requirements are therefore transformed into software features that can be implemented.

The 4th phase is usually composed of a set of demonstrations and final evaluation/validation of the built feature, often by stakeholders or a group of participants, to collect feedback and drive the first usage or showcase of the built artifact. At this phase, the chatbot prototype should fulfill the needs of the previously defined requirements and should work accordingly to what was agreed between all the involved entities. According to Henver (2010), this is the moment where we observe and measure how well the artifact supports a solution to the problem. The evaluation phase is important because it's where the built product will be used and tested by its target audience, compared against its original goals, and analyzed within the relevant metrics.

The 5th phase will comprehend an overall analysis of what was built and the definition of potential future enhancements that can be included to make the software feature more complete and adopted by customers and end-users.

3.2. Design Science Research Strategy

From the entire process described on the bellow topic, the problem identification results in a deeper analysis through the specific need and problem, as well as the potential solutions to fix it and start having the work-items to be done on a pre-ready stage. It is important to state that, not in the dissertation process but in real-world scenarios, each of the stages within the DSR scientific process are an iterative process. From the evaluation and conclusions, for example, it is quite often to revisit the development stage or even the objectives definition one.

The upcoming topics will specify how the DSR was applied in the context of this dissertation and how each stage was addressed to apply the suggested framework:

1. Problem Identification and Motivation: the first stage refers to the problem definition and the goals defined as part of the project. Chapter 1 of the dissertation specifies the problem background and the goals behind the creation of the chatbot for supporting global mobility employees.

2. Objectives Definition: similar to the first bullet, the objectives of the dissertation and the artifacts built are justified in chapter 1 (specifically 1.3) and fully supported with the analysis and research made in the Literature Review (chapter 2). With the overall goals in mind of having a chatbot prototype working against international employees' mobility scenarios, the topics studied for supporting the objectives were focused on the Global Mobility Industry, chatbot history, and characteristics, as well as tools and techniques supported in the requirements gathering and backlog management.

3. Requirements Gathering, Design & Development: The development stage of the artifacts is detailed within the chapter 4 of the dissertation, and will include not just the step-by-step on how the prototype will be built, but also the backlog list of requirements that the chatbot should meet as desired feature goals. The built prototype should work against the defined objectives and assumptions.

4. Demonstration & Evaluation: After the design and development phase is complete, the chatbot prototype built should be submitted to an evaluation. This evaluation will be done by a session of user testing, where the participants will have the chance to play and test the bot, followed by a quantitive and qualitative interview, to collect as much feedback as possible on the bot's usage and potential future enhancements. The testing session and interview details are also specified in chapter 4.5. As Pries-Heje (2008) states, evaluation regards the development of criteria, potential iterations, and the assessment of the artifact's performance in comparison to the previous acceptance criteria defined for each user story.

5. Conclusions, Limitations & Future work: Last but not least, after the evaluation stage is completed, a reflection of the developed work and artifacts built should take place. On this last stage of the framework, we should not just make an overview of the work completed, but also state limitations found during the process, as well as defining suggestions for potential future enhancements. This stage is detailed in chapter 5.

4. SOLUTION DESIGN & PROPOSAL

4.1. ASSUMPTIONS

As previously studied in the Literature Review chapter, the experience of living abroad for work, being an active member of the global mobility workforce, comprehends intrinsically a set of different challenges for both companies and employees, for the different phases of the expatriation experience: arrival, staying, and departure phase.

The opportunities associated with working abroad are desired by people who want to progress in their careers, improving their financial stability, and overall experiencing new cultures and ways of working. The chatbot prototype we are going to build as part of this dissertation will be essentially focused on the staying phase of the expatriation experience, working as a helpful virtual agent for the needs during the assignment experience.

With the assumption that the Bot will be focused on the staying phase, for the moment when the employee is already in place in the host country, it should be a communicative assistant that will be the bridge between the expatriate employee and the company that he represents, focusing on:

- Managing Requests & Expenses: the chatbot should allow the employee to manage the needed requests and the international submitted expenses, by providing the information about the status of both and helping the employee on submitting the created drafts, so there is no need on opening the software system and perform a lot of clicks for it;
- Managing Tasks: the chatbot needs to be prepared for answering the employee about upcoming tasks, and mark those as completed when needed;
- Budget Bank Accounts: for the cases where the employee has a specific budget for their international experience, the bot should be ready to answer on how the budget is being spent and how much is left in certain accounts;
- Calendar Events: the bot should help the employee with upcoming events, as well as working as a personal assistant to add and schedule more;
- Expatriation Benefits: the bot should be able to connect with the expatriation database and show the employee what benefits he has selected or has available as part of their assignment;
- Profile Information: the bot should store and be prepared for talking with the employee about their profile information (email, phone, emergency contacts, relevant documents to download, etc).

Regarding the Bot specificities, and also from what was studied in the Literature Review, the Enterprise level Chatbot should meet the following characteristics: working a service provided agent, with conversational based goals, and having an intelligent system on its processing model, so it can properly access, update and retrieve data, providing accurate answers for its users.

All the tools selected to achieve these goals are justified in the next chapter.

4.2. TOOLS JUSTIFICATION

To support the chatbot prototype development, a pre-analysis into 3 levels should be made, to ensure we get an appropriate and reliable bot for the international mobility experience. This analysis will include 3 specific tools definition:

1. Chatbot builder platform to be used;
2. Database structure and model tool;
3. Notebook code platform for the more complex queries and actions to be performed by the bot.

Each of the above levels should be able to communicate with each other to ensure the chatbot process will work as expected from the start (users interaction) to the end (chatbot response).

Chatbot Platform: Dialogflow

The candidates for the chosen solution were the ones previously highlighted in chapter 2.2.5. Table 2 will help us illustrate and weigh on the comparison for the most appropriate platform to choose for being the core of our chatbot:

	Dialogflow	amazon LEX	IBM Watson	wit.ai	Azure Bot Service
Channels	Voice, Text	Voice, Text	Voice, Text	Voice, Text	Voice, Text
Ease of Use	Dialogflow provides a web interface to create bots which makes it fairly simple for anyone to create basic bots.	Lex provides a web interface to create and launch bots. It runs on the same machine learning engine as Alexa.	IBM Watson Assistant provides a good and easy to navigate user interface. You will get video tutorials and ready to use samples to quickly get started.	Wit.ai provides UI to setup intents and test it out. Wit is very developer centric and non-techies will have a hard time understanding it.	Azure bot service is used for creating intelligent bots. The web interface is available to create and publish bots.
Integrations	• Google Assistant • Slack • Viber • Facebook Messenger • Twitter • Twilio etc...	• SMS • Slack • Facebook Messenger • Kik • Twilio	• Voice Agent • Slack • Facebook Messenger • Wordpress • Custom APIs etc...	No direct integration, HTTP APIs and libraries available for: • Node JS • Python • Ruby • Go	• Facebook Messenger • Slack • Skype • Kik • Telegram • Twilio etc...
Web and Mobile Integrations	• Codeless Integration with Kommunicate • Basic in-built web integration	• Basic chat UI provided for testing on the website	• Basic chat UI for websites	• Not available, you need to design your own	• Open source web chat widget available in Github
Languages	Supports 20+ languages including English, Spanish, Portuguese, French, Hindi, Chinese etc.	Currently, only US English is supported	Supports 10+ languages (in BETA) including English, Spanish, Japanese, Italian, Chinese etc.	Supports 50+ national and regional languages including English, Spanish, Afrikaans etc.	Supports multiple languages such as English, French, German, Spanish, etc.
Cost	• Free standard plan (good enough for small-medium businesses) • Enterprise Version: $0.002/request	• For the first year, 10k text requests and 5k speech requests/month are free. • Post that it is billed per request basis • Voice: $0.004/request • Text: $0.00075/request	• Free plan comes with 10k messages/month and a few other restrictions • Paid plans start from $0.0025/message	• Wit is free for both personal and commercial use	• Azure Bot Service is free for up to 10k messages per month • Paid plans start from $0.5 for 1000 messages • Additional charges for consuming other services such as Azure functions and Azure web app

TABLE 2 – CHATBOT PLATFORMS COMPARISON

SOURCE: DEVASHISH MAMGAIN (2019)

From the research made on its usability and scalability for the different platforms in chapter 2.2.5, and comparing it with the available alternatives pros and cons in Table 2, Dialogflow seems to be an excellent choice that fits the needs for the chatbot prototype development:

1. It provides a user-friendly interface for the chatbot creation (for anyone being able to build the chatbot basics with no-code);
2. It can integrate with most apps and different platforms for scalability (Slack, FB Messenger, Websites, Apps, etc);
3. Integration with external services, such as external databases and code notebooks – critical for the chatbot prototype to work against external data and functionalities;
4. It's free on a standard plan for it to start growing.

Considering all the above factors, the chosen platform for the chatbot prototype development is **Dialogflow**, from Google. For its process simplicity, based on a model where the user writes something, the agent looks at all the existing intents and matches it with the closest one, also its user-friendly builder tool, the intrinsic usage of NLP for interpreting the user inputs, this trendy chatbot enabler fits perfectly with the objectives of the prototype.

The Dialogflow structure is based on its Agent, Intents, Entities, Context, and Fulfillment, and each of those pieces will be defined as part of the Prototype Development chapter.

Database Structure - Airtable

For the chatbot prototype to interact with data, a new testing source to store this data and allow interactions should be built. Despite the simplest way should be building a spreadsheet with all the columns and relevant fields, a real updatable relational database is what will make the prototype more dynamic and work with simulated real case examples, such as mark a task as complete, or get the date for the newest upcoming event.

This is an important consideration to make before the prototype development, what database model and structure will the chatbot interact with. Given the fact that we will not implement the chatbot in an existing software or website, for prototyping purposes, we will build a testing database using the **Airtable** platform.

Airtable is another user-friendly online tool that allows users to create and share relational databases. This is also one advantage against the usage of a simple excel spreadsheet because, this database platform stores, not just the data but also the relationships between the data (Airtable Support Documentation, 2020).

The overall goal of the usage of this data model source is for replicating real international experience scenarios, by building specific tables, specific fields, and database relationships. The created database will have common tables and stored information, often used in global mobility softwares, and will be populated with testing records, for the different tables, to ensure the chatbot prototype

functionality works correctly. All the created tables and fields (in the testing database called "MovingExperience") can be found in chapter 4.4.2.

Notebook Code Platform – Runkit

In the normal chatbot workflow, there are specific questions from users, where the chatbot pre-defined configurations are not enough for finding our building out the most accurate and relevant answer. It is true that by default, the agent responds to a matched intent with a static response (Dialogflow CX Documentation, 2020). However, there are times, where the bot needs to provide a more dynamic and complex answer, by calling an external service, database, or API.

For these particular scenarios, Dialogflow makes usage of the Fulfillment feature, to provide more dynamic responses, actions, helping on querying and updating an existing database. When the desired response or action is not a pre-defined static one, Fulfillment uses written code that allows communication with a back-end service and database interaction via Webhook.

FIGURE 12 – INTENT WITH WEBHOOK CALL ENABLED
SOURCE: AUTHOR (2020)

The Figure 12 illustrates the configuration of an Intent, in Dialogflow, which has the webhook feature enabled. As many intents have the webhook call enable, those can make usage of the Fulfillment feature in Dialogflow. This one allows the chatbot developer to connect their chatbot with a webhook service, that will be responsible for communicate with an external API or Database. And this webhook is written in the notebook code platform needed to communicate as we expect with the Airtable database.

For those cases and the prototype development purpose, the **Runkit**, an interactive javascript notebook, is the selected tool to store and provide the Webhook code from the bot. The main reasons for choosing this platform are, first, because it's free, and second, because it's very flexible in things to build, such as giving the possibility to create any API without worrying about its service or configuration. Will be the bridge connecting the Chatbot API in Dialogflow with the Moving Experience Database API in Airtable.

4.3. BACKLOG DEVELOPMENT

Part of this dissertation's goals is to provide a detailed backlog of user stories, that can result in a powerful artifact for the future development of the Global Mobility Chatbot.

To properly categorize the business requirements and their respective user stories, the following are categorized in Personal & Behavioral Questions, Feature Database Questions, and Feature Database Update Actions.

For the specification of each User Story, the template “As <type of user>, I want <capacity>, so that <business value>” (Cohn, 2005), is the chosen story model, since it’s a convention in the software development world, especially in agile development teams.

BACKLOG REQUIREMENTS		
Category	Requirement Title	Requirement Description
Personal & Behavioral Questions	Chatbot introducing feature	As a chatbot user, I want the chatbot to introduce itself and explain what it does, so that I will narrow better what to ask.
	Chatbot reply to personal questions	As a chatbot user, I want the chatbot to answer personal questions about it and lifestyle, so that I will feel it more like a "real" experience.
	Chatbot goodbyes the user	As a chatbot user, I want the chatbot to say goodbye, so that I will know that I have “ended” the feature usage.
Feature Database Questions	Banking Related Information (IBAN, Amount, type, etc)	As a chatbot user, I want to ask questions about my bank accounts, so that I will know relevant information (IBAN, amount, etc) from them.
	User Emergency Contacts	As a chatbot user, I want to ask for information regarding my emergency contacts, so that I can use those when needed.
	User Moving Requests	As a chatbot user, I want to know if my requests were approved by the managers, so that I can know and count on that info immediately.
	Employee Expenses	As a chatbot user, I want to know the status of my submitted expenses, so that I know if I will receive any money for those or not.
	User Tasks	As a chatbot user, I want to know if tasks are completed, and their due date, so that I can properly organize my agenda with them.

	Upcoming Events	As a chatbot user, I want to the upcoming events dates and details, so that I can make sure I will not forget those.
	Currency Conversion	As a chatbot user, I want to convert money to my host country currency, so that I will know how much things cost there.
Feature Database Update Actions	Update Profile Information	As a chatbot user, I want to update my email, phone number, and marital status, so that I can maintain my information up to date.
	Inactivate or Activate Bank Accounts	As a chatbot user, I want to inactivate my bank accounts, so that I can inactivate the old ones I no longer use.
	Update Emergency Contacts	As a chatbot user, I want to update the email and phone number of my contacts, so that I can maintain that information up to date.
	Complete Tasks	As a chatbot user, I want to give tasks as completed, so that I can end the ones I have already accomplished.

TABLE 3 – BACKLOG REQUIREMENTS FOR THE CHATBOT DEVELOPMENT
SOURCE: AUTHOR

The above table details a high-level backlog of business requirements and their associated user stories, that the global mobility chatbot must support to be considered complete and valuable.

The categories are intrinsically implied with the core of its action type:

- **Personal & Behavioral Questions**: The group of business requirements that are tied with the chatbot's personality, a set of pre-configured static responses about the chatbot characteristics and habits. No Fulfillment required;

- **Feature Database Questions**: This group is based on requirements about the user being able to enquire its mobility database. From the requirements, we see that different database tables will be considered: Requests, Bank Account, Expenses, Events, and so on. For connecting with the external Airtable service, those requirements will need to be supported with the usage of fulfillment and webhook code;

- **Feature Database Update Actions:** Group of requirements similar to the above one, but with an implicit update of the database records, on things like making an account inactive, or updating the personal address. Those will also require Fulfilment and webhook code.

4.4. PROTOTYPE DEVELOPMENT

4.4.1. Agent

The first component to consider when building a Chatbot in Dialogflow is the Agent. The Agent in its essence is the chatbot application. Is the high-level component that triggers something in a user utterance, by collecting what is being said, mapping it to an intent, and taking proper action on it, providing the final response to the user.

