**Haute Ecole**

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Enseignement supérieur de type long de niveau universitaire

# Chat Bots in Database Management

## Application to an energy carrier

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# Chat Bots in Database Management

## Application to an energy carrier

# Acknowledgments

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I would also like to thank Etienne Cuvelier, my school professor, for his time and the guidance he provided through the writing of my Master's thesis and preparation of its presentation in front of the jury.

Finally, I extend my thanks to Pascal Verhasselt, my school coordinator, for his input during the early stages of the project and for setting up a seminar at school where I presented the chat bot project in front of my school mates.

[1] The chat bot is referred to as EVA (for Elia Virtual Assistant) in this document.

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# Introduction

The recent improvement in machine learning capabilities has increased the potential of artificial intelligence (AI) powered applications. This development in AI paired with the chat bot technology can help energy carriers to improve their database management.

This master's thesis is paired with the chat bot project realized during my internship at Business & Decision (B&D). The project's first goal is to deliver a proof of concept (POC) chat bot, called 'EVA' (for 'Elia Virtual Assistant'), this name is also a reference to a futuristic movie about a robot girl. The project second goal is to use EVA as a proof of technology, meaning to test the chat bot technology in the database management field.

EVA is destined to be implemented at the Elia Group (Elia), the company in charge of carrying high-voltage electricity on the Belgian electricity grid. Managing the quantity of electricity on the grid is a key issue for Elia. To do so, Elia uses smart captors to measure the quantity of electricity injected or retrieved in the grid. The problem is that sometimes, the smart captors are not yet registered in all of Elia's systems, which leads to a failure to load the captured information in the correct databases. These errors create confusion for Elia's employees and can result in an inefficient management of the quantity of electricity carried on the grid.

My major at *ICHEC Brussels Management School* being *Innovation and Technology Management*, and my minor being *Information Technology* (IT), it was natural to pursue an internship in a company active in IT consulting and services, such as B&D. The thesis and chat bot project are the opportunity for me to get familiar with a domain I have an interest in, namely: AI powered applications, such as chat bots.

Following guidelines identified in literature search on how to complete IT projects, the methodology to achieve project EVA is divided into four stages.

The **first stage consists in gathering information** from the company and external sources. To insure the follow up of EVA after the end of my internship, it is of vital to meet B&D's expectations and to address the needs of Elia and of the users. Therefore, a thorough inquiry is pursued to establish what are those expectations, needs and how to make sure they are met. **The second stage is to analyze the data** gathered by using SWOT matrices to compare EVA's potential technology components and to assess their strengths, weakness, the opportunities and threats they represent. **The third stage is to configure EVA (interpreter and code components)** and to run basic functionality tests by referring to a testing protocol. The latter is different from standard testing protocol since users will not directly be involved in EVA's development. Instead, a colleague of mine will roleplay the user and try EVA out. **The final step is to suggest the appropriate key performance indicators (KPIs)** to track EVA's technical performance and efficiency. The later can be assimilated to a satisfactory answer rate (total number of satisfactory answers divided by the total number of requests).

The document is structured in four chapters, namely: 'Theoretical and practical context', 'Project definition and methodology', 'Implementation' and 'Critical review and perspective'.

# Chapter 1: Theoretical and practical context

This first chapter sets the theoretical and economic environment around the project with references to managerial and technical literature. It opens with an introduction to the 'Blue Ocean Strategy' concept and lays down EVA's implementation guidelines (i.e. how to handle IT project). Then a description of EVA's development environment regarding B&D (history, industry, performance…) is given. Previous similar projects from B&D are also referred to allow for benchmarking on EVA's value. Finally, and to a lesser extent, relevant technical aspects of EVA are mentioned: a definition of chat bots and the human-robot interactions, an insight on machine learning, a review of artificial intelligence in database management and a definition natural language processing with an illustration taken from an *IBM Watson* interaction.

## 1.1. The 'Blue Ocean Strategy' concept

In their book, W. Chan and Mauborgne use the word 'Ocean' with a special meaning: it represents a market, with its limit, size and population: i.e. 'fishes' who represent companies operating in that market (2005). When there are many fishes in the same space, fierce competition prevails to sustain and grow: the ocean turns 'bloody' red. On the contrary, when there are few fishes or none, the ocean is a place with little to no competition at all. Therefore, the ocean remains blue and there is plenty of room for fishes to sustain and grow.

Table 1 below lists the characteristics of the 'Red Ocean Strategy' and 'Blue Ocean Strategy' and how they compare to each other. From this table, the 'Red Ocean Strategy' is depicted as being mainly focused on competitors and the 'Blue Ocean Strategy' is focused on the creation of a new market space. The authors also argue to forget about benchmarks related to competition (i.e. market share) and to focus on making the competition irrelevant by outmanoeuvering the competition instead of confronting it directly.

*Table 1: Red ocean strategy vs Blue ocean strategy*

| Red Ocean Strategy | Blue Ocean Strategy |
|---|---|
| Compete in existing market space. | Create uncontested market space. |
| Beat the competition. | Make the competition irrelevant. |
| Exploit existing demand. | Create and capture new demand. |
| Make the value-cost trade-off. | Break the value-cost trade-off. |
| Align the whole system of a firm's activities with its strategic choice of differentiation *or* low cost. | Align the whole system of a firm's activities in pursuit of differentiation *and* low cost. |

*Source: W. Chan, K. & Mauborgne, R (2005). Blue Ocean Strategy - How to create uncontested market space and make the competition irrelevant. Boston, Massachusetts: Harvard business school press, p.18.*

According to W. Chan and Mauborgne, the best strategy for a company to sustain and grow is to select the 'Blue Ocean Strategy', yet choosing it is not a guarantee of success, the **approach** to creating a 'Blue Ocean Strategy' is the key (2005). This statement is backed with one study of their own, gathering more than 150 strategic moves made by companies across a time of a 120 years and across about thirty industries. Also, application of the concept of 'value innovation', created from the words 'value' and 'innovation', is necessary when developing a 'Blue Ocean Strategy' because the focus of companies should not only be on value creation neither on pure innovation but a combination of both.

Table 2 below states the six principles of the 'Blue Ocean Strategy' and how each principle can reduce risk factors. The principles themselves are divided into two categories: formulation and execution.

*Table 2: The six principles of Blue ocean strategy and attenuation of risk factors*

| **Formulation principles** | **Risk factor each principle attenuates** |
|---|---|
| Reconstruct market boundaries | ↓ Search risk |
| Focus on the big picture, not the numbers | ↓ Planning risk |
| Reach beyond existing demand | ↓ Scale risk |
| Get the strategic sequence right | ↓ Business model risk |
| **Execution principles** | **Risk factor each principle attenuates** |
| Overcome key organizational hurdles | ↓ Organizational risk |
| Build execution into strategy | ↓ Management risk |

*Source: W. Chan, K. & Mauborgne, R (2005). Blue Ocean Strategy - How to create uncontested market space and make the competition irrelevant. Boston, Massachusetts: Harvard business school press, p.21.*

To sum up, W. Chan and Mauborgne argue that a company's key to success is not to compete with other companies but rather create its own market space. The benefice of creating new market space can also fall on customers by creating a new demand. The company 'Cirque du Soleil' is quoted as an example of a company successfully applying the 'Blue Ocean Strategy' concept: they made IT a core component of their business model and delivered a 'value innovation' driven product, creating a new demand from customers in the entertainment industry.

B&D's strategy with EVA's development is an illustration an application of the 'Blue Ocean Strategy' concept. B&D aims to provide a new service within its 'ocean' boundary currently composed of the IT consulting and service market, in the geographical area of the Benelux. B&D's business environment is incredibly competitive and can be compared to a 'Red Ocean' situation. By applying the 'Blue ocean strategy' concept, B&D could outmanoeuver its competitors by going where there is no competition. Specifically, in EVA's case, B&D could expand its services range and provide a new type of service on the market. Considering the size of B&D, it seems possible, inside its 'Red ocean', to develop a 'Blue Ocean' bubble in which B&D could sustain and grow.

Furthermore, EVA is a good illustration of a 'value innovation' driven product because: first, it is 'innovative' in the sense EVA is using the chat bot technology and applying it in a new field; Second, it as 'value' in the sense it brings valuable information to its users.

## 1.2. IT guidelines

According to Bloch, Blumberg and Laartz, IT projects should follow guidelines that can be regrouped into four categories (2012):

1. "Focusing on managing strategy and stakeholders instead of exclusively concentrating on budget and scheduling.
2. Mastering technology and project content by securing critical internal and external talent.
3. Building effective teams by aligning their incentives with the overall goals of projects.
4. Excelling at core project-management practices, such as short delivery cycles and rigorous quality checks."