For the purpose of this dissertation, we will call the agent “Green”, for having no associated gender, and we will use as its image this colored robot in a computer, ready to help the human. The icon was downloaded from the Flaticon free library (https://www.flaticon.com/), but for future application on a real global mobility software, it should and can be adapted to each brand’s image and specifications.

The first configurations that should be done within the Agent, are Agent Name, Description, and Defaulted Time Zone. The option “Log interactions to Dialogflow” was also enabled, for making the chatbot platform collect and store each user query and interactions. This will help later on automatically training the bot with the usage of history, making it more accurate and smart after each user conversation.

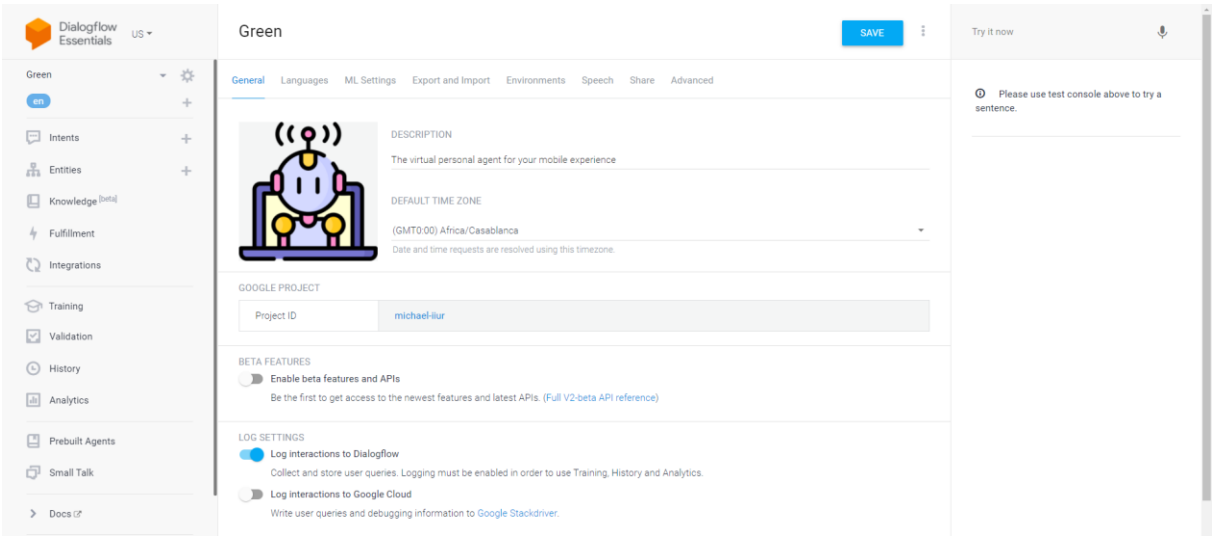


FIGURE 13 - DIALOGFLOW AGENT CREATION
SOURCE: AUTHOR

As we can see from Figure 13, the agent has as its description “The virtual personal agent for your mobile experience”, representing the purpose of the chatbot in the context of an international move or assignment. The defined timezone is the one that refers to the country of the author (GMT0:00).

There are other configurations, regarding the supported languages, ML settings for better support on speech and spelling automation, and also advanced features like using sentiment analysis for getting a sentiment score for each user query and interaction (only available in the Enterprise Edition), but for now, we will keep it simple with the configurations added above.

4.4.2. Database Structure

To support the chatbot prototype development accurately, a testing database should be set up, to supply the needed information for chatbot users. Airtable is the chosen platform to support this interactive database for the bot because it is a flexible tool that can connect the information and help people build their creative prototypes on top.

A new database was set up in the Airtable platform with the name "**MovingExperience**":

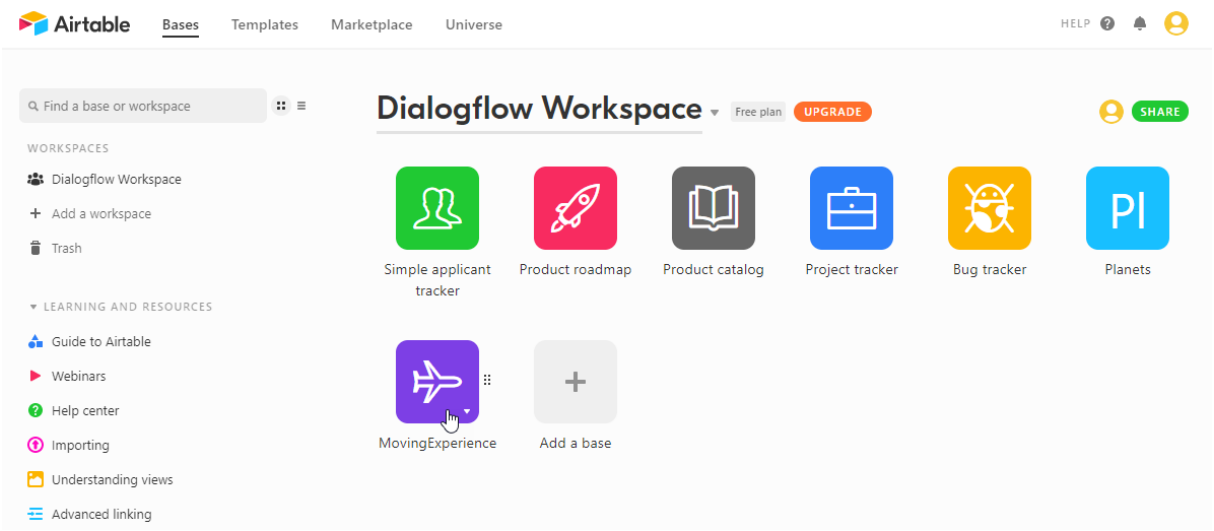


FIGURE 14 – MOVINGEXPERIENCE DATABASE IN AIRTABLE
SOURCE: AUTHOR (FROM AIRTABLE PLATFORM)

This database has as its primary objective support the data that will be used in the conversations with the expatriate employee chatbot user.

For the reality of a moving experience to a different country, based on the research made in the Literature Review, the following tables will be created and populated with non-real testing data, to support some potential real relocation scenarios:

User Profile

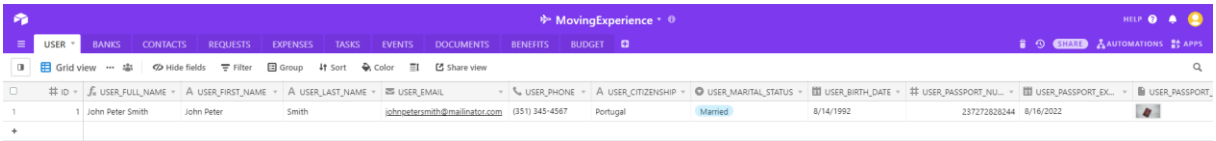


TABLE 4 – USER PROFILE TABLE
SOURCE: AUTHOR (FROM AIRTABLE PLATFORM)

The User Profile table has some personal & work information about the logged user, such as Name, Email, Marital Status, and also fields directly related to a moving experience, such as Passport Information and Citizenship.

Emergency Contacts

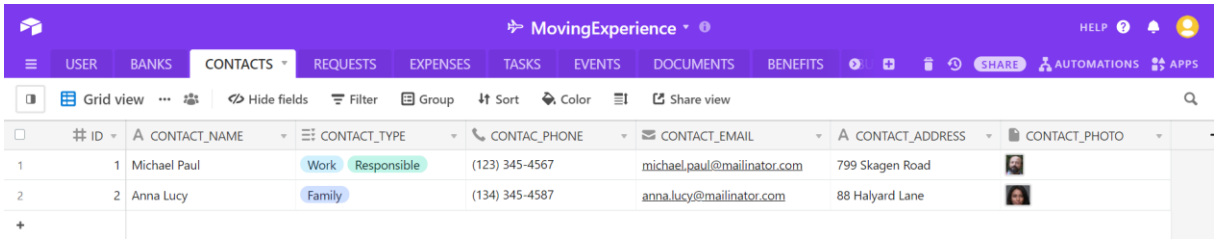


TABLE 5 – EMERGENCY CONTACTS
SOURCE: AUTHOR (FROM AIRTABLE PLATFORM)

The Emergency Contacts table has contact information (phone number, address, email) of the responsible or family of the international employee.

Budget Bank Accounts

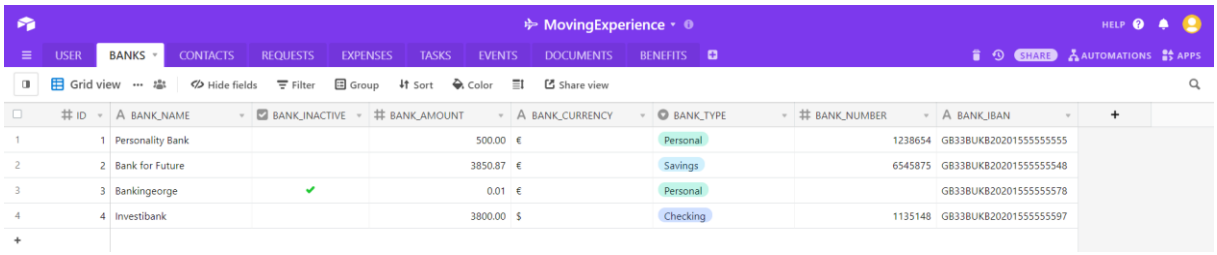


TABLE 6 – BUDGET BANK ACCOUNTS
SOURCE: AUTHOR (FROM AIRTABLE PLATFORM)

The Budget Bank Accounts table has information about the available assignment budget of that worker. With characteristics such as Banking Name, the available amount, in specific currencies, the bank type, or relevant data like the Account Number and the Account Iban. This is a reference to the usage of an allocated budget, and this table will also support updates, meaning that we will have an intention to inactivate or activate a specific Budget Bank Account.

Requests

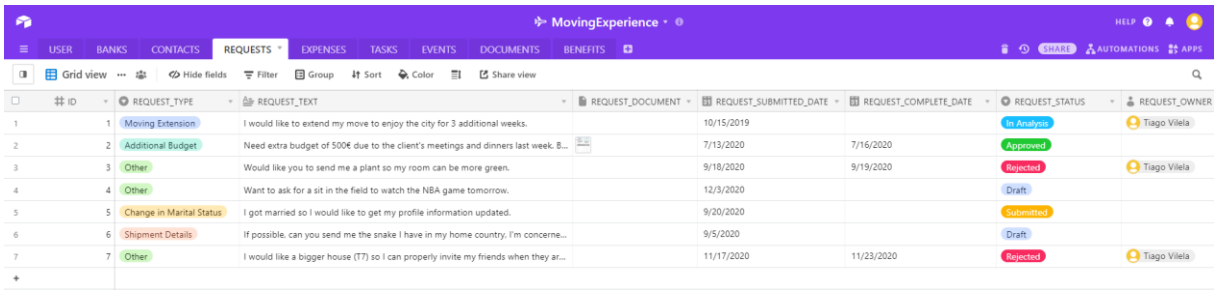


TABLE 7 – REQUESTS
SOURCE: AUTHOR (FROM AIRTABLE PLATFORM)

The Requests table stores the data referent to user's requests that can vary from asking for additional budget, requiring a pet shipment within their international move, or simply generic requests. For it, is essential to have normal request characteristics, like submitted dates, requested status, typification, and all these details are supported in the table above.

Expenses

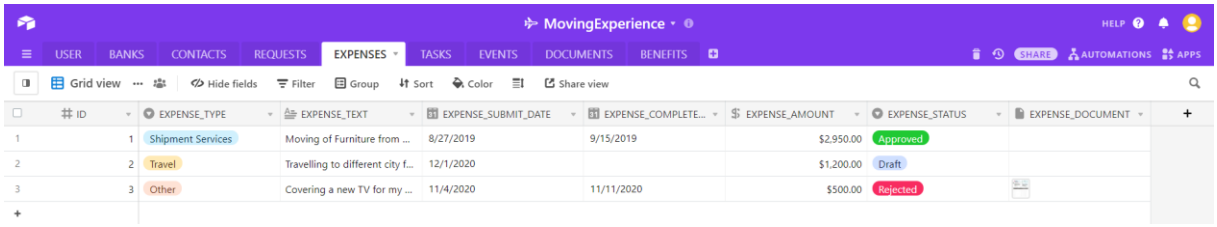


TABLE 8 – EXPENSES
SOURCE: AUTHOR (FROM AIRTABLE PLATFORM)

The Expenses table, similar to the requests ones, have on its structure typification, a description, submit date, the amount, and, the most relevant piece, the status. This will support the enquiring by the chatbot users on things like "What is the status of my expense submitted last week?".

Tasks

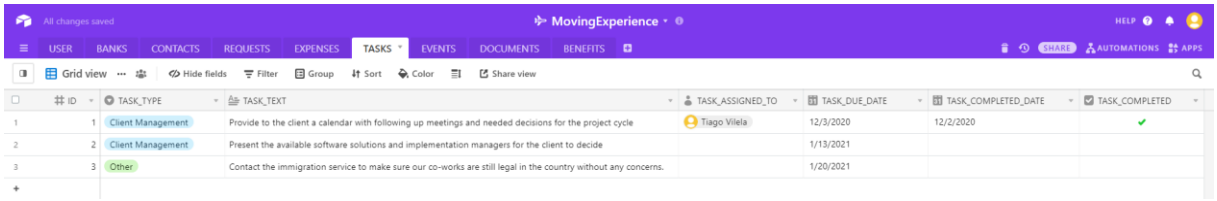


TABLE 9 – TASKS
SOURCE: AUTHOR (FROM AIRTABLE PLATFORM)

Such as any worker in the world, an international expatriate also has its tasks to complete. This table will support the task number, description, typification, due dates, and also is an intended table to support updates on data. The user will have the possibility to mark a specific task as completed.

Events

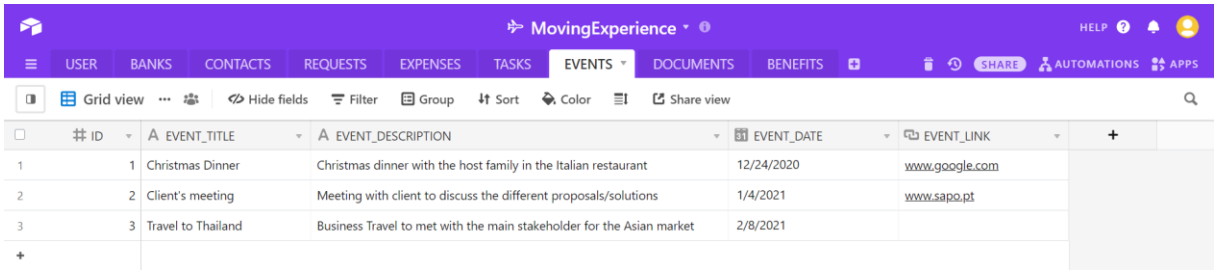


TABLE 10 – EVENTS
SOURCE: AUTHOR (FROM AIRTABLE PLATFORM)

The Events table stores information about upcoming events in their moving experience, such as Christmas dinner, clients' meetings, specific dates of travel, and the user will have the chance to ask the bot about next and past events.