Comments:

Category # 1 focuses on **strategy**. First, it underlines the importance of checking whether EVA is or is not aligned with B&D's strategic goals and expectations. Through his check, the value of EVA in B&D's eye is deducted. As later described (cf. infra chapter 3, B&D's expectations, p.40), EVA is in line with B&D's strategic goal to develop new skills and acquire experience with the chat bot technology. Second, it points to the imperative to check whether EVA answers the stakeholders' needs and the importance of involving users as possible in the development process. As indicated in the introduction (cf. supra p.9), no interaction was allowed between users and me; Yet during the test phase, a testing protocol was followed with the aim to ensure EVA respond efficiently to users' requests.

Category #2 focuses on minimizing **technological risks**, i.e. securing the technical resources to complete EVA is a challenge. The availability of these resources constitutes a risk for every IT project, especially regarding EVA since the technology around chat bots is new to me and since B&D's experience in this field is new.

Figure 1 below illustrates the project success factors (PSF), per category, to pay attention to. Each category contains PSF that sometimes can seem basic i.e. clear objectives; Yet, "on average, large IT projects run 45 percent over budget and 7 percent over time, while delivering 56 percent less value than predicted" (Bloch, Blumberg and Laartz, 2012). Such risks remain, whatever the size of the project, hence paying attention to them is important.

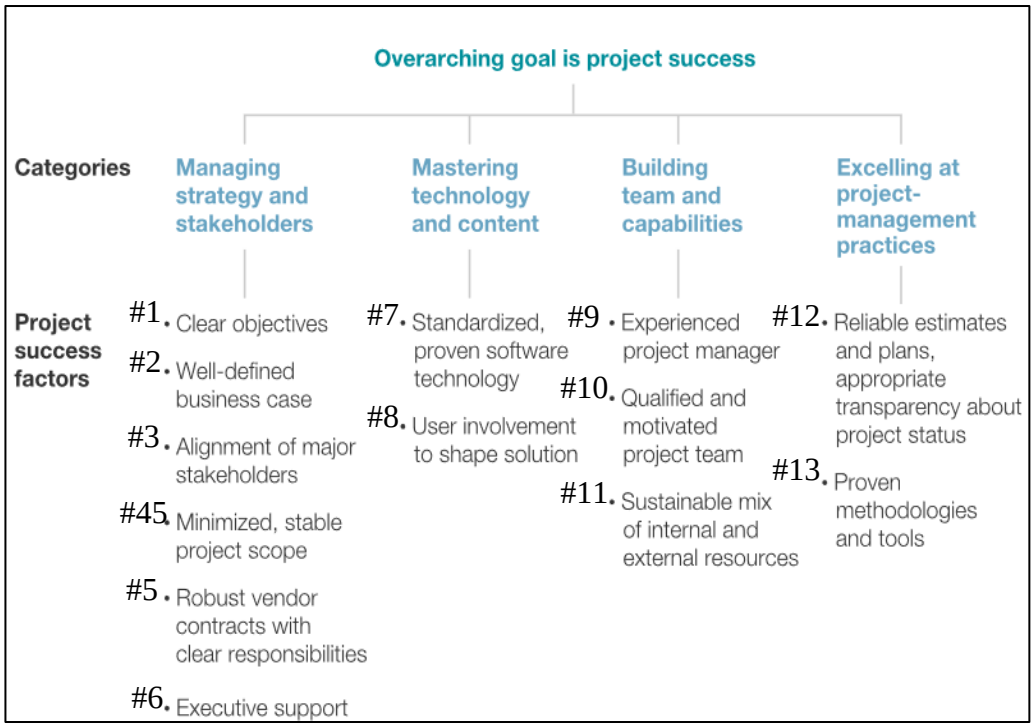



*Figure 1: Project success factors per category*

*Source: Bloch M., Blumberg S. & Laartz J. (2012, October). Delivering large-scale IT projects on time, on budge and on value. Retrieved April, 2018, from https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/delivering-large-scale-it-projects-on-time-on-budget-and-on-value*

In EVA's scope, categories #1 and #2 are the most relevant. Since EVA is developed by me only and is to be implemented at first on a limited scale, category #3 is more about making sure experts are available when needed and during the information gathering, both internal and external sources are investigated. Regarding category #4, its importance is low since the selection of many tools are imposed on the project.

To sum up, Bloch, Blumberg and Laartz provide a list of vital elements to keep in mind throughout EVA's planning and implementation. Considering the project's scope, the risk of exploding the budget is low. EVA's cost is further developed in the next chapter (cf. infra chapter 2, method and justification, objective #4, comments, p.35).

## 1.3. Environment and value of EVA

### 1.3.1. Environment

Business & Decision (B&D) is a French company operating in IT management consulting and services. It is mostly geographically active in Europe and North American. I was assigned to the Benelux region main office located in Woluwé- Saint- Lambert (Brussels). According to

the European Commission definition of SMEs, B&D Belgium can be classified as Medium-sized company.

History and context

B&D was founded in France in 1992 and since them expanded to the USA, Asia and Africa. The development of B&D Benelux, started when B&D acquired Flux Consulting in Belgium in 2004, followed by opening an office in the Netherlands in 2004, and then another in Luxembourg the following year. Recently, B&D opened an office in Anvers with the hope to gain greater presence in the Flemish region of Belgium.

At the Belgium level, the opening of a new office in Anvers highlights a will to expand in the Flemish speaking part of the country. Currently, B&D has agreed to sell most of its shares to the Orange group; this will make Orange its main shareholder. The implications of such a change are not yet established but B&D should keep its name since the company name acquired a good reputation in the Benelux region.

Mission, values and business ethics

B&D mission statement is: "*Return on investment through ROI (Return on Information)*". (Business & Decision, 2018)

B&D's values, as described by Patrick Bensabat, founder of the company, are as follows:

"*By creating Business & Decision, I wanted to build a workplace where people could feel good and enjoy their job. Looking at the professional and human qualities of our employees, I'm convinced we are succeeding in that goal. Our future will always depend on the values of people who join us." (Business & Decision, 2018)*

Industry, domain of expertise and product

B&D belongs to the sector of information technology services (Nacebel code: 62020), with three domains of expertise; data, digital and strategy & innovation.

The *Data Insight & Visualization* team, to which I was assigned to during my internship, has developed particularly in relation to the Microsoft framework, competences in data management and visual representation because expertise in these domains are highly valued by B&D's customer base.

B&D Brussels office employs 241 people, including twenty-seven support staff. To facilitate allocation of tasks in respect to competencies, employees are required to upload the latest version of their CV on a shared B&D platform. It is common practice for B&D business managers to show this database to their clients to display the skills and expertise of B&D consultants.

Competitors and key performance indicators

B&D's competitors are companies such as IBM Solutions, which is a leader in the market. Indirect competitors are software companies such as SAP Belgium.

In terms of performance for 2017 it was not possible to obtain the data because the company is in the process of being bought, B&D is legally obligated to respect the Financial Services and Markets Authority (FSMA) rules (https://www.fsma.be/en).

According to *Trends Top* website, B&D's 2016 figures are the following (see figure 2 below):

*Figure 2: B&D benchmarks compared to the median of the sector in 2016*


*Source: Trends Top. (n.d). Retrieved February, 2018, from https://trendstop.levif.be/fr/detail/453257244/business-decision.aspx*

Comment: the number at the top represents B&D's performance and the other number represents the sector's median.

The website *Trends Top* ranks B&D at the 102th position in the IT Services sector in Belgium, in terms of 2016 turnover (see table 3 below). However, the other key indicators are rather encouraging. In terms of financial performance, B&D's number are expected to be higher than the previous year. Orange is likely to finalize the acquisition of B&D. This operation should be mutually beneficial since Orange would beneficiate from B&D's experience in data and business intelligence, and B&D would have access to greater funding.

*Table 3: B&D ranking for 2016*

**Classement Trends Top / Chiffres-clés financiers exercice 2016 (EUR)**

| | | | |
|---|---|---|---|
| Rang secteur | 102 | Cash-flow | 1.315.120 |
| CA ou marge brute | 23.241.573 | Investissements | 425.372 |

*Source: Trends Top. (n.d). Retrieved February, 2018, from https://trendstop.levif.be/fr/detail/453257244/business-decision.aspx*

### 1.3.2. B&D current experience in similar projects

Shortly after the start of my internship (January 2018), a team of B&D consultants participated in a "*Hackathon*" organized by GlaxoSmithKline (GSK). The problem to solve was the booking and management of meeting rooms available at GSK main building (more than 400 rooms including many meeting rooms). B&D's team came up with the idea of using a chat bot to assist employees in booking a room including tracking of their actual occupation. The solution developed by the B&D team convinced the jury and it won the Hackathon. Since then, part of that same team is working on a POC to follow through with the project and submit a full offer to GSK. The main framework used to develop the POC chat bot is the Microsoft Azure Platform, which is the same framework EVA is built on.

Late 2017, B&D developed a customer oriented chat bot for a bank. The chat bot, now active on the bank website, aims to help customer answer the most frequently asked questions. This way, instead of spending time on the phone with the bank help line, the customer directly finds the information on the website via the chat bot. During their interactions with the chat bot, the customers can enter their identity and have a personalized answer, for example regarding the banking policy they subscribed to.

### 1.3.3. EVA's value

Regarding B&D, as mentioned in the introduction (cf. supra introduction, p.9), one of the underlying goal of the project is to test the chat bot technology in the database management field. From the two elements gathered in the part above (cf. supra chapter 1, B&D experience in similar projects, p.17), the chat bot technology is relatively new to B&D and therefore, EVA is pioneer project. In addition, there are currently at least three other chat bot-related projects ongoing at B&D, which furthermore highlights the important of this type of project.

Elia is highly interested in improving the quality of its data as illustrated by a project they launched last year in data strategy. The initiative consisted in implementing the 'EDW Data Quality' project to help tackle the company's data quality issues. This is considered as a central issue by Elia. From this we can deduct EVA will also be valuable to Elia, and this motivates the B&D chat bot project initiative.

## 1.4. Chat bots and human-machine interactions

Chat bots, short for "chatting robots", are computer programs which conduct real-time conversations with humans (or other chat bots), via written text or live audio.

Designing a chatting machine that would be as capable to conduct a conversation as an ordinary person has fueled computer scientists' imagination and ambition ever since 1950, when British mathematician Alain Turing framed that challenge as a famous benchmark for artificial intelligence.

Until recently, software research around chatting programs had only been slowly progressing and did not yield notable results. During the last years, however, notable software and hardware advances in natural language processing (NLP), machine learning and cloud computing have given rise to a host of widely available chatbots, employed for personalized (yet still limited) conversations. Some chatbots are developed as standalone applications, while others are integrated in messenger applications, social platforms and larger IT ecosystems, on a range of digital devices.

While many chatbots currently assist with specific tasks (such as placing shopping orders or finding out the weather forecast), the range of chatbot capabilities and uses is quickly expanding, spanning areas such as banking, telecom and entertainment. As a typical use case, businesses across the industry spectrum are rushing to develop and enhance chatbots for effective customer service.

While a general-purpose chatbot on par with humans is not expected in the foreseeable future, chatbots will likely evolve and enter the mainstream, as they are getting progressively better at understanding and responding to user questions and commands.

Figure 3 below is an illustration taken from the Microsoft website and represents a typical chat bot which is providing the users with information, hence the 'information chat bot' name. This figure is a good visualization of the different components inside the POC. This representation

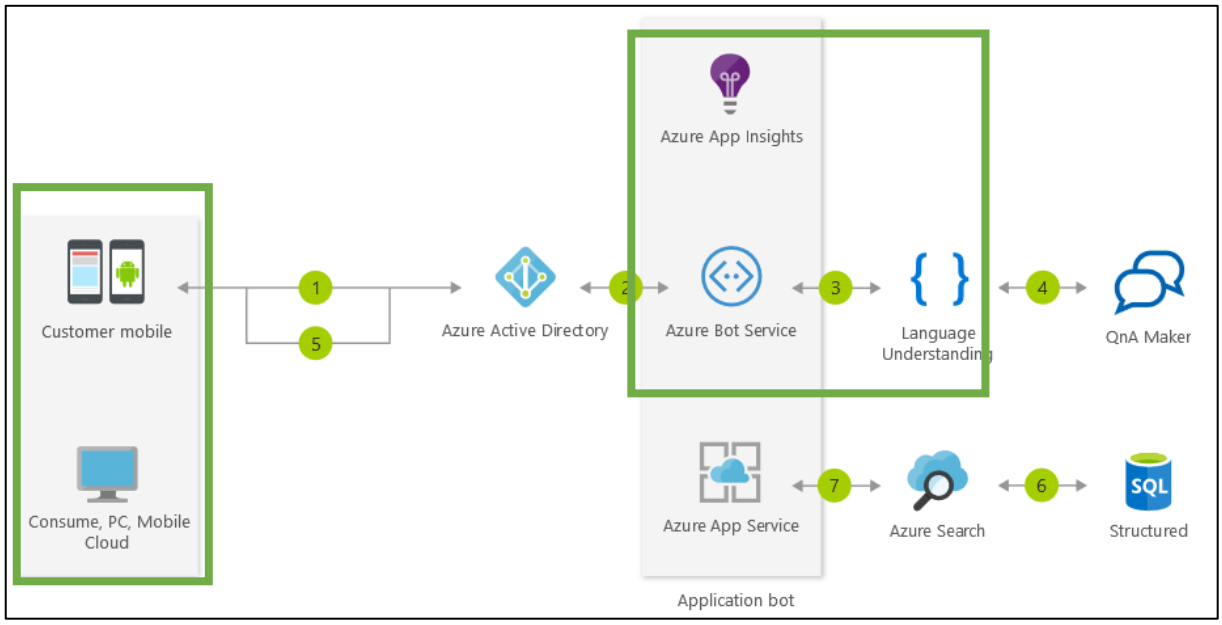



*Figure 3: Microsoft Azure – Information chat bot*

*Source: Microsoft. (n.d.). Information Chatbot. Retrieved April, 2018, from https://azure.microsoft.com/en-us/solutions/architecture/information-chatbot/*

from Microsoft is generic but particularly the steps in the two green squares below are the ones applicable to EVA.

## 1.5. Machine learning

Many definitions of machine learning exist, yet the most insightful one comes from an aggregation of individual definitions gathered by Faggella, D.:

*"Machine Learning is the science of getting computers to learn and act like humans do, and improve their learning over time in autonomous fashion, by feeding them data and information in the form of observations and real-world interactions."* (2017).

From this definition, not only we gather that computer can be 'taught', but also that they can learn autonomously.

An advanced machine learning technique is called 'neuro network', inspired by the interaction between synapses of the human brain. Just like the human brain, the more 'neurons' it possesses, the more complicated reasoning a machine can do. This approach is called 'deep learning', it uses a combination of advanced statistical techniques to weigh inputs, transforming them into several aggregates which are evaluated through performance indicators. The best aggregates emerge and continue their comparative life into the network while the other stops. Its typical application is in the field of image recognition.

To put the importance of deep learning into a global perspective, according to figure 4 illustrate the investment in deep learning research, China leads the way with a record of 350 publications in 2015.

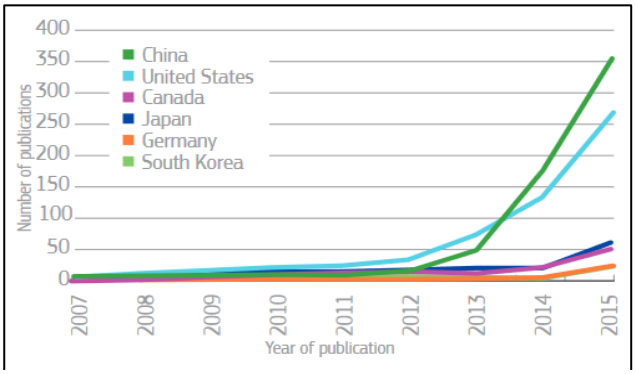



*Figure 4: Number of publications of deep learning related articles over the years*

*Source: European Commission (2018, March). The Age of Artificial Intelligence, towards a European strategy for human-centric machines. European Political Strategy Center Strategic Notes. PDF: ISBN 978-92-79-81355-9. DOI: 10.2872/481078. P.4..*

In 2017, the world was struck when *AlphaGo*, a computer program, defeated the world Go champion. Previously, other computer programs have defeated human players i.e. in 1997

when the World chess champion lost to *Deep Blue* and in 2011 when *IBM Watson* won the game '*Jeopardy!'*. Yet *AlphaGo* achievement was labeled as astonishing given the complexity of the Go game itself. Like chess, Go is a strategy game involving two players using black or white pons over a board. The goal of this ancient Chinese game is to capture opponent's pons and control as much of the board as possible. The difference between chess and Go is that the later cannot be modeled with an issue tree since one move can trigger an almost infinite combination of future moves and it is complex to evaluate which move is best. To master the Go game, the computer program had to combine a new form of issue tree and a more advanced machine learning technique: deep neural network (deep means the input is weighted by several layers). At the start, *AlphaGo* played against human players and from the interactions, it gathered its own understanding of the game. Nowadays, the latest versions of *AlphaGo* no longer play against humans but it plays against itself, enabling it to learn much faster and unlock new potentialities.