Documents

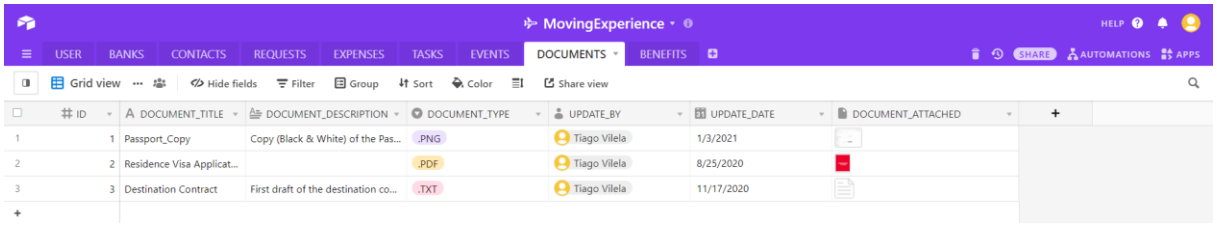


TABLE 11 – DOCUMENTS
SOURCE: AUTHOR (FROM AIRTABLE PLATFORM)

The Documents table stores all the documents uploaded by the employee on the move or its superiors, which can be documents related to the assignment experience (like contracts, visa applications, copies of passports, etc) or more personal documents. It is built to support several types such as .xls, .txt, .png, and others.

Benefits

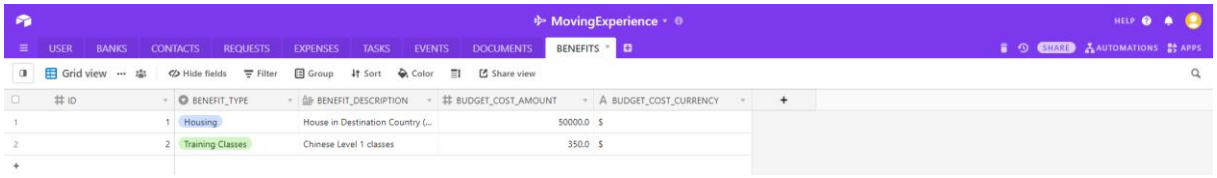


TABLE 12 – BENEFITS
SOURCE: AUTHOR (FROM AIRTABLE PLATFORM)

The Benefits table usually is where the associated benefits, referring to the employee move, are kept and can be accessed. These benefits usually can be selected by the expatriated employee (within a variety of available options) or are tied to the relocation company policy. Things like Housing

Allowance, Training & Cultural classes, support for the shipment costs of furniture or pets, between many other benefits related to the assignment. Sometimes, the employees can have an associated budget and depending on the benefit election (bigger house, more training classes, etc), that benefit will impact the overall moving experience budget. Those fields were also built within this Benefits table.

The tables will be the base for the chatbot's live interaction with the user, because they will allow him to ask for the relevant information that is stored in the database, such as when and where will be the next client's event. The data, its structure, and relationships will be stored and now it's time to make the proper connections with the Chatbot API and the Airtable API.

The connector that we need to save for configuring later the connection between the chatbot and the database is the respective Airtable API Key:

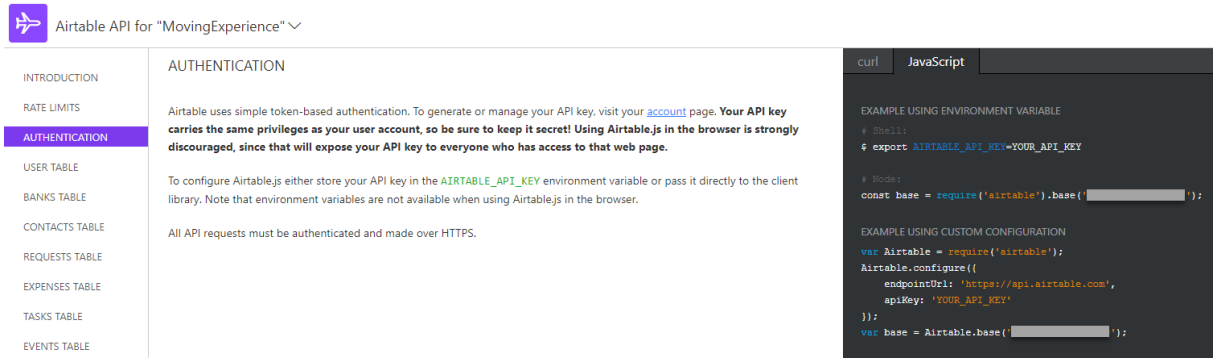


FIGURE 15 – AIRTABLE API KEY
SOURCE: AUTHOR (FROM AIRTABLE PLATFORM)

In the API Authentication configuration screen, the automatically generated API key (gray boxes on Figure 15) is available to be picked up and used for connection of external systems. Will be an important configuration to use alongside the Runkit Webhook code.

4.4.3. Intents & Entities

After the Agent is created and the database structure that will support the Chabot is set up, the next steps rely on defining the Intents and respective Entities that will be created in the Dialogflow platform. The Intents can be defined as what the user wants, and Dialogflow is responsible for providing answers to users on matching these intents. These intents can be defined into two major types:

- **Static** Intents;
- **Dynamic** Intents.

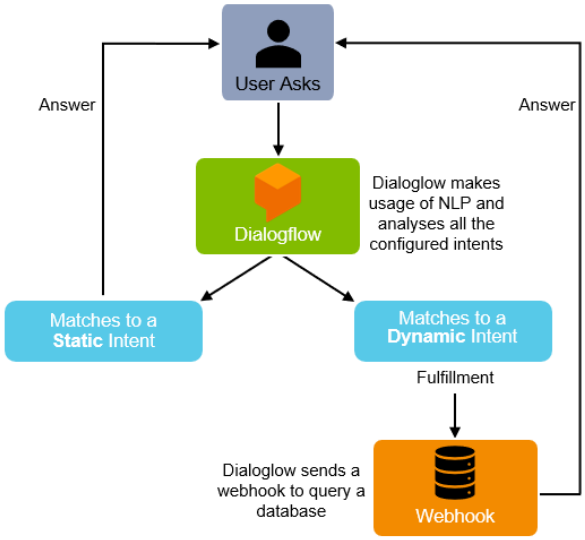


FIGURE 16 - DIALOGFLOW STATIC & DYNAMIC INTENTS FLOW
SOURCE: AUTHOR

The Figure 16 illustrates the flow process of an Intent matching in Dialogflow. If the matched intent is static and the response is configured, the agent will simply provide that response to the end-user. However, when the asked question has its intention of collecting or updating data in a database, Fulfillment is required to complete the action.

For a better organization of the chatbot intents and entities matrix for this dissertation, we will categorize the chatbot intents and entities into **3** different groups:

- **Static Intents**: this group of intents will have the intents that have static answers, that do not require a webhook for an external database connection, such as the typical Default Welcome and Fallback Intents, as well as personal questions for the chatbot, like “What do you do?”, “What’s your age?”, between others;
- **Dynamic Main Intents**: here will be stored the majority of our intents, and these will require a connection to the built Airtable database. In this group, we will have intents for fetching information in the database such as “What is the IBAN of my bank account?”, “What and when is my next event?”, or “What is the status of my last expense?”;

- **Dynamic Advanced Intents**: in this group, we will have follow-up actions and real updates on the data, as examples, we can have “Please inactivate my bank account”, “Complete the last client management task”, or “Change my phone number in the profile information”.

4.4.3.1. Static Intents

The following Static Intents table will organize the intents and entities to support the prototype development:

STATIC INTENTS	
Intents	Entities
DefaultWelcomeIntent	N/A
DefaultFallbackIntent	N/A
AskMood	N/A
AskAge	N/A
AskGender	N/A
AskProfession	N/A
AskHobbies	N/A
GoodbyeIntent	N/A

TABLE 13 – STATIC INTENTS
SOURCE: AUTHOR

The defined intentions in this Static Intents table, despite seeming too non-related with the chatbot's overall goal (replying to questions about the international moving experience), are the ones that will give a “human” side to the chatbot.

In the Dialogflow platform, these intents are positioned below the Agent and Language configurations:

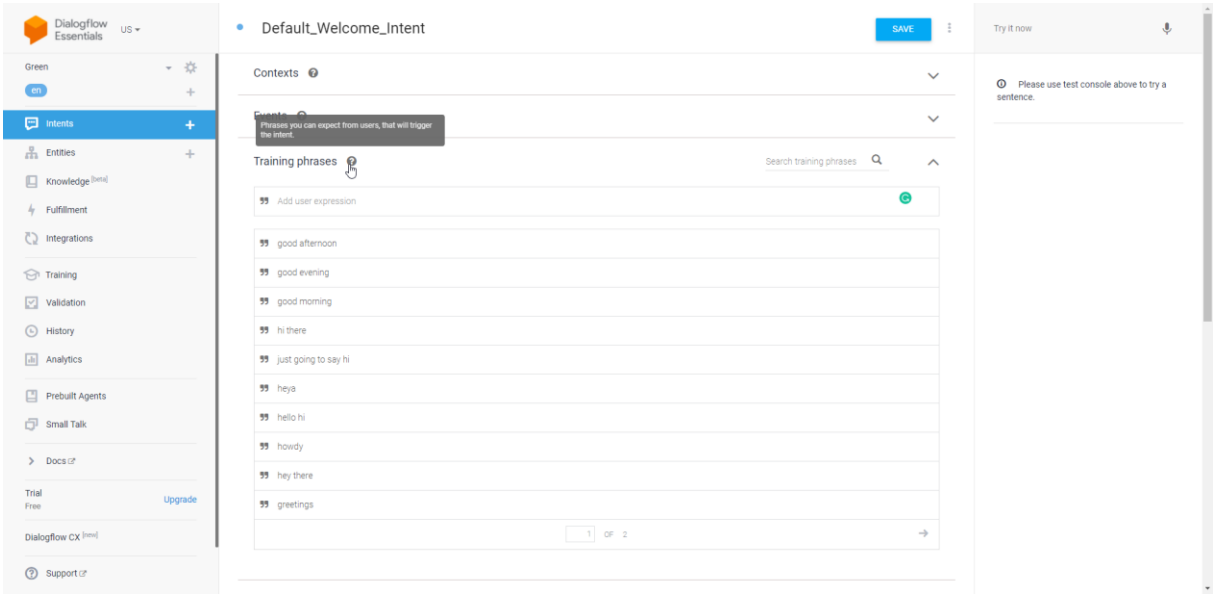


FIGURE 17 - INTENTS TRAINING PHRASES CONFIGURATION
SOURCE: AUTHOR

As we can see from Figure 17, the Intent configuration in Dialogflow has a set of steps, including Context, Events, Training phrases, Action and Parameters, Responses, and Fulfillment. Following the provided example of the Intent “Default_Welcome_Intent”, in the picture below, the Training phrases, which as the tooltip says “Phrases you can expect from users, that will trigger the intent”, were added to the chatbot.

From this moment, the chatbot should match what the user says to this intent when phrases like “good afternoon”, “hi there” or “greetings” are written or spoken by the users. There is no need to add a lot of different training phrases because the Dialogflow will automatically train the bot and understand the user even if the message is not the same as what is configured.

After the Training Phrases section is finalized, we need now to configure the Responses that the bot will provide:

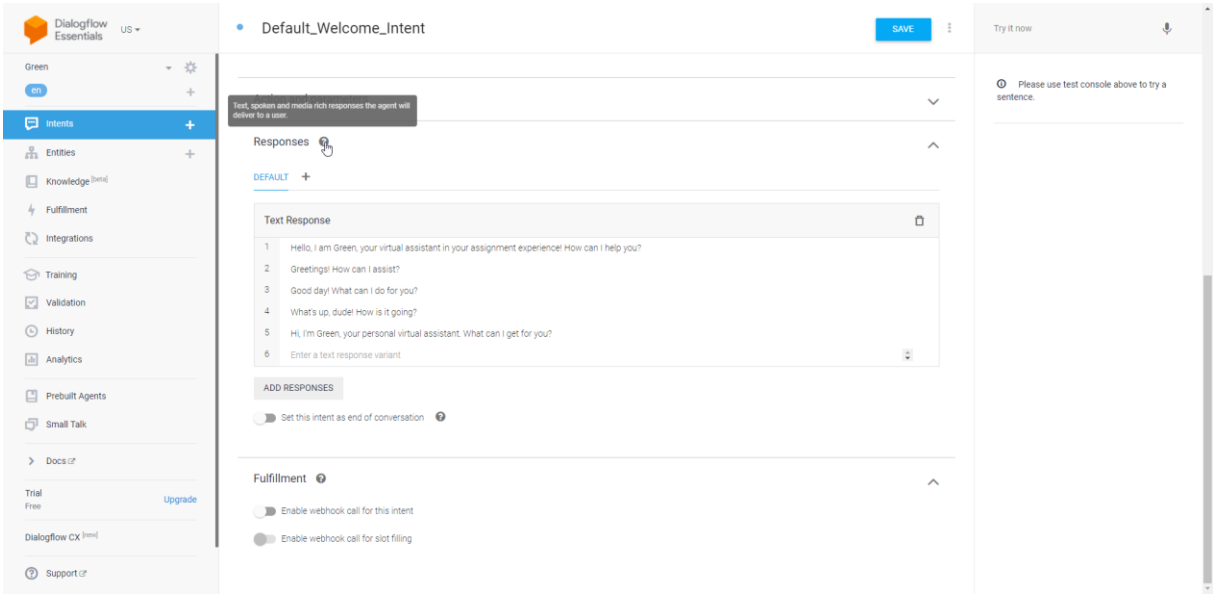


FIGURE 18 – INTENTS RESPONSES CONFIGURATION
SOURCE: AUTHOR

The Responses, as the tooltip shows, are “Text, spoken and media-rich responses the agent will deliver to the user”, which means, is what the chatbot will answer when the user writes something that matches the configured intent.

Direct responses to the Welcome Intent were added, such as “Hello, I am Green, your virtual assistant in your assignment experience, how can I help you?”, or, simpler, “Greetings, how can I assist?”, to complete and start a direct conversation with the Chatbot user. In this case, since it’s a static answer, the Fulfillment checkbox can be kept disabled, because we will not need a webhook to reply to this static intent.

These configurations of just the Training Phrases and the Responses already produced a viable testing conversation with the Green chatbot. In the Integrations menu in Dialogflow, the feature “Web Demo” allows you to see how does your chatbot works with what has configured already:

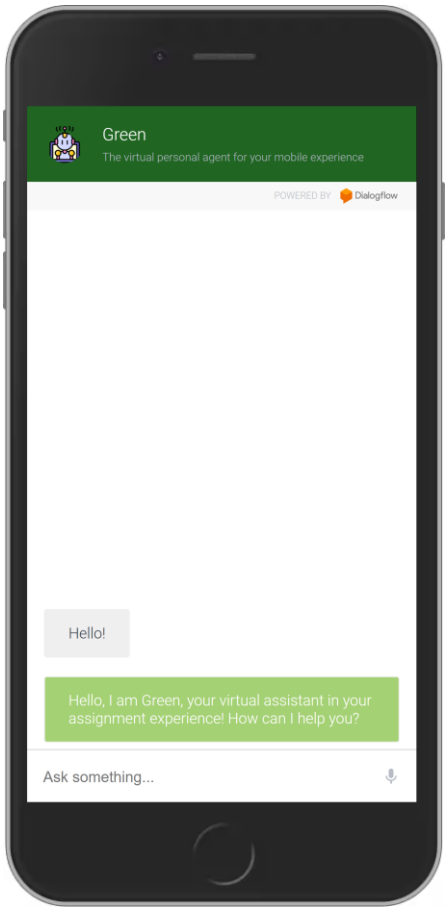


FIGURE 19 – DIALOGFLOW TESTING WELCOME INTENT
SOURCE: AUTHOR

In figure 19, we can see that the user said “Hello” to the Green chatbot, and it replied one of the pre-defined responses. The configuration of the following ones (ask age, ask hobbies, goodbye intent, etc) will be similar in terms of its configuration, the only change will be the phrases and responses content.