According to Digital McKinsey, machine learning is a key enabler of artificial intelligence development areas (2017). Figure 5 illustrates the five areas of AI impacted by the development in machine learning. The areas related to EVA are language processing and virtual agents. The biggest advantage of machines over human is that the former can learn faster and is far less likely to do the same mistake twice. In fact, by design, it is almost virtually impossible.

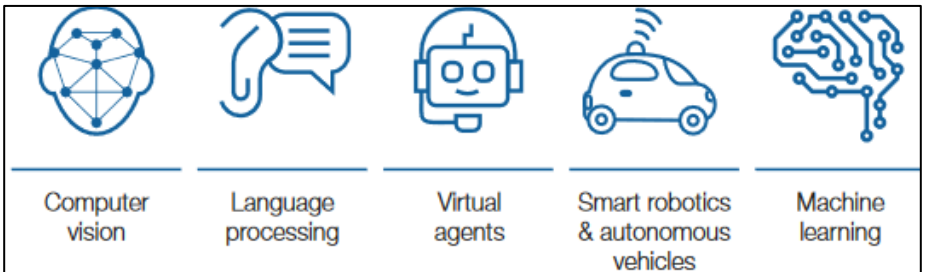



*Figure 5: Five areas of AI development in which machine learning is an enabler*

*Source: McKinsey. (2017). AI revolution. McKinsey, Forbes. From http://mckinsey.pl/wp-content/uploads/2017/09/AI-revolution_McKinsey_Forbes_EN.pdf*

In the scope of the chat bot development, one component of the chat bot, the interpreter component, has a self-taught part and an assisted learning part (cf. infra chapter 3, Configure LUISA, Train LUISA, p.59). During the configuration of the interpreter, the self-taught part gets into action: the interpreter trains himself. The assisted learning part is for example when the interpreter does not recognize the user's intent or it associates the users' intent wrongly, there is the possibility to 'guide' the interpreter manually. The net effect is that the chat bot further 'learn'.

## 1.6. Artificial intelligence (AI) in database management

According to Ghosh, "*The Smart Machine Age is upon us and is likely to disrupt many different human processes, tasks, and activities over the next 10 years and far longer as the key technologies continue to develop.*" (2017). This illustrates well the wave of automation which we are experiencing.

Ghosh predicts it is no longer humans but sophisticated AI applications will be able to solve many problems, thanks to the quantity of data which machines can use to train themselves and develop better algorithms. Furthermore, the article urges to prepare ourselves for the coming implications of AI at the workplace, deep learning and data management, internet of things in relation to the algorithm economy and the use of AI applications in several industries. AI at the work place "can end up saving about 2 trillion in annual wages" (Ghosh, 2017). Even senior managerial positions are at risk of being automated.

To highlight the importance of AI, figure 6 below taken from the European Political Strategy Center Strategic illustrates the rise of investment in 2017 in AI throughout the globe (2018). To go more in details, it also illustrates the domination of North America (mostly the United States of America) in terms of share of investment in AI.

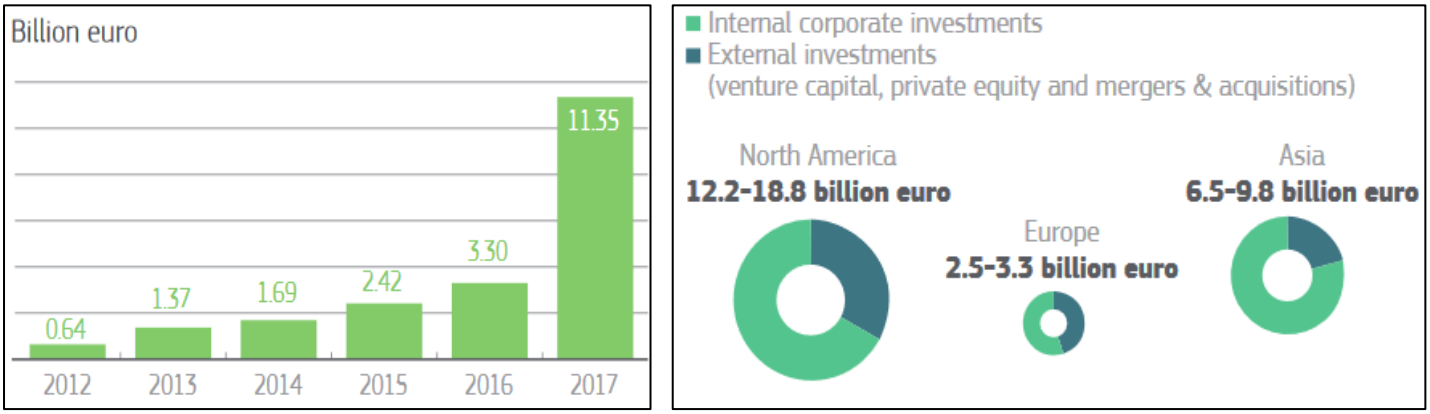



*Figure 6: Global AI investments over the years (on the left). Global AI investment per geographic region in 2017 (on the right)*

*Source: European Commission (2018, March). The Age of Artificial Intelligence, towards a European strategy for human-centric machines. European Political Strategy Center Strategic Notes. PDF: ISBN 978-92-79-81355-9. DOI: 10.2872/481078. p.2. and p.5.*

Regarding Internet of Things' (IoT) and the algorithm economy, it appears the algorithms market has become a competitive differentiating factor between companies offering similar hardware products. It is predicted that "data management will be driven by algorithms and AI applications far into the future" (Ghosh, 2017).

Regarding AI applications in industries, the industry that relates the most to EVA is the industrial operations industry. Companies already familiar with IT analytics are using the full potential of AI to "optimize real-time business operations with 'unprecedented granularity, preciseness and impact'" (Ghosh, 2017).

According to Ghosh, we gather a smart automation wave is on its way. Putting jobs at risk but also providing opportunities to benefit from super computer programs. With the help of machine learning technique and other capabilities, computer programs can solve more complex problems in creative ways since they have their own understanding of the problems and therefore, can come up with their own solutions.

As discussed above, via machine learning, computer programs feed on information provided, in a way, the more information they capture, the more intelligent and better understanding they accumulate. Fortunately, for the computer programs, a vast amount of data is available to them in almost every domain.

The number of data generated around us has dramatically increased. We observe the increasing number of connected objects which have incorporated in them functional devices (i.e. smart watches tack location and heart rate). This can be assimilated to the IoT concept, in which objects are connected and can share information between them. Another element is the increasing speed of calculus of processors, which still follow closely Moore's law (the capacity of processer doubles every two years). One last element is relatively low cost of storing data, i.e. using Cloud services. Yet the abundance of data brings two main issues: how to select the relevant data and how to bring values from those data. Furthermore, this abundance can lead to misunderstanding and the need for clarification.

A potential solution to the database management challenge may reside in the use of virtual assistance such as chat bots.

Figure 7 from the European Political Strategy Center Strategic illustrates (EPSC) the numbers of AI companies in the world and the domination of the USA in that field (2018). The Silicon Valley (California, USA) gathers giant technology oriented companies such as Facebook, Apple and Netflix.

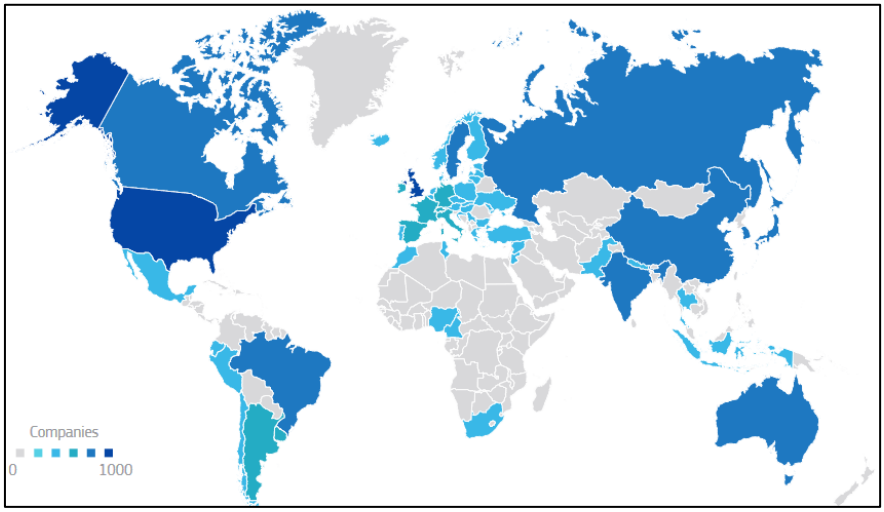



*Figure 7: Number of AI companies per countries*

*Source: European Commission (2018, March). The Age of Artificial Intelligence, towards a European strategy for human-centric machines. European Political Strategy Center Strategic Notes. PDF: ISBN 978-92-79-81355-9. DOI: 10.2872/481078. p.5.*

To put AI in an European perspective, according to ESCP: the European strategy for AI should be based on four axis approaches (see figure 8 below) (2018):

1. "**Support**. Build an environment that is favourable to the development and uptakes of AI technologies;
2. **Educate**. Focus on individuals to build AI skills and educate users;
3. **Enforce**. Deploy and adapt policy tools to tackle economic and societal challenges posed by AI;
4. **Steer**. Ensure a human-centric approach that guarantees the highest level of welfare for citizens."

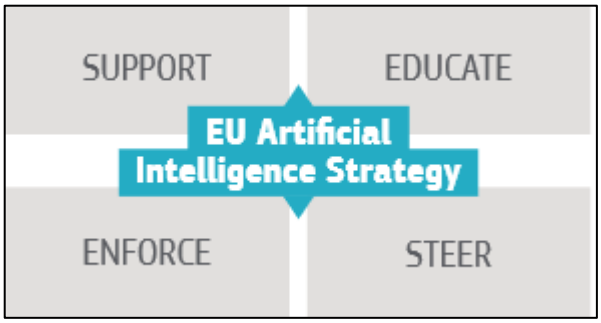



*Figure 8: European strategy for intelligence*

*Source: European strategy for human-centric machines. European Political Strategy Center Strategic Notes. PDF: ISBN 978-92-79-81355-9. DOI: 10.2872/481078. p.8*

Since B&D Belgium parent company originates from France, it is appropriate to mention the latest information regarding France stances on AI. "The French government has entrusted a task force (the 'Mission Villani') to propose an AI strategy for France" (European Political Strategy Center, 2018).

Moreover, in a speech on the 29th of March the French president, Emmanuel Macron, promised to spend 1.5 billion euros over the next four years. Macron's plan aims to make France a world leader in AI. "The strategy includes building up a network of four or five interdisciplinary research institutes, doubling the number of students on AI-relevant courses, and creating an ethics council to oversee research in the area. (Brooks, 2018). Also according to Brooks, Emmanuel Macron accepted the recommendation of the Villani mission to supervise AI development and pledged to set up an AI ethical counsel and that all algorithms developed by or for the French government would be open (2018).

From these two elements we gather the French government takes development in AI seriously and recognizes the importance to invest in the domain.

To relate this part to the project, massive quantity of data generated by Elia on the electric grid clearly brings difficulties to users to manage their data and have a good visibility. EVA comes in handy to help improve database management and to reduce users' confusion.

## 1.7. Natural language processing (NLP)

Kiser defines NLP in the following way: "*NLP is a way for computers to analyze, understand, and derive meaning from human language in a smart and useful way.*" (2016). From this definition, we gather NLP aims to capture the meaning of human conversation, including context, content and feelings. NLP has many applications and adds great value to the chat bot capabilities. For example, being able to talk natural to a chat bot is more convenient and quicker than spending ten minutes on the phone, trying to get an answer, a chat bot could easily give rapidly.

The main difference between NLP technique and the rest is that NLP understands the hierarchical structure of a language. It is usage is mostly reserved to texts analysis i.e. to summarize or perform sentiment analysis. This is important because right now most of data is generated by humans for humans. To provide machines with an understanding of human writing is to grant the machines access to all the knowledge from books and other articles. This can liberate new potential for machines in terms of learnings.

Also, NLP algorithms uses machine learning principles: fed with data, the machine learns and gathers its own understanding. So far, NLP can understand formal discussion but it is expected future version will understand regional languages, slang and culture contexts. Although language comes easily to human, because of its intricacy it is difficult for a machine to fully grasps. The best example is the challenge to make the machine understand sarcasm or idioms, both can also be misunderstood by humans. One potential lead to help machine better understand human language is to feed the machine with a new type of data: the tone (using a voice discussion channel).

As mentioned later (cf. supra chapter 3, Chat bots in customer service, p.44), the chat bot technology is now mostly customer oriented, meaning chat bots aim to fully understand customers' queries to respond accurately. In a later section (cf. infra chapter 3, Interpreting technique - keywords vs natural language processing, p.51), a comparison is made between keywords interpreting technique and NLP, which will illustrate the superiority of NLP in a customer oriented context.

NLP can be associated with sentiment analysis techniques to understand the emotions exchanged during a human-machine conversation (cf. infra chapter 3, chat bot market now and perspectives, p.46). This understanding is particularly important for company's active in industries in which the experience of the customer is vital, typically in tourism industry i.e. customers sharing their experience after a stay at a hotel. This illustrates how the chat bot technology benefit from synergies between techniques and technologies.

The best example of a computer program relying on NLP is 'IBM Watson' which uses cognitive techniques. Watson reads and interprets the text like a human would do. It aims to understand the intent of the users to identify potential answers. Watson learns, on its own, by analyzing texts but is also guided by human when necessary. This part is associated to machine learning

techniques since Watson collaborates with experts to train how to pair questions and answers correctly.

Watson operates mostly in the medical field to assist doctor to provide the best solution to individual patients. Healthcare is a predilection field for Watson to operate in since the number of parameters for each patient to consider is almost infinite. Watson can gather the parameters and identify a couple of solutions.

According to the video IBM Watson YouTube channel (see figure 9 below), here is how NLP technique works (2014):

The original message from the user is on the left. This message is analyzed (see highlighted words such as 'person', on the right). From the identification of words and context, Watson generates a couple of hypothesis. The next step is for Watson to look for evidence to back up or turn down these hypotheses.

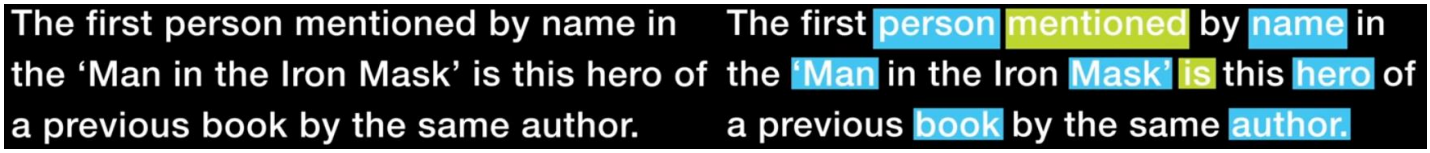



*Figure 9: Watson step 1*

*Source: IBM Watson (2014, October 7), IBM Watson: How it Works. [Video Podcast.. Retrieved from https://www.youtube.com/watch?v=_Xcmh1LQB9I*

Figure 10 on the below illustrates how each word highlighter corresponds to a hypothesis. Then each hypothesis is scored base on statistical modelling known as weighted evidence scores. The intent identified is estimated on how high the response is rated during the previous step. To sum up, via analytics Watson can glean insights that can help human experts to make better and more informed decisions.

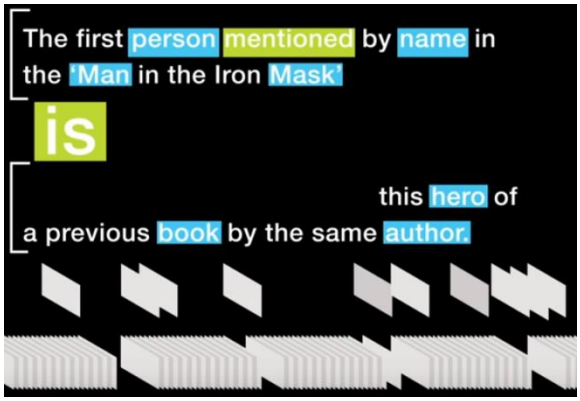



*Figure 10: Watson step 2*

*Source: IBM Watson (2014, October 7), IBM Watson: How it Works. [Video Podcast]. Retrieved from https://www.youtube.com/watch?v=_Xcmh1LQB9I*

To relate to EVA, NLP is the technique EVA uses to interpret users' queries. NLP makes EVA easier for the user to communicate with, and the challenge consists in configuring EVA's interpreter in a way the users is always understood. It is possible to assist the interpreter in the learning process by manually associating user queries with existing intents.

## Chapter conclusion

This chapter started by going over the managerial literature, thanks to which the motivations behind EVA (Blue ocean strategy) have been identified along with how to make the EVA's implementation successful by following a specific methodology for IT project management. Then the description of B&D's environment (history, industry…) was enriched by giving the economic context around the project. The similar projects carried out by B&D, such a development of a Room-Me prototype, are also referred to put EVA into perspective.