With these pre-defined intentions, chatbot users can ask things like “What’s your age”, “How are you feeling today”, “What do you do”, and these questions improve the overall customer experience and the relation between the bot and the user. As Pavliscak (2016) said, I don’t want chatbots to replace humans, what I really want is to have a not-so-painful personal conversation with them.

Depending on the use case of the chatbot, those can have if needed entities associated with the static intents. For instance, if the chatbot is present in the online shop of a local business, it might be interesting to configure the entities such as opening hours, available services, and so on. For our international mobility use case, it is not needed to configure any entity associated with the straight-forward static queries from the user.

4.4.3.2. Dynamic Main Intents

As we have done with the Static Intents, the following table will organize the intents and entities referring to the Dynamic Main ones, which will have stored the requirements for fetching international mobility data in a database. These intents will connect to the Airtable Moving Experience Database:

DYNAMIC MAIN INTENTS			
Intents	Entities	Action	Associated Table
Budget Bank Accounts			
ViewBankAccountAmount	@bank-type, @bank-name	getBankAccountAmount	Banks
ViewBankAccountNumber	@bank-type, @bank-name	getBankAccountNumber	Banks
ViewBankAccountIBAN	@bank-type, @bank-name	getBankAccountIBAN	Banks
ChangeBankIntent	@bank-type, @bank-name	changeBankAttribute	Banks
Requests			
ViewRequestStatus	@request-status, @request-type, @request-date	getRequestStatus	Requests
ViewRequestSubmitDate	@request-status, @request-type, @request-date	getRequestsSubmitDate	Requests
ViewRequestCompletedDate	@request-status, @request-type, @request-date	getRequestCompleteDate	Requests
ChangeRequestIntent	@request-status, @request-type, @request-date	changeRequestIntent	Requests
Expenses			
ViewExpenseStatus	@expense-status, @expense-type, @expense-date	getExpenseStatus	Expenses

ViewExpenseSubmitDate	@expense-status, @expense-type, @expense-date	getExpenseSubmitDate	Expenses
ViewExpenseCompleteDate	@expense-status, @expense-type, @expense-date	getExpenseCompleteDate	Expenses
ViewExpenseAmount	@expense-status, @expense-type, @expense-date	getExpenseAmount	Expenses
Tasks			
ViewTaskDescription	@task-type, @taks-date	getTaskDescription	Tasks
ViewTaskDueDate	@task-type, @taks-date	getTaskDueDate	Tasks
ViewTaskCompletedDate	@task-type, @taks-date	getTaskCompletedDate	Tasks
ViewTaskCompletion	@task-type, @taks-date	getTaskCompletion	Tasks
Emergency Contacts			
ViewContactPhone	@contact-name, @contact-type	getContactPhone	Contacts
ViewContactEmail	@contact-name, @contact-type	getContactEmail	Contacts
ViewContactAddress	@contact-name, @contact-type	getContactAdress	Contacts
ChangeContactIntent	@contact-name, @contact-type	ChangeContactIntent	Contacts
User Profile			
ViewUserEmail	N/A	getUserEmail	User
ViewUserPhone	N/A	getUserPhone	User

ViewUserPassportNumber	N/A	getUserPassportNumber	User
ViewUserPassportExpireDate	N/A	getUserPassportExpireDate	User
ViewUserPassportDocument	N/A	getUserPassportDocument	User
Events			
ViewEventTitle	@event-title, @event-date	getEventTitle	Events
ViewEventDescription	@event-title, @event-date	getEventDescription	Events
ViewEventDate	@event-title, @event-date	getEventDate	Events
ViewEventLink	@event-title, @event-date	getEventLink	Event
ChangeEventIntent	@event-title, @event-date	getEventIntent	Event

TABLE 14 – DYNAMIC MAIN INTENTS
SOURCE: AUTHOR

The defined intentions and entities in this Dynamic Main Intents table, represent the core of the Green Chabot in terms of what the user wants and can ask, related to its international moving experience.

Each of the mentioned above intentions will have its connection to each table, in the Airtable MovingExperience database, specifically one of the following: User Profile, Emergency Contacts, Budget Bank Accounts, Requests, Expenses, Tasks, Events, Documents, or Benefits.

To highlight the configuration and the usage of these dynamic main intents, and their connection to the respective table, we will use as an example the Intent of ViewBankAccountAmount, which is the intention where the user can check how much money he has left from its assignment budget:

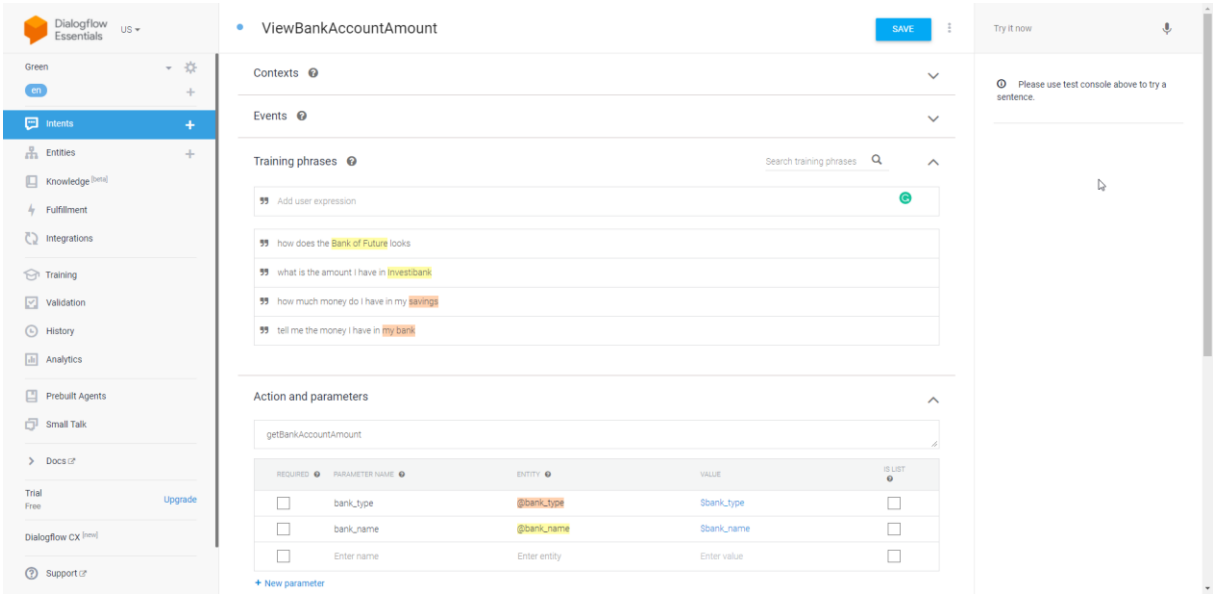


FIGURE 20 – DYNAMIC MAIN INTENT CONFIGURATION
SOURCE: AUTHOR

The ViewBankAmount Intent has on its configuration, the same Training Phrases that the previous static one had, but regarding its context, such as “How does the *[Bank Name]* looks?” or “How much money do I have in my savings?”, for properly inquiring the Budget Bank Accounts table.

As visible in Figure 20, the Intent configuration has some words (in the Training Phrases section) highlighted in yellow and orange. Also, those words, are associated with what is defined under the Action and Parameters section, where these parameters are nothing less than the associated Entities.

For the ViewBankAmount intent, there are listed 2 specific Entities: @bank_type and @bank_name. These Entities are available in a menu option in Dialogflow, right below the intents option, and these can be defined as parameters of similar data categorization (such as the type) and will help the chatbot find the most relevant record to provide accurate information.

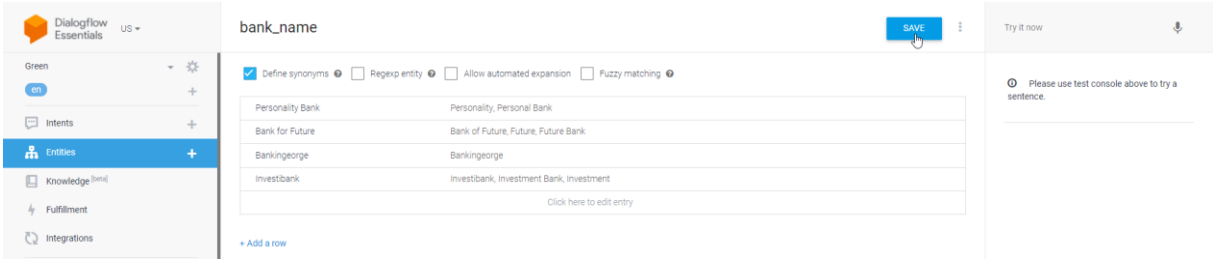


FIGURE 21 – ENTITY CONFIGURATION
SOURCE: AUTHOR

There are system entities, that can be used in our chatbot configuration, like dates, emails, and so on, but this @bank_name one is a custom entity-specific for this context. On the configuration of the entity, multiple values are set up as part of that Entity, and those will help the bot on identifying the relevant record for providing information.

Despite the Bank names added to the Entity (Personality Bank, Bank for Future, Bankingeorge, and Investibank), also synonyms were configured for each entry. This will help train the bot and work also with different types of speech and writing.

For this particular scenario, the chatbot must be smart to understand the user's input, check the relevant data in the MovingExperience database, and provide the accurate answer for the user in what regards to the budget amount he has in certain specific bank accounts. For this dynamic interaction with the Airtable database and API, 2 specific configurations are demanded and highlighted in the following figure:

- Action nomenclature: getBankAccountAmount;
- Fulfillment toggle: enabled.

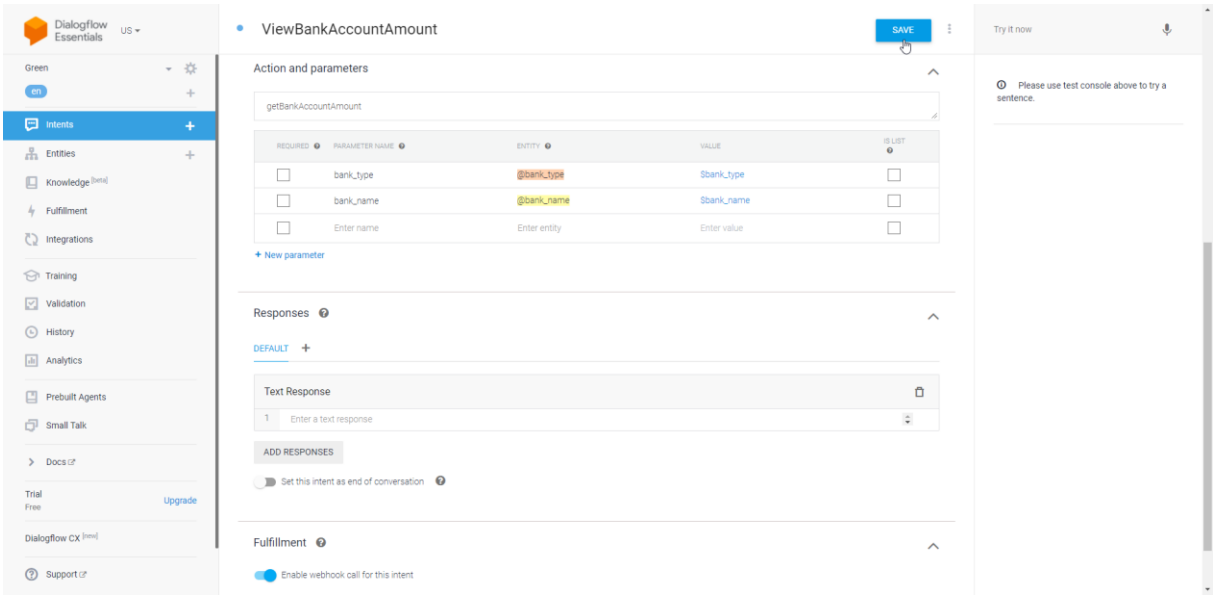


FIGURE 22 – ACTION AND FULFILLMENT INTENT
SOURCE: AUTHOR

When the Fulfilment toggle is enabled, it means that this specific intent is configured for enabling and triggering a webhook call.

This is the moment where we will enter one of the most powerful features of the Dialogflow platform: Fulfillment. Fulfillment is the layer that allows us to configure an external connection to a web service, which can access and have actions against a specific database. This "bridge" between the Dialogflow API and the Database API, is configured in a Dialogflow menu option, right above the Integrations menu:

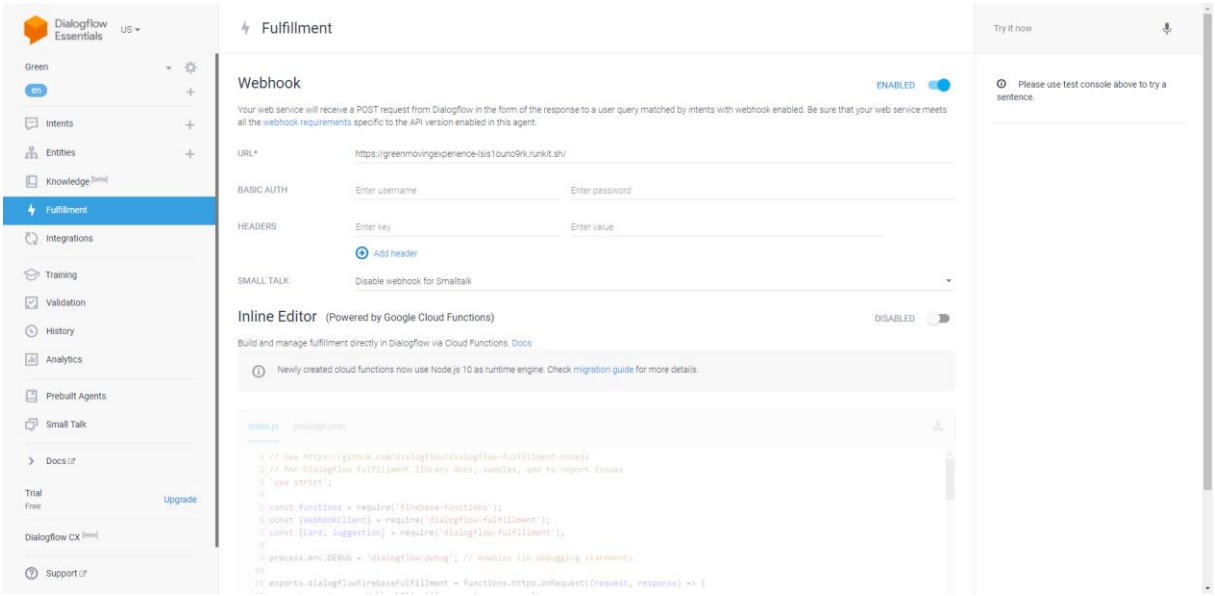


FIGURE 23 – FULFILLMENT WEBHOOK CONFIGURATION
SOURCE: AUTHOR

The configuration of the Fulfillment feature is pretty straight-forward, we just need to make sure the toggle is enabled, and in the URL field, we must provide the URL published by the webhook code platform, which for this particular case, is Runkit.

The Runkit notebooks allow developers to build sandbox testing JavaScript environments, open to connecting different external services through its APIs. Both API keys (Airtable workspace and Moving Experience database) should be added in the Runkit Environment Variable configurations, so those can be properly invoked in the webhook code:

FIGURE 24 – FULFILLMENT WEBHOOK CODE FOR GETBANKACCOUNTAMOUNT
SOURCE: AUTHOR

The Webhook code set up above will be responsible, for processing an accurate answer for the user, regarding the available amount in its budget bank account.