To illustrate machine learning is acting as a key the enabler of the latest artificial intelligence developments, the example of AlphaGo was illustrated. Machine learning gives power to machines to learn for experience just like humans do. Of course, the machine can learn much faster, especially if feed with the right data, and in right quantity. To gather huge quantity of data is not an issue any more since the number of device recording data (i.e. IoT connected objects).

Machine learning allowed artificial intelligence areas such as natural language and virtual assistance to enter new applications, especially in the field of customer service.

To sum up, we have now a better understanding of the chat bot technology capabilities and its various technological components. We are also aware of why the chat bot technology's potential has increased of the last years and will likely become a greater part of our lives by unlocking new opportunities for companies, in the data management field.

# Chapter 2: Project definition and methodology

This second chapter is focused the project's definition and the methodology followed to realize it. Regarding the project's definition, two figures help visualizing key elements of the project (EVA and dataset). The main goal is split into eight objectives, themselves capturing managerial and technical aspects of the project. Regarding the methodology applied, the project is realized in four consecutive stages. Also, each objective is described, commented and justified. The justifications made are based on the project success factors (PSF) identified in the previous chapter (cf. supra chapter 1, IT guidelines, p.13), the customer requirements and the constraints imposed by B&D. A table illustrates and recapitulates all the important information about the objectives and methodology. The evolution of the objectives and the planning is also described.

## 2.1. Project definition

### 2.1.1 Project visualization

Figure 11 below illustrate EVA's components and interactions with external parties. EVA is mainly made of three components: a web bot application, an interpreter (called LUISA) and a code. The web bot application is the component that brings LUISA and EVA's code together. It also enables to open discussion channels such as 'Skype Business'. LUISA delimits the capacity to understand the task the user wants EVA to perform. EVA's code is motor because it defines what EVA should respond to the user. Also, EVA interacts with two external parties, namely: users and Elia databases.

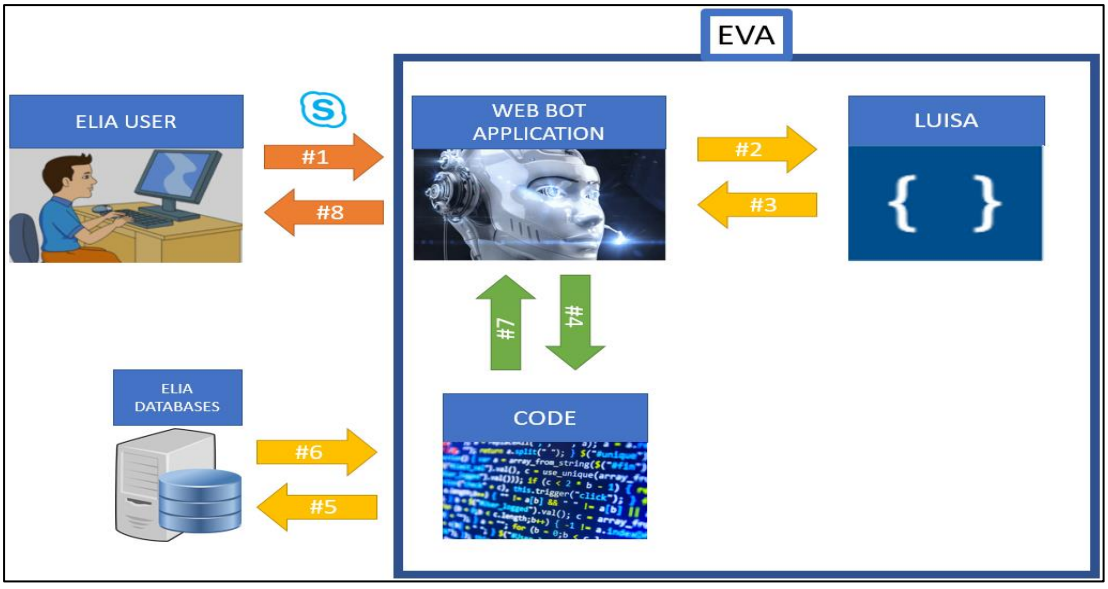



*Figure 11: EVA's components and interactions with external parties.*

Walkthrough:

The user uses his 'Skype Business' application to open a communication channel with EVA. EVA receives the user's message and passes it on to LUISA (EVA's interpreter) for it to be analyzed. Once LUISA's analysis is completed, the nature of the task the user wants EVA to execute is identified and passed on to EVA's code. If the user's request involves the task to find information in databases, the code establishes a connection with the database to retrieve the information. The information is then passed on to the user via the same 'Skype Business' communication channel.

### 2.1.2. Goal, objectives and strategic alignment

The project's primary goal is to deliver EVA (a POC chat bot) to Elia, a company operating in the energy sector in Belgium. EVA aims to assist users at Elia to retrieve information from their databases quicker and more effectively. The primary goal is divided into eight objectives, fitting in two kinds of category: managerial and technical objectives. The objectives are as follow:

#1: Understand B&D's expectations

#2: Understand Elia Group and users' needs

#3: Select EVA's technological components

#4: Create a web bot application on the Azure platform

#5: Create a LUIS application: LUISA

#6: Write EVA's code

#7: Test EVA

#8: Suggest a list of KPIs to track EVA's performance

EVA is an opportunity for myself to grow familiar with the technologies around chat bots, such as machine learning and AI. It is also an interesting challenge to think on how can technological development be captured and benefit the business world. In this case, the challenge is to capture the developments in AI and see how it can benefit databases management.

For B&D, EVA is an opportunity to acquire new knowledge in the promising chat bot industry, and simultaneously, to create a valuable demonstrator / business case on chat bot technology to display to their existing and prospect clients. This is in line with two of B&D's objectives, namely to develop their expertise in the natural language processing technology and in machine

learning. Elia is already one of B&D's client for five years, technically managed by Fernando. B&D aims to submit EVA in the hope the client will chose to fully invest in its deployment.

During the welcome session *Data Insight & Visualization* team presented their strong points and potential development areas. EVA perfectly fits in the two domains where my team is willing to improve, namely: natural language query and machine learning (cf. infra chapter 3, Figure 12, p.40).

To sum up, I can confirm EVA is well aligned with Elian and B&D's strategic goals, and with goals of the team *Data insight and Visualization*.

### 2.1.3. Framework and constraints

The reference framework to develop EVA on is the Azure platform. This choice was imposed because B&D is familiar with this platform and to some extant most of Microsoft's products. Azure is a platform that gathers all the applications and services provided by Microsoft. This makes it easier to develop projects that require various Microsoft components. In EVA's case, for the chat bot to work, it necessitates a web bot application (so the bot is accessible online thanks to communication channels like 'Skype Business') and an interpreter (developed on LUIS platform, another Microsoft application). It is convenient to have a central location to gather EVA's components.

For the interpreting technique, NLP was also imposed for EVA since developing knowledge in the natural language is one of the goals of the B&D *Data Insight & Visualization* (cf. supra, chapter 3, B&D's expectations, p.40)

While the technical domain of EVA is new to the company, there are many colleagues, including myself, who presently work on chat bot related projects. Mastering the technical skills (i.e. programming the chatbot) is the most challenging part. Training on chatbot technology could have been requested, but the time frame is too short to follow a training and training is scarce. Academic publications find it difficult to catch up to the latest technological developments. Fortunately, the resources online are numerous, for example: the website *Class Central* offer a list of free classes.

Regarding users, not being able to involve them in EVA's development process is an important constraint and risk. The most likely reason behind this is B&D is reluctant to put their client in contact with interns (such as myself).

To sum up, the constraints are numerous yet they help to focus on other parts of the project, especially since the chat bot technology was not familiar to myself at the start of the project.

### 2.1.4 Dataset

The data set is a sample from the client's database. The data set is composed of two tables, namely: Error FactContractualPower and Error FactTertiaryReserveNonCIPUAssociation,

The information bellow comes from the project description document written by Fernando. I have selected the important information and rephrase some of the text:

The datasets sample belongs to the grid of electricity transportation in Belgium. The first and second tables mentioned above represent the contractual power and one of the reserves. Both tables refer to a specific energy provider. There is a specific name for the points of the grid where energy is either injected or distributed from: **metering points**. These points can be of several types (delivery points, closed distribution systems, access points…). A certain thing about these points is that there are physical devices that are capturing measurements every 15 minutes on them. These will be used to identify if contractual values are being respected. Note that these devices are mobile, and they can change position. They have nonetheless a unique identifier, called a mnemonic.

Users should ask to EVA the following question: 'why is data from contractual power not missing from the Excel sheet?' To take the example of Error FactContractualPower database, figure 12 below illustrates how the data end up there. First, smart-captors measure electricity injected and taken out of the grid a several points on the network. The data captured is sent to Elia Data warehouse which thanks to extract, transform and load (ETL) process is transferred into the two Contractual Power data tables. The green rectangle represents the actual contractual power error database.

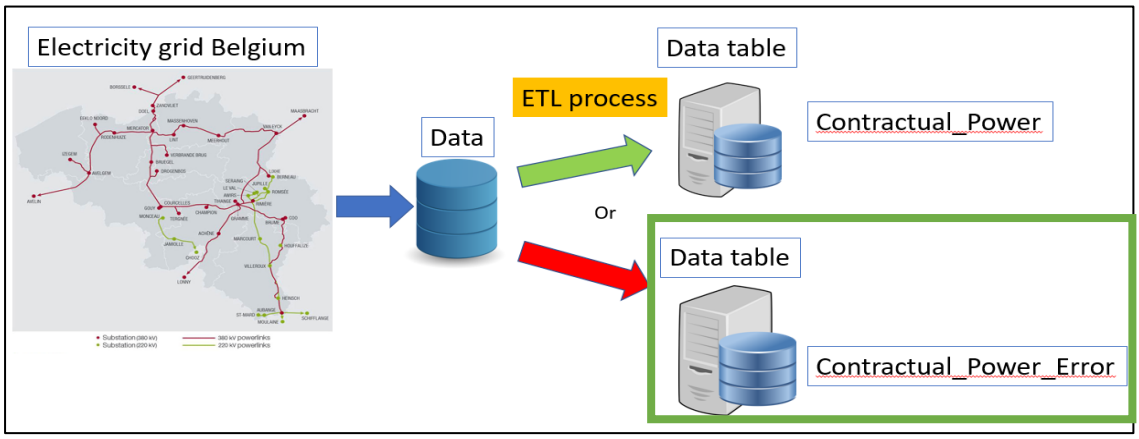



*Figure 12: Illustration of how data get into ELIA data tables*

*Source: Slide from the PowerPoint presentation made by me for the school's seminar*

## 2.2. Method and justification

Table 4 below gathers the stages, objectives, along with the method, deliverables and completion time estimated. The objectives in yellow are of a managerial nature and objectives in blue are of a technical nature.

*Table 4: EVA's method, deliverable and time dedicated (in days) for completion*

| **EVA** | | | | | |
|---|---|---|---|---|---|
| Project's goal: deliver a POC chat bot to improve database management of the Elia Group | | | | | |
| Stage | # | Objective | Method | Deliverable | Days |
| 1 Data gathering | 1 | Understand B&D's expectations | ▪ Data gathering from B&D, external sources (i.e. literature on chat bots), and through interactions with Fernando and my colleagues at B&D. | Analysis dossier | 5 |
| | 2 | Understand Elia Group and users' needs | ▪ Data gathering from external sources to the project (colleagues at B&D, Elia website…) and through Fernando. | Analysis dossier | 5 |
| 2 Comparison of technological components | 3 | Select EVA's technological components | ▪ Data gathering from B&D and external sources;<br>▪ Use SWOT matrices to compare technological components and make selections. | Analysis dossier | 5 |
| 3 Configuration and testing | 4 | Create a web bot application on the Azure platform | ▪ Log on the Azure platform and create a web bot application. | Web bot application | 5 |
| | 5 | Create a LUIS application : LUISA | ▪ Follow a development process (five tasks);<br>▪ Link it to the web bot application created previously. | LUISA | 10 |

| | | | | | |
|---|---|---|---|---|---|
| | 6 | Write EVA's code | ▪ Data gathering from the internet (i.e. Github.com and stackoverflow.com) and internal sources of B&D (Arnaud, C# programmer);<br>▪ Up load the dossier containing EVA's code on the web bot app. | EVA's code | 30 |
| | 7 | Test EVA | ▪ Follow the testing protocol. | Evaluation report document | *5* |
| 4<br>Suggest KPIs | 8 | Suggest a list of KPIs to track EVA's performance | ▪ Data gathering on frequent KPIs used from chat bots. | KPIs document | *5* |

## STAGE # 1: Data gathering

Objective # 1: Understand B&D's expectations

Methodology:

- Data gathering from B&D, external sources (i.e. literature on chat bots), and through interactions with Fernando and my colleagues at B&D.

Project success factors (PSF) (cf. supra chapter 1, IT guidelines, p.13):

- Category: Managing strategy and stakeholders

  # 1. Clear objectives;

  # 2. Well-defined business case;

  # 4. Minimized, stable project scope;

  # 6. Executive support.

- Category: Building team and capabilities

  # 9. Experienced project manager.

- Category: Building team and capabilities

  # 10 Qualified and motivated project team;

  # 11. Sustainable mix of internal and external resources.

Result (deliverable):

- Complete understanding of B&D's expectations (Analysis dossier).

Comments:

- The first piece of information to analyze was the project description document given and written by Fernando, EVA's project supervisor and my supervisor at B&D during the internship;
- Quickly, it appeared more data was needed to achieve **PSF # 1** and **# 4**. It was important to check with Fernando my understanding of the project description document, its objectives and define a defined scope;
- Regarding **PSF # 2**, EVA's description document was clear enough to define the business case;
- Regarding **PSF # 6**, from the start of the internship, I was well supported by Fernando;
- Regarding **PSF # 9**, in addition to the internal resources retrieved, external resources were gathered mostly from the internet (i.e. chat bot market trends);
- Regarding **PSF #11**, Fernando is a competent project manager with years of experience. Also, regarding **PSF # 10**, my colleagues at B&D, especially Gerrit Denayer (head of innovation team), Guillaume Assogba and Arnaud Gastelblum (C# programmers) were enthusiast and available to share insights on the chat bot technology and its components;
- The number of project success factors highlighted is high (four), which underlines the critical important of this objective.

Objective # 2: Understand Elia Group and users' needs

Methodology:

- Data gathering from external sources to the project (colleagues at B&D, Elia website…) and through Fernando.

Project success factors:

- Category: Managing strategy and stakeholders

  # 3. Alignment of major stakeholders.

- Category: Mastering technology and content

  # 8. User involvement to shape solution.

- Category: Building team and capabilities

  # 11. Sustainable mix of internal and external resources.

Result (deliverable):

- Accurate understanding of Elia's needs, average understanding of users' needs (Analysis dossier).

Results:

- Elia Group and users' needs are well described in the project description document. EVA should help users to manage two databases: 'contractual power' and 'tertiary reserves';
- Regarding **PSF # 3**, the information previously gathered during the realization of objective #1, helped to map the stakeholders and their relationships. The Elia Group (through users) and Fernando (through his team) are the two stakeholder parties. (cf. infra chapter 3, B&D's expectations, p.40);
- Regarding **PSF # 11**, i.e.: on Elia's website is advertised that last it a project oriented to increase the data quality and consequently is aware of the importance of its data quality and management practices.

Comment:

- Regarding **PSF # 8**, more details will be given in the Objective #7 below.

## STAGE # 2: Comparison of technological components

### Objective # 3: Select EVA's technological components

Methodology:

- Data gathering from B&D and external sources;
- Use SWOT matrices to compare technological components and make selections.

Project success factors:

- Category: Mastering technology and content

  # 7. Standardized, proven software technology.

- Category: Building team and capabilities

  # 11. Sustainable mix of internal and external resources.

- Category: Excelling at project management practices

  # 13. Proven methodologies and tools.

Result (deliverable):

- All the of EVA's components are identified and chosen (Analysis dossier).

Comments:

- Regarding **PSF # 7**, the identified technological components are all studied and compared. The most significative differences are between the programming languages or the interpreting techniques. The later are imposed for the project so only one

component selection is made, the choice of EVA's interpreter (LUISA). Concretely, the difference between the interpreters is slim;

- Regarding **PSF # 13**, the tools used to compare the technology components are SWOT matrices;
- Despite this objective being classified as a managerial objective, it is composed of comparisons between EVA's technological components and their alternatives. What makes it a managerial objective is the choice made regarding the interpreter.

## STAGE # 3: Configuration and testing

### Objective # 4: Create a web bot application on the Azure platform

Methodology:

- Log on the Azure platform and create a web bot application.

Project success factor:

- Category: Excelling at project management practices

  #13. Proven methodologies and tools.

Result (deliverable):

- Configurated web bot application.