Dialogflow will identify, with its matching capabilities, the user intention to check the amount of money in a budget bank account, and the webhook code will be responsible to analyse the external database in Airtable (Moving Experience), and after finding the relevant information, will build an answer for the user, using the available information in the database table.

A set of high-level highlights we can see from the webhook code:

- **Line 6** – variable declared to connect this webhook code, with both external APIs previously configured;

- **Line 23** – constant declared for the action “getBankAccountAmount” (previously configured in the Dialogflow Intention);
- **Line 29**, **31** – as part of the previous constant, we can see here the connection to the database table “Banks” (which is referring to the budget bank accounts table) and filtering the records by the “Bank_Name” and the “Bank_Type”, which is provided by the user on its intention, and are the configured entities in Dialogflow;
- **Line 35** – response formulation, where it will include the respective entity (@bank_name), and the information retrieved by 2 fields in the database: the bank account amount and the bank account currency.

With this webhook code published, the URL code should be copied and placed in the URL field configuration, in the Dialogflow Fulfillment screen, and should be ready to work. Now, it’s expected that if the user enquires the Green chatbot about a certain amount available in one of the budget bank accounts, the bot should reply with the exact amount stored for that row, and with the currency specification in front of it.

This is how it behaves:

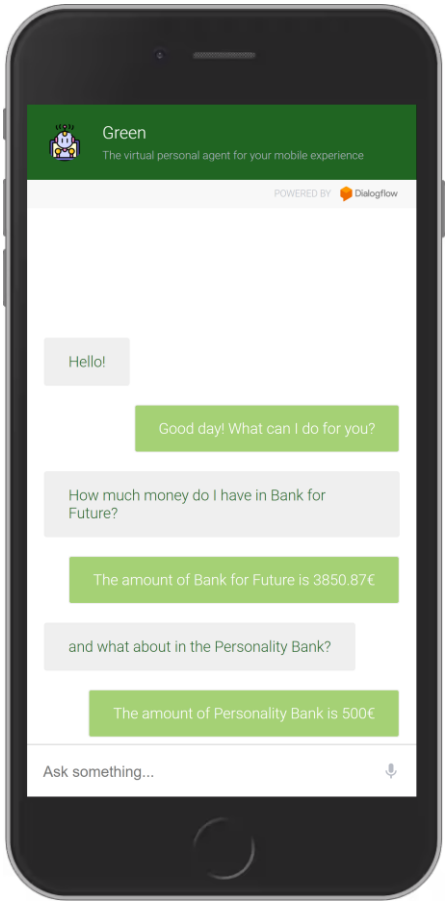


FIGURE 25 – DIALOGFLOW TESTING THE BUDGET BANK AMOUNT GET FEATURE
SOURCE: AUTHOR

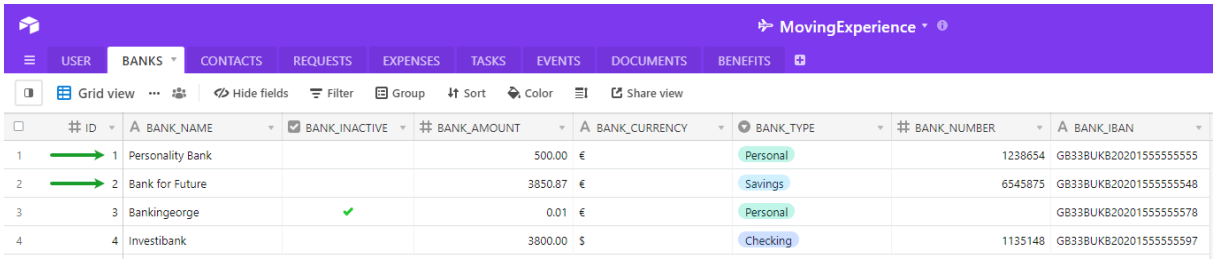
We can see from the screenshot above, that the user started with a regular conversation with the bot, using the common “Hello”.

After, the user enquires the bot how much money does he has in the Bank for Future. After typing that, the Dialogflow chatbot will match that statement, with the Intent “ViewBankAccountAmount”, and since it's an Intent configured with an action and the fulfillment enabled, it will use the webhook code presented before.

The webhook code (in Runkit), will connect with the Banks table in the Moving Experience Airtable database and will retrieve the response for the chatbot user, with the information from the relevant record: “The amount of *@bankName* is [Bank_Amount] [Bank Currency].”

Since the available (at this moment) amount in the “Bank for Future” is specifically 3850.87 €, and the amount in the “Personality Bank” is specifically 500€, the chatbot is smart to build these answers, and its automatically trained to not need an exact sentence and work well in the context of the conversation. We can see that in the second question from the user “and what about in the *@bankName* ?”, the Dialogflow is smart enough to understand that the user wants the same information, but from a different record in the Budget Bank Account table.

The 2 first records (highlighted with green arrows) in the Budget Bank Account Table are the ones fetched by the chatbot, and the information retrieved is in the [Bank_Amount] and [Bank_Currency] fields:



	ID	BANK_NAME	BANK_INACTIVE	BANK_AMOUNT	BANK_CURRENCY	BANK_TYPE	BANK_NUMBER	BANK_IBAN
1	1	Personality Bank		500.00	€	Personal	1238654	GB33BUKB20201555555555
2	2	Bank for Future		3850.87	€	Savings	6545875	GB33BUKB20201555555548
3	3	Bankingeorge	✔	0.01	€	Personal		GB33BUKB20201555555578
4	4	Investibank		3800.00	$	Checking	1135148	GB33BUKB20201555555597

FIGURE 26 – BUDGET BANK ACCOUNT TABLE IN AIRTABLE
SOURCE: AUTHOR

The remaining dynamic main intents (viewUserPassportDocument, viewEventDate, viewExpenseSatus, and others) were configured similarly, changing depending on the fields, field types, and information to retrieve (single or multiple rows), but everything in what regards to the webhook code and the Dialogflow configuration, follows the pattern built for bank accounts.

4.4.3.3. Dynamic Advanced Intents

The prior defined Dynamic Main Intents table comprehends all the intents and entities whose major goal is to define actions for providing information to the chatbot user, such as inquiring about the status of a submitted request, if a specific expense was approved, what are the available benefits within the expatriation experience, between others.

The provided intents and entities in the following Dynamic Advanced Intents table have the overall goal of making the chatbot, not just an information robot provider, but also a way to help the chatbot user updating relevant information and work as a virtual assistant on keeping the mobility database up to date:

DYNAMIC ADVANCED INTENTS			
Intents	Entities	Action	Associated Table
InactivateBankAccount	@bank-type, @bank-name	inactivateBankAccount, activateBankAccount	Banks
UpdateUserEmail	@contact-email	updateUserEmail	User
UpdateUserPhone	@contact-phone	updateUserPhone	User
CompleteTask	@task-type, @taks-date	markTaskCompleted	Tasks
SubmitDraftRequest	@request-type, @request-date	submitDraftRequest	Requests
SubmitDraftExpense	@expense-type, @expense-date	submitDraftExpense	Expenses
CreateNewEvent	@event-title, @event-date	addNewEvent	Events

TABLE 15 – DYNAMIC ADVANCED INTENTS
SOURCE: AUTHOR

Like the prior, the Dynamic Advanced Intents will also interact with the testing data in the Airtable Moving Experience Database, but in this particular case, to update the data by the conversation interaction between the user and the bot.

From the defined database tables in chapter 4.4.2, the chosen built actions in Dialogflow that can update the Moving Experience database, are the following:

- Inactivate Bank Account: give the possibility for the chatbot user to ask for a specific budget bank account to be set as inactive (inactive = true);
- Update User Email and/or Phone: give the possibility for the chatbot user to update himself its profile information data, in this case, was built for updating only these two fields, but in the future can be extended for other fields;

- Complete Task: the possibility for the employee user to say that certain tasks are completed, and mark those as completed. Despite marking the task as completed, this action should also have the capability to update the Complete Date field to the system today's date (same date as the task was marked as completed);

- Submit draft Requests or Expenses: the possibility for the chatbot user to submit a request, or an expense, whose current status is as the "draft". This will cover the scenario where the employee can submit previously created requests or expenses;

- Create Events: one of the database tables available in the Moving Experience is the events. Events that can be meetings, gatherings, dinners, between others. The same way it's common for a mobile phone user to set up a reminder, this Intent has the goal to provide the chatbot user capability to schedule and add events to its calendar database.

Similar to what was done in the prior chapter, to highlight the configuration and usage of the dynamic advanced intents, we will detail the CompleteTask Intent, on its Dialogflow configuration and chatbot prototype usage:

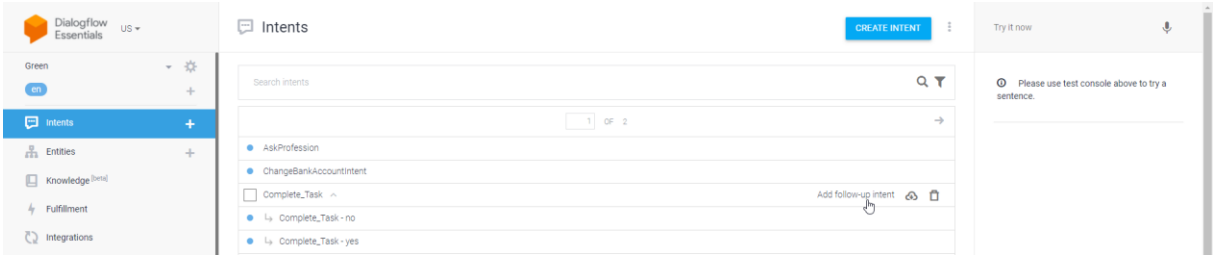


FIGURE 27 – COMPLETE TASK INTENT CONFIGURATION
SOURCE: AUTHOR

For the Complete_Task intent configuration, as we can see in Figure 27, we went a bit further in the Dialogflow capabilities and 2 Follow-Up intent were built to provide more confidence for the chatbot users when trying to update the database.

This particular intent, when used, has the overall goal of marking a task as completed (boolean field in the Tasks Airtable database), and the two follow-up intents, are questions that the Green chatbot will enquire for the user to make a final decision: Are you sure you want to complete your task? If the user says "Yes", or any similar word, then the task will be completed, otherwise, it won't.

The follow-up intents feature in Dialogflow is very powerful, not just for the provided value in the conversation between the bot and the users, but also because its configuration is very user-friendly and intuitive. Only by adding the follow-up intent directly from the "main" intent (in this case, Complete_Taks), Dialogflow will be responsible for automatically generate the context configuration and the action to be used later in the webhook code if necessary:

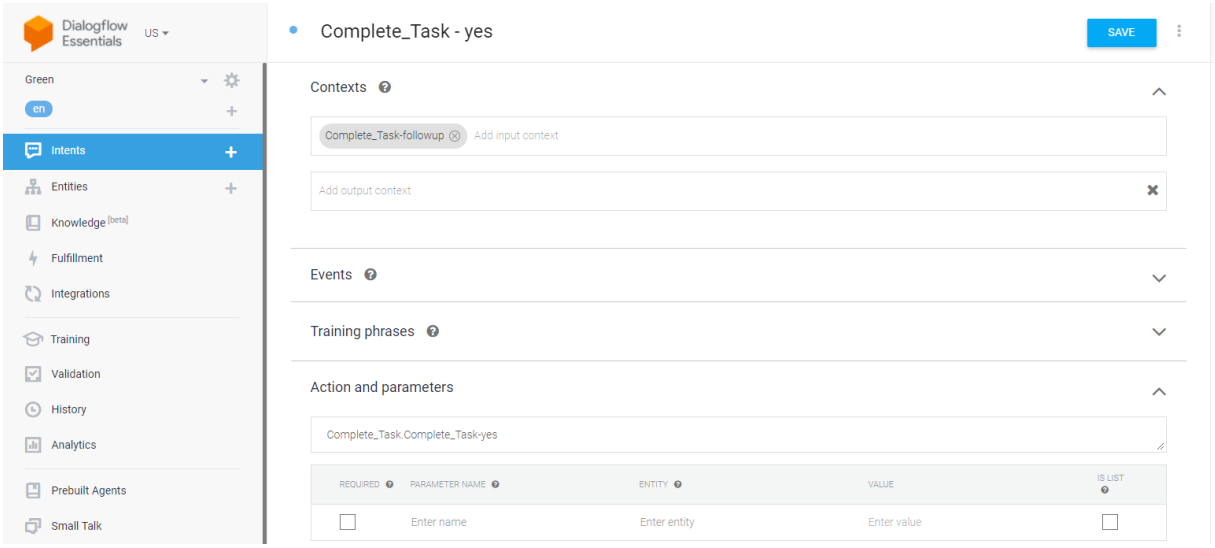


FIGURE 28 – COMPLETE TASK – YES: FOLLOW-UP INTENT CONFIGURATION
SOURCE: AUTHOR

As we can see in Figure 28, the context "Complete_Task-followup" and the action "Complete_Task.Complete_Task-yes" are automatically created, which will facilitate the setup of this action usage in the webhook code responsible for updating the Moving Experience database.

It is important to state that when using the Follow-up intents feature, the main intent, should have as its text responses, the questions that will drive the user for the additional "yes" or "no" answers, such as "Are you sure you want to complete the task?", otherwise it would be confusing and likely the chatbot users will not know that they are facing a confirmation dialogue.

In this particular "Complete Tasks" scenario, the follow-up intent with the "no" answer, meaning, not updating the database to mark the task as complete, will not have any webhook fulfillment connection, because it will not do anything regarding updates. For that intent, a simple text response was configured saying "Okay, your task will not be completed". For the follow-up intent "Yes", whose goal is to update the tasks database table and mark it as complete, the Fulfillment webhook toggle was enabled, and the automatically created action will be called in the webhook to make sure that what the user says will have a direct impact in the Airtable database:

```
83  const completeTask = (req, res) => {
84      let contexts = req.body.queryResult.outputContexts;
85      var item = contexts.find(item => item.name.endsWith('/contexts/complete_task-followup'));
86      let taskType = item.parameters.task_type;
87
88      let id = 0;
89      let mainRecord;
90      let responseJson = {};
91      responseJson.fulfillmentText = "Not found"; // displayed response
92      let table = base('TASKS');
93      table.select({
94          maxRecords: 1,
95          filterByFormula: 'LOWER({TASK_TYPE}) = lower("' + taskType + '")',
96      }).eachPage(function page(records, fetchNextPage) {
97          records.forEach(function(record) {
98              id = record.get("ID");
99              mainRecord = record;
100             responseJson.fulfillmentText = "Awesome, your task was marked as completed.";
101             res.json(responseJson);
102         });
103         fetchNextPage();
104     }, (err) => done(err, res, responseJson));
105
106     table.update([{
107         "id": mainRecord.id,
108         "fields": {
109             "TASK_COMPLETED": true
110         }
111     }], (err, record) => {
112         if (err) {
113             done(err, res, responseJson);
114         }
115     });
116 }
```

FIGURE 29 – FULFILLMENT WEBHOOK CODE FOR COMPLETETASK INTENT
SOURCE: AUTHOR

The webhook code above is responsible for the action of updating and check the “completed” checkbox in the Tasks database. After the user expressing his intention to mark complete the task, it will automatically update the Airtable database. In a real-world application of the Green chatbot, for example, if the user has a dashboard with all the tasks, the particular one that was updated will or no longer be part of the to-do list, or will be in the completed state. The code does not account for it, but it could be more robust if it also updated the complete date with the specific date of the user’s intention to complete it.

A set of highlights from the webhook code:

- **Line 83, 84, 85, 86** – declaring the variables of “CompleteTask”, the context to be grabbed from the user and bot conversation (complete_task-followup), and the parameter that will be used to identify which task to be updated;

- **Line 92 –** declaring the Airtable database table (Tasks) that will be updated after the user expresses his intention to complete the task (by saying yes or one of the other configured training phrases in the follow-up intention);

- **Line 100** – the response provided for the user when the task selected is updated (“Awesome, your task was marked as completed.”);

- **Line 106, 107, 108, 109 –** the specification of the table field (Task_Completed) that is going to be updated, and, in this case since it's a boolean field, the value to be set in the database (True), meaning that it be checked and marked as completed.

The Complete_Task intent, alongside its Follow-up intents (Yes and No), in Dialogflow, and the webhook code provided, will connect the chatbot user's intention to mark his task as completed and will update the information in the respective tasks table. This is how a conversation between the user and the Green chatbot will look like with the intention of completing the "Client Management" task:

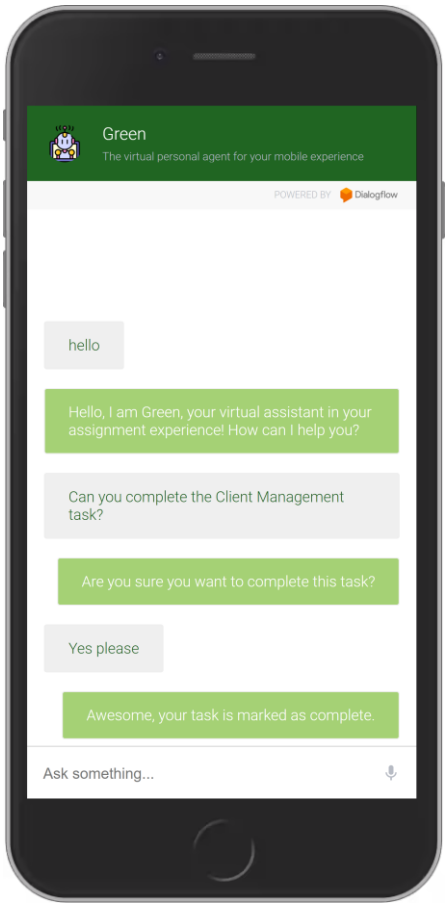


FIGURE 30 – DIALOGFLOW TESTING THE COMPLETE TASK FEATURE
SOURCE: AUTHOR

As we can see in Figure 30 after the user expressly states his intention to mark the task as complete, the chatbot (on its follow-up question) asks the user if is sure about his intention, and after saying "Yes", the task is finally completed and the information is updated in the Airtable database:

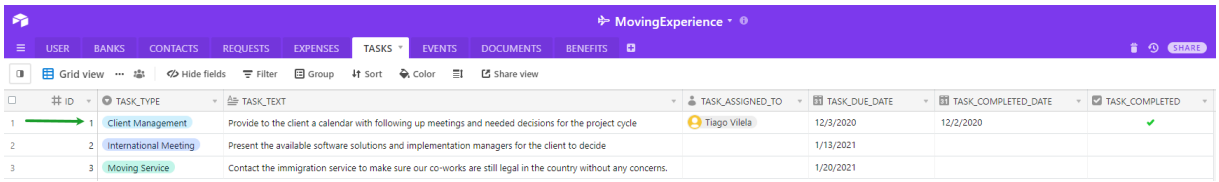


FIGURE 31 – TASKS TABLE UPDATED IN AIRTABLE
SOURCE: AUTHOR

The goal of this intention example is to provide a way for the chatbot user to complete his tasks and consequently update his moving experience database table. As we can see in Figure 31, after the conversation flow seen in Figure 30, the database was properly updated. If we take a deeper look, we can see that record 1 (which has the Client Management task), was updated and the field [Task_Completed] is marked, meaning that it is completed after a simple chatbot conversation.

This is one of the most powerful features of any chatbot, the capability to update real data, in real-time, without the need on going to specific screens in the app or submitting IT requests to do it. The additional dynamic advanced intents followed the same configuration and webhook code structure as the one shown in this example.

4.4.3.4. Context Usage

Directly tied with the Dynamic Main Intents, deeply analyzed in chapter 4.4.3.2, we do have on our Intents table, 4 singular records with different characteristics than the others. Those are:

- changeBankIntent;
- changeRequestIntent;
- changeContactIntent;
- changeEventIntent;

Each is considered a context-based intent, meaning that is not a main intent for asking for specific information, but those have the overall goal of maintaining the context inside a conversation. A quick example could be, in my Budget Bank Accounts, I will ask “How much money do I have in my Bank of Future?”, and right after ask “and what is its IBAN?”. If the context does not exist, the bot will not be able to answer this second question, because since it does not store context, it can not provide an IBAN without first knowing from which entity (@bank-name for example).

Meaning that without it, the conversation could happen, but it would be a very rigid one like I would need to ask, again, “What is the Iban of my Bank of Future?” for the chatbot to understand. But gratefully, Dialogflow has as part of the Intents feature, a configuration defined as “Contexts”.

The Context as part of the intent configuration, and has the tooltip of the options states, can be used to remember parameters and values, so those can pass from one intent to another. An option to remember and keep the context of a conversation, per user session:

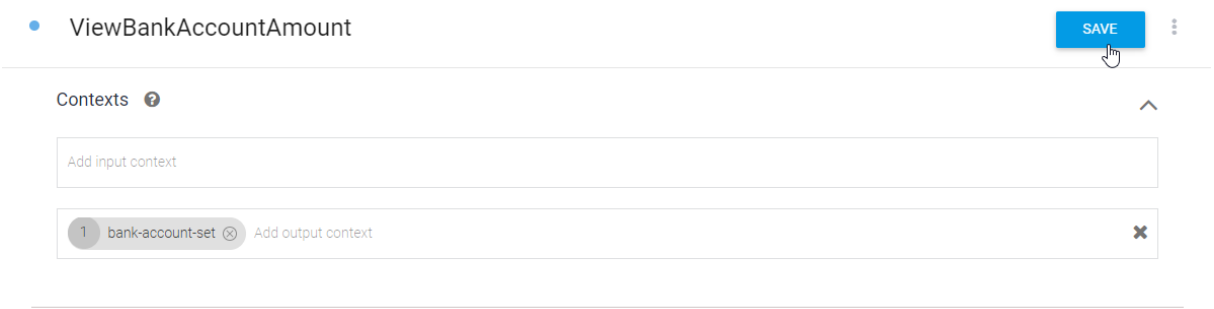


FIGURE 32 – CONTEXT INTENT CONFIGURATION
SOURCE: AUTHOR

To follow-up with the Bank Account Intent example used before, and to explain the configuration and usage of the context, Figure 32 highlights the context configuration for the ViewBankAccountAmount intent. Dialogflow allows the configuration of both the Input Context and/or Output Context.

The way the chatbot will interpret those is if an intent has input-context configured, it is expected to receive the same output-context configured in a different intent. The output-context allows the bot to pass relevant information for the following intent. By this configuration, we can see that the

ViewBankAccountAmount Intent is configured to pass the bank-account-set context to the next intent. And the next intent is the one called “changeBankIntent”:

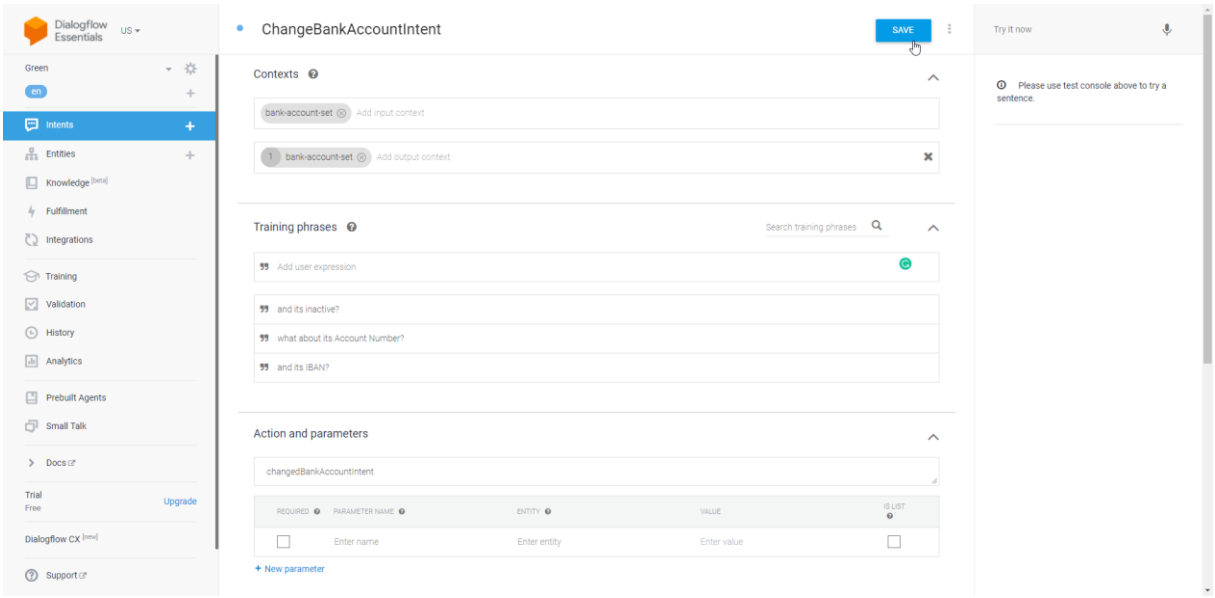


FIGURE 33 – INTENT CHANGING CONTEXT CONFIGURATION
SOURCE: AUTHOR

ChangeBankAccountIntent is the name given to the above Intent, which its primary goal is to maintain a normal conversation with the chatbot user, assuming that the provided context by the user will keep stored and remember on following-up intentions.

In the Input Context configuration, we can see that the bank-account-set context is configured, the same that is configured in the output-context but from the ViewBankAccountAmount intent. In summary, this means that after this intent is asked by the user, if the user asks a question about the same budget bank account, but for different information, like what is its IBAN, or if it’s active or inactive, the chatbot will be able to reply with that context.

For this intent, an action with the name changeBankAccountIntent was setup, and the Fulfillment toggle was enabled to allow a webhook code to formulate and continue the conversation:

```
63  const getIban = (req, res) => {
64      let contexts = req.body.queryResult.outputContexts;
65      var item = contexts.find(item => item.name.endsWith('/contexts/bank-account-set'));
66      let bankName = item.parameters.bank_name;
67
68      let responseJson = {};
69      responseJson.fulfillmentText = "Not found ";
70      base('BANKS').select({
71          maxRecords: 1,
72          filterByFormula: 'LOWER({BANK_NAME}) = lower("' + bankName + '")',
73      }).eachPage(function page(records, fetchNextPage) {
74          records.forEach(function(record) {
75              console.log('Retrieved', record.get('Value'));
76              responseJson.fulfillmentText = 'The IBAN of ' + bankName + ' is ' + record.get('BANK_IBAN');
77              res.json(responseJson);
78          });
79          fetchNextPage();
80      }, (err) => done(err, res, responseJson));
81  }
```

FIGURE 34 – FULFILLMENT WEBHOOK CODE FOR CHANGEBANKACCOUNTINTENT
SOURCE: AUTHOR

This particular webhook code was set up to provide context when the user asks for the Budget Bank Account IBAN, after asking anything regarding the bank account itself. Dialogflow will remember the previous question and provide the relevant context for the second question.

Two highlights of the webhook code:

- **Line 64, 65** – declaring the context from the previous intent. The “bank-account-set” is the configured context in both intents (ChangeBankAccountIntent and ViewBankAccountAmount)

- **Line 76** – the provided response for the user, without the need from him to identify from which bank account does he wants to have the IBAN retrieved. The “BANK_IBAN” field is defined to provide the current value in the Airtable Database.

All the remaining Budget Bank Account fields (Inactive, Bank Type, Bank Number, etc) followed the same webhook code structure as the Bank Iban structure above.

These Intents and Context configurations, alongside the webhook code that will make the connection and retrieve information from the Budget Bank Accounts table, in Airtable, will result in a nice conversation between the Green chatbot and the chatbot user, by remembering the context passing from one intent to a second intent:

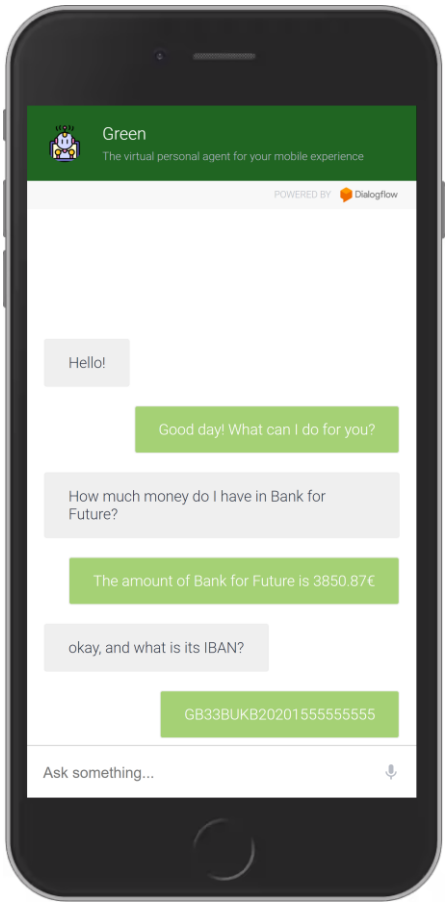


FIGURE 35 – DIALOGFLOW TESTING THE CHANGE BANK INTENT FEATURE
SOURCE: AUTHOR

From the screenshot taken in Figure 35, we can see that the chatbot user, after greetings, asks the bot how much money is available in the budget bank account “Bank for Future”. After getting a reply from the bot, with the amount and the currency, the user asks what is the IBAN of that account, but without specifying any entity: “okay, and what is its IBAN?”.

Since Context is configured in both Intents, when it passes to the second intent, will take with it, the output-context defined in the first intent. Meaning that will take the entity @bank-name, which in this case is the “Bank for Future”, with it, and when asking the chatbot after about an IBAN, Dialogflow will know that it's referring to the “Bank for Future” account, and reply according to that context.

The context feature in Dialogflow is extremely powerful since it makes the conversation between bot and user lighter, coordinated, and closer to a real-human conversation by remembering the provided context and information in prior Intents. A similar configuration was applied for the remaining 3 context-based intent.

4.5. EVALUATION

4.5.1. Goals and Participants

With the mindset of having the Green Chatbot usability and value evaluation, it was submitted to experimentation by 4 different persons, with different nationalities, roles, academic backgrounds, and ways of living, that could have used the global mobility chatbot in different contexts of their daily lives.

The goals of this evaluation are essentially 3:

1. Understand the impact and the added value a global mobility chatbot can have in the international mobility life;
2. Understand how well is the chatbot designed, built, and how good are the conversation flow, the chatbot usability, and the artificial intelligence capacity;
3. Collect the top strengths and the bigger gaps that the chatbot has right now, as well as collecting feedback on how it can be improved in the future.

To have differentiated and heterogeneous feedback, the group of people selected have different nationalities, work roles, academic backgrounds, and different points of view on the way they would use and take advantage of a global mobility chatbot feature or application. The following table details each of the selected participants in the evaluation study, and right after it is stated the why's on each selection:

GREEN CHATBOT EVALUATION PARTICIPANTS			
Name	Nationality	Work Role	Academic Background
André Hassany	Angolan	Student (FMDUL)	Dental Medicine (current) at FMDUL
Rómulo Alexandre	Portuguese	Software Team Lead (BNP Paribas)	Post-Graduation in Information Management at Nova IMS
Sofía Gonzalez	Spanish	Digital Marketing Specialist (PHC Software)	Degree in Journalism at Universidad Complutense de Madrid
Tiago Bastos	Brazilian	Software Developer (Equus Software)	Degree in Computer Engineering at Universidade Federal de Pernambuco

TABLE 16 – EVALUATION PARTICIPANTS DESCRIPTION
SOURCE: AUTHOR

The different characteristics and backgrounds of each selected participant will provide more complete feedback on the chatbot usage and capabilities. All reside in Portugal, but with different roles and coming from different places, cultures, and perspectives. The first one, André Hassany, is a dental medicine student from Angola that lives in Portugal. The second one, Rómulo, is Portuguese and took the Information Management course at Nova IMS, and his current role as a software

analyst can provide good insights on chatbot usability, as well as the artificial intelligence capacity it has. The third, Sofía Gonzáles, is a Spanish Digital Marketing Specialist that works in PHC, a Portuguese software house. Her knowledge of the software industry and the international mobility experience can provide good inputs in the applicability of the Green Chatbot. Last, Tiago Bastos is a Brazilian software developer who, despite having a good knowledge of software development, works in a Global Mobility software company (Equus Software), which can provide a very interesting insight on how the chatbot can be valuable when applied and integrated with Global Mobility software solutions.

4.5.2. Interview Questions & Structure

The following questions were applied, in an individual interview, to fulfill the goals of the chatbot evaluation:

1. On a scale from 1-10, how valuable do you think the chatbot will present for global mobility programs? Justify.
2. On a scale from 1-10, how do you classify the chatbot's understanding capabilities? Justify.
3. What is in your opinion, the top feature of this chatbot? Justify.
4. What is in your opinion, the most critical gap of this chatbot?
5. On a scale from 1-10, how likely do you think global mobility softwares will adopt this chatbot? Justify.
6. How do you see chatbots in the future and what will they be capable of? Justify.

Due to the current COVID-19 pandemic, the questionary to this group of people was made over the Zoom platform. Each interview took from 45 minutes to 1 hour, organized with a 15 minutes introduction to provide context, 20 minutes of playing with the chatbot, and the remaining time for the 6 questions, where the questions for the classification from 1-10 were answered over the Zoom chat, and the open questions over the Zoom call.

It started with an introduction to the topic, the global mobility scenario, and a quick walk-through in the Green chatbot usage and the database available for the conversation, by the author.

After this introduction, each of the participants had the chance to play 20 minutes with the chatbot and have conversations as they want, observed by the author. This testing session was done on top of the Dialogflow Web Demo site, which can be launched and published directly from the Dialogflow platform, by clicking on the Integrations menu and publish the text-based “Web Demo” option. The microphone was enabled, so the participants could use not just text, but also voice commands in the conversation:

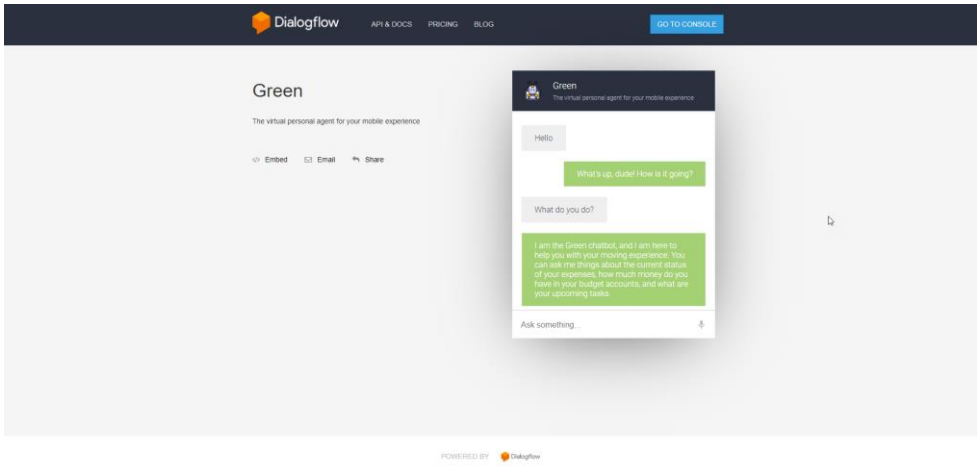


FIGURE 36 – CHATBOT TEST SITE USED IN THE EVALUATION
SOURCE: AUTHOR

4.5.3. Interview Answers & Discussion

After fun sessions where the participants were able to play with the chatbot, having conversations, always guided by the author when feeling blocked, the time for the questionary arrived. The author presented on a slide deck each of the questions (in Portuguese), and the participants used the zoom chat to answer on the scale number. The justification questions were discussed, and the author took notes, translated those, and summarized them for better understanding:

1. On a scale from 1-10, how valuable do you think the chatbot will present for global mobility programs? Justify.

André: 8. I think that chatbots and virtual assistants are becoming more popular over time and therefore make sense for international mobility programs. Especially, if there are some work or college tasks to complete, makes total sense to use it. I see a good value-added with these types of virtual helpers.

Rómulo: 6. I see the value in having chatbots for the niche of Global Mobility. If we are considering softwares or platforms that support these travels, I think it makes total sense to provide a service like this. I just don't give a higher rate, because I think the majority of the features included can easily be replaced by the top-used apps in the market. Usually, tasks can be managed by Outlook, the expenses are properly organized in Expensify, the majority of banks have their own app (even if we are considering only the budgeting scenario). Nevertheless, I think that if there exists a market for this, and there are already apps that support global mobility, a chatbot feature can be a good and differentiated added value.

Sofía: 8. I believe the more help and support you get on international work travel, the more you productive you get on your daily basis. It is quite common to submit support tickets and expenses when you are working abroad, and if you can have a 24/7 assistant that helps you follow-up and keep track of it, the better your life will be.

Tiago: 7. I think building a chatbot for a Global Mobility software is something that will differentiate your company from the competitors. I would not say that it's a primary need on a global mobility software but is something that can place your company as an innovative company. In addition to it, we often see employees that have assignments using apps and platforms to support their move. With that, tons of data are generated every day. If there is a feature to simplify that visibility and provide assistance for the employee when required, it is valuable for every end-user.

2. On a scale from 1-10, how do you classify the chatbot's understanding capabilities? Justify.

André: 7. Pretty complete. There were some moments where it felts a bit lost with some random questions, but I think it's normal due to the current chatbot simplicity. Overall I think it was very direct and provided the asked information.

Rómulo: 5. I gave this rate because I truly believe this is a starting point and just a prototype. There are plenty of areas where the chatbot can grow and can provide more natural conversations. It's common for the chatbots to asks more conversational questions such as "are you sure you want to do this", "are looking for record x", "can you describe what are you asking", those kinds of things that

make the conversation between user and chatbot look more natural and less “robotized”. As more questions and answers the bot has configured, the more trained it can get. I believe there is room to grow here and the artificial intelligence capabilities from the chatbot builders' platforms already help a lot in this part.

Sofía: 7. The chatbot seemed to be very effective in its responses, heading in the right direction in each question. There was just a moment that I felt frustrated when trying to inactivate a bank account. It asked 2 or 3 times about “What budget bank do you want to inactive” and it was a bit frustrating. But I was able to make it with the right guidance. All the rest was good and effective.

Tiago: 6. It is very straight-forward and efficient in answering what you are looking for. I was able to trick the bot by changing some unexpected parameters in the conversation. But that just happened because I was looking for gaps, and so overall the experience with it was positive, it has fulfilled what is required.

3. What is in your opinion, the top feature of this chatbot? Justify.

André: The possibility to check the status of the requests if those are already in progress, and also checking due dates of events and tasks to complete. Very interesting in the way it assists.

Rómulo: The ability to complete tasks and inactivate the budget accounts. I think the most incredible and powerful feature of this prototype is not just the capacity to read and select the data, but also the capacity on updating certain types of information. It can grow, become more complex, and be a serious assistant with keeping the data accurate and updated. Also liked what you’ve shown me about the context, the not need to specify the record identifier if it’s already in the context of a conversation.

Sofía: I really like the way it organizes the tasks and provides the relevant information about those. The possibility of marking those as closed and currently checking the due dates it’s very valuable in the context of international mobility. Would be interesting if we could set alarms based on the task's due dates.

Tiago: The updating data, being able to update and state if a bank account is active or inactive, updating profile information, emergency contacts, and so on, shows a very good capacity and scalability of the chatbots in the context of softwares and apps to be implemented.

4. What is in your opinion, the most critical gap of this chatbot?

André: Nothing that I can remember.

Rómulo: The lack of more follow-up actions. As I have said in the question before, I think it’s very valuable for the conversation flow if the chatbot can be more interactive and not work as a simple robot to answer things. Asking for feedback and make more conversation with the end-user tends to improve the chatbot adoption, independent from the industry and field of action.

Sofía: I missed providing information about the closest service providers. I am very used to Google Assistant and based on my location, I can ask things like "Where is the closest sushi restaurant in town" or "At what time will the supermarket X close". I guess I could still use Google Assistant or Siri for this but would be an added value for the chatbot.

Tiago: It is still missing some important pieces of the Global Mobility industry, like a "Learn About" area depending on the country you are going to, the possibility to read and print some compensation bonus information, replying to feedback questionaries about the move, and a couple of other things. But for a start, it is already a very interesting chatbot that covers very scenarios about the assignment. I see it as a version 1 that can grow over time and become more useful.

5. On a scale from 1-10, how likely do you think global mobility softwares will adopt this chatbot? Justify.

André: 7. It adds value in the context of international moves and expatriations, so I think it is something to consider from the software companies that work in those markets.

Rómulo: 7. I tend to agree. Chatbots are growing for a lot of years already and I do not expect it to stop. Every time we see bots in many different areas (shop sites, Facebook, etc) because they are effective and capture the customer's attention. In the enterprise area, I believe it makes sense to build anything that can reduce time in repetitive and time-consuming tasks, and chatbots are a good way to provide it. I do not see why it will be different I the Global Mobility Industry.

Sofía: 8. For sure. It is becoming more often to use assistants to provide information and guide on completing tasks. I do not see reasons for a lack of adoption specifically in this area.

Tiago: 10. I really believe this is a game-changer in the Global Mobility industry. I do not know any global mobility software that has one and I really think that the first one to do it will be considered super innovative. Plus, it has a significant gain for either the employee on move (who can have assistance on things to complete) and their managers (who will have more time to their own tasks since the chatbot can help on providing part of their support).

6. How do you see chatbots in the future and what will they be capable of? Justify.

André: I think those will become more complete and will be more capable of providing help and guidance for its users. Right now, some people find those annoying, and without many capabilities, but with time I believe this trust in the machine will improve.

Rómulo: Becoming a central piece on each software, site, or platform. I believe that the future of Informations Technology relies on, not only, but 2 major areas: robotics and voice recognition. The chatbot capabilities and survival are dependent on these two. I see chatbots in the future acting in critical areas like medicine, justice, and more. The more the technology grows, the more we see powerful and better robots, better assistants. We can now look at an Alexa, and it can turn on the lights in your living room, schedule an appointment, order a pizza. The future is bright for chatbots

and the growth of those in the last 20 years only makes me think that we are just in the beginning, and in the future, they will pass from a nice-to-have thing to a must-to-have tool.

Sofía: I think they will grow and be placed in areas that currently they aren't. With the right marketing strategy, in the digital marketing place, chatbots can be very powerful and reduce the time on leads phone calls, which can be an incredible time-saver for all companies. I think we will see it more often considered as a fundamental element of marketing campaigns.

Tiago: I believe that as more the technology grows, the more complete and powerful chatbots will become. The growth of Artificial Intelligence and the capacity to understand and make conversation with users can empower chatbot adoption by software and other companies around the world.

4.5.4. Discussion

The following analysis will be referring to the interviews accomplished within this Evaluation chapter. The obtained results from the 6 questions can be discussed individually to better understand the built artifact (Green Chatbot) in the context of a Global Mobility scenario. Question 1, 2, and 5, since those are structured questions with a scale-answer format, will have a quantitive and qualitative analysis, and the remaining 3, 4, and 6 will have a qualitative analysis, given that those are classified as unstructured open-ended questions, that will give the chance for the participants to express their feelings regarding the chatbot usage and potential future application for it. All of this will capacitate us to evaluate the built prototype.

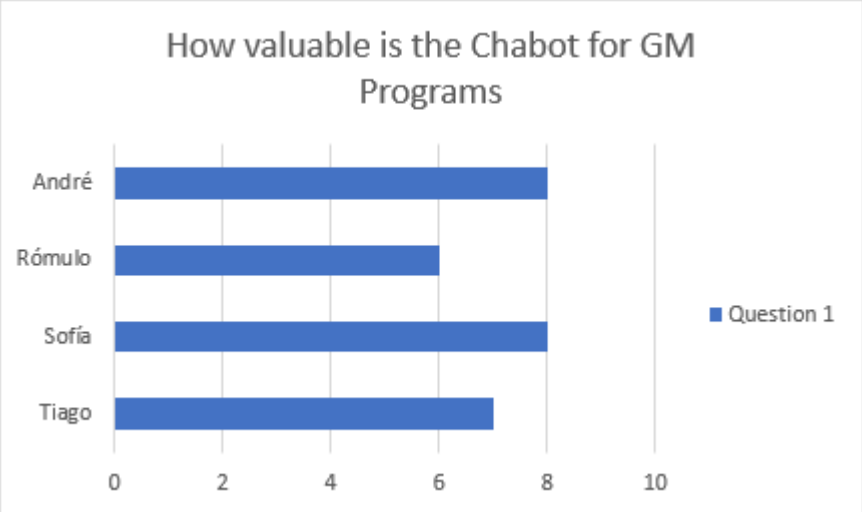


FIGURE 37 – EVALUATION QUESTIONARY (QUESTION 1)
SOURCE: AUTHOR

The participants have attributed to the Green Chatbot value, in the context of Global Mobility, a classification of 7.25 points (out of 10), on average, which can lead us to conclude that the perception of value is good and that it can have a positive impact when used as an artifact during international mobility programs.

If we make a more detailed analysis of each participant's answer to Question 1, we can understand that there is a common advantage out of the chatbot usage which is the support on keeping up to date with tasks to complete, submitted requests, and expenses.

Also, there is a non-related answer opinion which states that having a chatbot as an available feature, marks a position of innovation for the company, which is interesting because it evaluates the value of building a chatbot not just as an interesting tool for the global mobility employee user, but also because it places an innovative and trend follower position for the company that uses it.

In the lowest rank evaluation received (6), the main reasons for that rely on the fact that people are often used to perform the available actions the chatbot provides, in other platforms/apps that are designed for it (Outlook, Expensify, etc.). Which is an interesting point of view and something that should weigh by the moment to decide if it is really valuable to integrate and build a new chatbot in the GM software solutions, or if it is something that can face lower adoption.

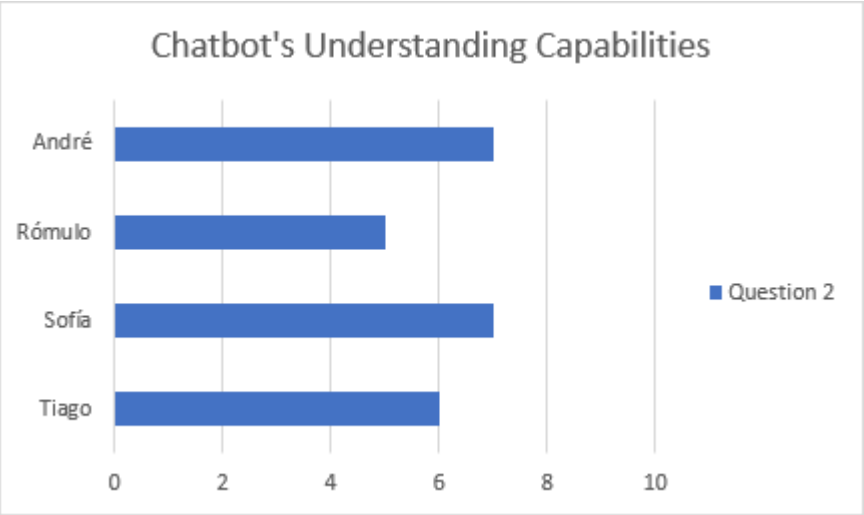


FIGURE 38 – EVALUATION QUESTIONARY (QUESTION 2)
SOURCE: AUTHOR

In Question 2, concerning the chatbot's understanding capabilities, the participants have classified the prototype bot with an average of 6.25 points out of 10. This is probably the more challenging part of any built chatbot, the capability of understanding what the user is asking, and providing a normal conversation without giving frustration to the person who is using it. This will rely on how well is the bot trained, and well are the intents and training questions configured.

In general, there were some gaps found by the participants and the Green Chatbot was not able to understand all the questions and conversations they have with it. Part of some potential future developments relies on analyzing "where" did people get stuck and build more intents and training phrases to support those limitations. A good suggestion to make the bot more user-friendly in what refers to its conversation (from the participant Rómulo), was to build more follow-up and conversational questions, to guide the user to what he wants, and to make the overall conversation smoother.

Despite the founded limitations, there was a good appreciation of the effectiveness of the chatbot when the questions were targeted to the context of Global Mobility and related with the supported prototype database.

For Question 3, the overall goal was to collect feedback on the most appreciated feature in the bot by the participants. Since it was an open question, it is interesting to understand the perception of value per each and find a correlation with their work role and technology knowledge.

For both Sofía and André, the most valuable feature of the chatbot relies on its follow-up capacity with the current tasks and items to complete, working as a 24-7 virtual assistant. The way it can provide details on the due dates of tasks, events, how it can organize those, show a summary list to the end-user, and ultimately mark those as complete, is something that would help and provide additional value on its day-to-day usage.

On a different hand, we see that Rómulo and Tiago stated as their favorite feature of the bot, the capacity on updating information in the respective database, not just working as a simple information provider. Having the bot prepared to change the information on the user profile, the

emergency contacts, the tasks, bank accounts, and so on, make the chatbot more scalable in terms of what other feature can it be applied in the future.

The participant Rómulo also expressed that one of the impressive pieces of the Green Chatbot is its ability to understand the context of the conversation. This feature, not just provides value to the bot as a whole, but also makes the conversation more “humanized”, because allows the end-users of the bot to not have to repeat every single question when the provided entity (specific bank or a specific task) is already in place. It allows the user to have a more direct conversation with the bot, which is good and avoids boring and frustrating conversations.

On the opposite side, Question 4 is focused on the most critical feature gap missing from the chatbot. And again, since this was structured as an open question, the feedback from the participants differs depending on their perception of the bot usage, considering their current knowledge about chatbots and the tech or global mobility industry in general. This question is important to collect potential future requirements for chatbot development.

One of the participants affirms that the Green chatbot should have more follow-up actions and conversational interactions, for the talk between the end-user and the robot to become and feel more natural. This is something that naturally makes the chatbot more robust and more complete, causing less frustration, so definitely something to be considered for future developments.

On a more functional side, the other participants focused their attention on missing features. Sofía stated that geolocation features for providing information about the closest services would be a good add-on to the bot, the capacity to inform on closest supermarkets, pharmacies, shops, etc. This is something that traditionally mobile phone users tend to google for it, but that can also be interesting on the Global Mobility perspective, identifying the closest services that make sense in the context: immigration services, cultural and language training classes, shipment services, among others.

Tiago, due to his background and current role in the Global Mobility Industry, as a software developer, focused their feedback on typical GM features that the chatbot did not support, such as the learning area about the host country, the capacity to consult earning statements and reports, and so on. Those will also be considered as part of potential future developments on top of the Green chatbot.

The following chart will provide the Question 5 evaluation from the participants: How do they evaluate the possibility of Global Mobility softwares to adopt and integrate the Green chatbot in their software/platforms?

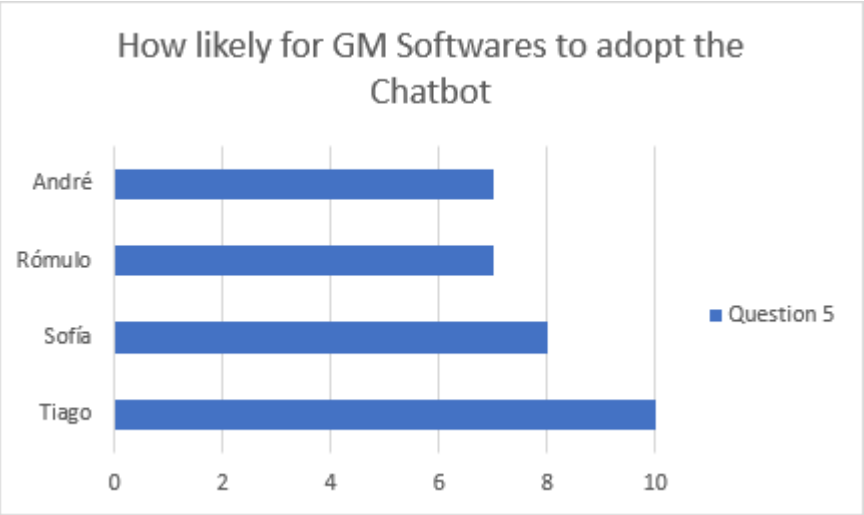


FIGURE 39 – EVALUATION QUESTIONARY (QUESTION 5)
SOURCE: AUTHOR

This question was directed to understand the perception of the participants of how well Global Mobility softwares and companies would adopt and integrate a chatbot with similar characteristics to the Green Chatbot in their own platforms.

In this particular question, a classification of 8 out of 10, on average, was the final result. People understood that having a chatbot can be a true added value for Global Mobility platforms. Since employee users already have to use a software solution to provide and work with their mobility data, having a 24/7 assistant that can provide feedback and guide the users to complete their tasks and duties, is something seen with good eyes and valuable.

Overall, participants classified as valuable because it is an extra help and fits properly in the international mobility solutions. It is becoming every day a trendy feature in the digital and software market (as we have seen in the Literature Review chapter), and it makes sense to also expand for this market. On the best classification from the participants (10), it considers a very good added value again, not just for the provided value to the end-users (mobility employees), but also for the company that provides it, because it becomes marked as an innovative company.

Last, but not least, Question 6 was the most abstract question of the survey, whose objective was to identify what do the participants think, in general, about the future of chatbots in the tech world. With no surprise, all think that chatbot usage will become more effective and those will be present in the majority of sites and platforms. With more capacity, more features, more humanized conversation, becoming more efficient in the conversations and natural language understanding. The constant growth of technologies such as Artificial Intelligence, robotics, and voice recognition, will likely launch the chatbot capacities to become the true virtual assistant, replacing the human efforts and cost with that, which can have lead to an ethical discussion and problem associated with it. Marketing, general Software, Websites, apps, are some of the areas that the participants stated that chatbots can grow. But if we think deeply, it can expand way over it, becoming a fundamental element in more transversal fields, such as medicine, justice, human rights, and more.

5. CONCLUSIONS

5.1. SYNTHESIS OF THE DEVELOPED WORK

The internationalization and overall companies' expansion outside country borders is the basis that supports the Global Mobility Industry growth. Despite the impact caused by the current COVID-19 pandemic (which affected all industries, not just this one), it is expected that it should go back to normality and continue the growth we have seen in the past years. The set of benefits and advantages, from a social, financial, and life quality perspective, that both companies and employees win with this, is becoming every day something more desirable.

To manage and track efficiently the employee assignments, software houses are working and building software, apps, and platforms to support this specific niche, and employees are able to complete their tasks, manage their calendar events, submit expenses and requests through these platforms.

The growth of chatbots and virtual assistants in the tech world, backed by the constant growth and innovation of technologies such as Artificial Intelligence, Machine Learning, and Natural Language Understanding, represent and will drive us to the overall objectives with this Master's Dissertation:

- Study a conceptual model of how a chatbot can be built for supporting the Global Mobility industry and international moving scenarios;
- Build a Product Backlog with the set of requirements needed for accomplishing and support the chatbot development;
- Create a chatbot prototype, that can later be used as guidance for real development and submit it to a user testing evaluation.

The Literature Review studied in chapter 2, which started with the GMI (concepts, challenges, and opportunities), passed on the study of Chatbots, its definition, concepts, used backing technologies, and culminating on the Software Requirements study, was the scientific basis for accomplishing the 3 proposed goals.

To meet the needs of the second established goal – building the chatbot backlog – not just the study of the GMI and Chatbot basis was important, but also chapter 2.3 (Software Requirements) helped the author on building the requirements list using standards of the agile development methodologies, specifically for the requirements definition and user stories construction. To facilitate the comprehension and readability of the backlog, the same was split into 3 different categories, depending on the chatbot functionality to be built:

- Personal & Behavioral Questions;
- Feature Database Questions;
- Feature Update Questions.

Each of the categories had a set of requirements defined, with title and description, which had the goal of supporting, with chatbot software features, the studied challenges and opportunities in the Global Mobility world, which were deeply investigated in chapter 2.1 (Global Mobility Industry).

After the first objective was reached, specifically in chapter 4.3 (Backlog Development), we were heading to accomplish the third goal, which was the challenging task of building a prototype, that could support not just what was studying in Literature Review, but also targeting part of what was defined as the product backlog.

To build a chatbot prototype, a couple of considerations and decisions were needed to be taken before starting building it. And the first one relied on choosing the right chatbot enabler platforms to support it. Given what was studied in the chatbot market analysis (chapter 2.2.5), and later deeply in the tools comparison (chapter 4.2), the selected platform was the Dialoglow (by Google). Given its simplicity, expansion capacity, integration, multi-language support, and free standard plan, Dialogflow seemed the right answer to move forward with the project.

The Chatbot was built on top of Dialogflow, and the author after creating an account in the platform started putting into practice all that was studied in chapters before, such as the creation of the agent, the creation of each intent, and respective entities (both simple and dynamic), and the respective pieces that together give place to a very useful prototype.

For a better and “more close to reality” support of the chatbot usage, a testing database was built, on top of the Airtable platform, with a set of database tables and fields, that make sense according to what was studied in the Global Mobility literature review part. This specific structure was the basis for the chatbot interaction with a dataset, specifically for supplying information on the dynamic intents, where the user could ask and update the information present there.

Also, in order to connect the Dialogflow platform API with the Airtable API, as well as performing more complex activities such as selects and updates of the database, and context usage inside conversations, a javascript webhook code platform was used called Runkit. This was the perfect marriage between the usage of a powerful platform like Dialogflow with the structured relational database in Airtable. All these 3 pieces combined resulted in the Green Chatbot, the prototype built resulting from the core of this dissertation.

After built, the Green Chatbot was submitted to a user testing evaluation, with a restricted group of 4 participants, carefully selected with different work roles, nationalities, and backgrounds, whose details of it can be found in chapter 4.5 (Evaluation).

Overall we can consider that the goals of the dissertation were fully accomplished since we were able to make an exhaustive investigation of the GMI and the Chatbot concepts and structure, a backlog full of requirements was created, and a prototype directed to what was studied was built. The evaluation part of the dissertation gave the author ideas and more direct feedback on potential future enhancements, as well as current limitations of the Green Chatbot, which are summarized in the following chapters.

5.2. LIMITATIONS

Despite achieving the overall goals of the dissertation, there were some evident limitations during the process and the prototype built. Part of those limitations will also be considered as potential future enhancements, which will also be highlighted in the upcoming chapter:

1. No real-world scenario implementation

The built prototype was done isolated, in the Dialogflow chatbot enabler platform, not integrated within any global mobility platform or solution. This resulted in having a chatbot whose context is not immediately understandable, and in the user testing session, that was evident. The author needed to guide and introduce the GM context to each participant individually, and when you don't have the context where it is being used, the value obtained out of the feature is not immediately visible.

2. No geo-location chatbot capacity

One of the good outcome features of any chatbot is the capacity of understanding the end-user location, for providing good information about the closest services. Especially, when talking about a GM scenario, a geo-location service would be beneficial for highlighting general services and cultural spots that are closest, specifically when the employee is already in the host country.

3. No connection to any external service or information provider

Within the Global Mobility Industry, some generic Data Provider services share and provide information regarding the arrival country, currency exchange rates, COLA indexes, among others. When this is connected with the software features, those tend to become more powerful and complete, for example providing a way for the end-user to exchange a specific amount from the host country's currency to its country currency. Will be considered as part of a future enhancement.

4. Not a lot of chatbot specific features

As was also highlighted in the participant's testing session, the chatbot is still in the very first draft version. The lack of more follow-up questions is something that causes the conversation between the chatbot and the end-user to not be as natural as a conversation should. Something that for a real chatbot development should be considered to anticipate frustrations from the users. Plus, the lack of more context-related intents. The context is important to cause less frustration and also to keep the conversation more natural.

5. No real database connection in the prototype

The database used in the chatbot prototype was a draft one built by the author, in Airtable, which makes the chatbot less real than if it was built in a real-world scenario. The built intents and features were limited to what that database has, which ended up being not as extended as it could.

5.3. FUTURE WORK

After this master dissertation is fully completed, it can be used as a potential artifact to support the development of a chatbot in a real Global Mobility software. The investigation covered the pros and cons of each chatbot enabler platform, a set of requirements that can be adapted depending on the context and the features wanted to provide, and with some adaptations, it can be used for the basis of a very innovative feature in a GM platform.

Therefore, the first recommendation and future consideration would be picking up this work and prototype, and trying to implement it in a real Global Mobility software, against a real used database. This is a good basis for a deeper investigation and real-world application, and with it, more intents and entities can be built to support more aligned conversations.

Something that was disregarded during the dissertation development and the prototype construction, was the UX and UI of the chatbot. The visual design of the chatbot can and should be adapted to each of the scenarios where global mobility companies are inserted. This is something that should be worked alongside with the Marketing department, to ensure the chatbot name and its visual is aligned with the patterns and branding of each company.

If the same chatbot prototype and intents are considered to be used and place, then more training phrases should be added to each of them. Currently, each intent has 3 or 4 training phrases, which is fine, but if we want to take the most advantage out of the bot conversation and the AI learning capabilities, we must add more phrases so it becomes complete.

Something to be considered and that was highlighted in the previous limitations chapter, is the connection to external services. In the GM world, there are data providers and APIs that exist to be connected and support features across the global mobility scenarios, such as the currency exchange rates, the spendable factors, etc. An analysis should be made to the existing ones, to make sure and try connecting the bot to the ones that make sense. This will provide a wider usage of the chatbot and its features.

Also to cover one of the limitations stated in the previous chapter, the chatbot, when placed in a real software, should have built within a geo-location service feature. This will make the chatbot more complete, and provide detailed information to its user about the closest services and things in the arrival country. Plus, it can be an add-on if we want to build any marketing campaign based on where the employee is located at the moment. This recommendation has a bigger weight if the end-users of the chatbot are more often using it on a mobile phone rather than in a desktop app.

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