Comments:

- A web bot application is created on the Microsoft Azure platform, using my B&D account and linking the application to a resource center of B&D. The resource center serves the purpose of gathering the costs of hosting the application;
- Regarding **PSF # 13**, the web bot application is a well proven tool made by Microsoft;
- It is on the Azure platform that the 'Skype Business' channel is opened for the user to interact with EVA;
- This is the component that involves cost since it consumes resources. After benefitting from a month of free trial, the billing period started. The total cost of EVA's development comes from hosting the chat bot on Azure. This cost is estimated to be below 200 euros. This amount represents the 'direct cost' meaning the extra money B&D invested in the project. Yet more indirect costs come into play i.e. regarding the time consultants and experts spent with me to provide me with guidance on the project. I also spend five months on the project and if I had been a regular employee, five months of salary would have substantially increased the total cost of the project. To sum up this point, adding the indirect costs to the direct cost increases significantly the total cost of the project.

Objective # 5: Create a LUIS application - LUISA

Methodology:

- Follow a development process (five tasks);
- Link it to the web bot application created previously.

Project success factor:

- Category: Excelling at project management practices

  #13. Proven methodologies and tools.

Result (deliverable):

- Configurated and tested LUIS application (LUISA).

Comments:

- The development process of LUISA consists on the completion of five tasks, namely:
  - **Task one** is create a new LUIS application and name it LUISA. **Task two** is to create LUISA's intents list. **Task three** is to create LUISA's entities list. **Task four** is to train LUISA to recognize the users' intents. **Task five** is the testing of LUISA thanks to the 'test' option on the LUIS application platform.
- Task two and three is based on the information collected during the completion of objective #2;
- Regarding **PSF # 13**, the LUIS application is a well proven tool, developed by Microsoft and used by many other existing chat bots;
- The following step is to train the chat bot, this training is both supervised, meaning I can manually teach the interpreter to recognize the users' intents, and unsupervised, every time the list of intents and entities is modified to make the changes effective it is necessary to launch a training, from which I have no supervision;
- This objective is the first big technical objective because it is necessary to create a set of intents and entities. Fortunately, the LUIS application platform is intuitive and ergonomic.

Objective # 6: Write EVA's code

Methodology:

- Data gathering from the internet (i.e. Github.com and stackoverflow.com) and internal sources of B&D (Arnaud, C# programmer);
- Up load the dossier containing EVA's code on the web bot app.

Project success factor:

- Category: Excelling at project management practices

  #13. Proven methodologies and tools.

Result (deliverable):

- EVA's code written and working.

Comments:

- Part of existing codes available on code sharing platform such as GitHub.com and Stackoverflow.com are identified and used for EVA's code;
- EVA's code is written on the software 'Visual Studio 2017';
- Regarding **PSF # 13**, Visual Studio 2017 is a well proven tool developed by Microsoft;
- Before the EVA's code is added to the web bot application on the Microsoft Azure platform, it is tested on 'Visual Studio 2017' software using a real-time debugger service provided by the software and a bot emulator program;
- This objective is EVA's biggest technical objective because it involves writing the code of the chat bot. EVA's code can be compared to its motor;
- As the coding is built by parts of codes from various sources, the challenge (apart from finding the write coding parts) is to assemble them and make the code perform the desired tasks.

Objective # 7: Test EVA

Methodology:

- Follow the testing protocol.

Project success factor:

- Category: Mastering technology and content

  #8. User involvement to shape solution.

Result (deliverable):

- Tested and ready to use for demonstration EVA (Evaluation report document).

Comments:

- Not being allowed to interact directly with users and involve them during the development of EVA is a risk (cf. supra chapter 2, framework and constraints, p.29). Therefore, **PSF # 8** could not be achieved;
- Nevertheless, a testing protocol did its best to overcome the obstacle mentioned above.

## STAGE # 4: Suggest KPIs

Objective # 8: Suggest a list of KPIs to track EVA's performance

Methodology:

- Data gathering on frequent KPIs used from chat bots.

Project success factor:

- Category: Excelling at project management practices

  #13. Proven methodologies and tools.

Result (deliverable):

- KPIs identified (KPIs document)

Comments:

- During the researches, two kinds of KPIs are identified, namely: KPIs relevant to assess the technical parameters (such as time responsiveness) and KPIs to assess EVA's capacity to provide users to effectively respond to the users' queries;
- The list of KPIs identified will serve as guidance;
- Regarding **PSF #13**, the KPIs suggested that are developed by Microsoft and are already available on the Azure platform, are proven metric tools (cf. infra chapter 3, 4th stage: suggest KPIs t track EVA's performance, p.67).

Global comments:

- Each method is justified directly justified by one or many project success;
- Most tools used for EVA's development are made by Microsoft and this makes it easier to combine them together;
- Objective # 1 is the one that gathers the highest number of PSF, illustrating the primary importance of this objective to a successful completion of the project.

## 2.3. Planning

### 2.3.1. Initial

At the beginning of the project, I came up with a methodology inspired from the project success factors identified previously (cf. supra chapter 1, IT guidelines, p.13), and a list of ten objectives. Each objective was allocated a certain number of days depending on two factors:

1. The importance of the task in relation;
2. The difficulty to realize the task.

In respect to **PSF #12** (reliable estimates and plans, appropriate transparency about project status), to keep Fernando informed on the development of EVA, I came up with the initiative to share with him an online Excel sheet recapitulating the objectives, the numbers of days for each objective and the current progress. This aims to keep progress on EVA transparent.

To sum up, the total of days for managerial objectives accumulated accounted for more days than the total of days for technical objectives. This can be explained by the higher number of

managerial objectives and the importance of these objectives, especially during the project's first stage.

### 2.3.2. Adjustments

**First**, the initial planning was shared with Gerrit Denayer (leader of the innovation team) since he worked on a similar project adjustment. His expertise was sought out mostly regarding the managerial objectives identified and the day estimated. **Second**, the initial planning was shared with Guillaume Assogba (programmer working on another chat bot project). His expertise was sought out mostly regarding the technical objectives of the project and the day allocated for each technical objective. **Finally**, during the seminar organized at school, I gathered insight from my colleagues and teachers, especially regarding the necessity to allow more days for difficult objectives.

To sum up, the planning went from ten to eight objectives and the duration of the most challenging objective saw the number of days allocated to them grow.

## Chapter conclusion

After this chapter, we have a clear view of the goal of the project, how it is divided into four stages and subdivided into eight objectives, of managerial and technical natures. In terms of framework and constraints, the Microsoft Azure Platform is imposed for the project since B&D and the *Data Insight and Visualization* team are experienced in using products and tools from the Microsoft suite.

The dataset EVA manages are the two error databases Contractual Power and Tertiary Reserves, which is where missing data end up, along with the reason the data failed to load in the right data tables.

The methodology followed to accomplish each objective is linked to the project success factors identified in the previous chapter (chapter 1, IT guidelines, p.13). Objective # 1 clearly contained the highest number of PSF, highlighting it as being the most important objective since the project's initiative comes from B&D and can consequently be considered as the main stakeholder of the project.

Regarding the planning of each objective, it was adjusted a first time following a meeting with B&D's experts and a second time flowing a seminar during which I presented my project at school. During the last modification, few of extra days were added to have a wider safety margin in terms of days for the hardest objectives.

# Chapter 3: Implementation

This third chapter regroups the different stages of the realization of EVA. The **first stage** is to gather data on B&D, Elia Group and users, chat bots in customer service and market trends. The **second stage** leads to the choice of EVA's the technology components and to the selection of the interpreter. The technological components selected is LUISA made on the LUIS application platform. The **third stage** is the implementation of EVA, followed by testing. The **final stage** consists in identifying the right metrics to evaluate EVA's performance.

## 1st stage: Data gathering

### 1.1. B&D's expectations

The first step for this objective was to analyze the formal project description written by Fernando. However, more information was also gathered by interacting further with Fernando and my colleagues at B&D. It terms of expectations beyond EVA's delivery, B&D expect this project to also serves as a proof of technology, meaning to test whether the chat bot technology applied in the database management field can bring value to its customers.

Regarding the B&D's strategic goal: the will to develop skills and acquire experience with the chat bot technology; since the start of my internship, I noticed the increasing interest in the chat bot technology at the company. For example, two weeks after the start of my internship, B&D participated to a challenge organized by GSK, to which the B&D team came up with a chat bot solution. B&D won the challenge is currently also working on a POC for GSK. Moreover, the number of chat bot related projects has drastically increased at B&D, proving the chat bot is a hot topic. There are currently, at least three chat bot related projects that are ongoing at B&D.

Figure 13 below is taken from a Strategic Management meeting at B&D which took place in February 2018. The figure represents the different areas of the Microsoft data platform, the green squares are the areas the Data Insight and Visualization team is comfortable. The team *Data insight & Visualization* chose natural language query and machine learning as two areas among others to improve in.

To sum up, my desk researches and interactions allowed me to understand beyond B&D's immediate expectation (delivery of EVA) and to understand EVA is also a proof of technology.

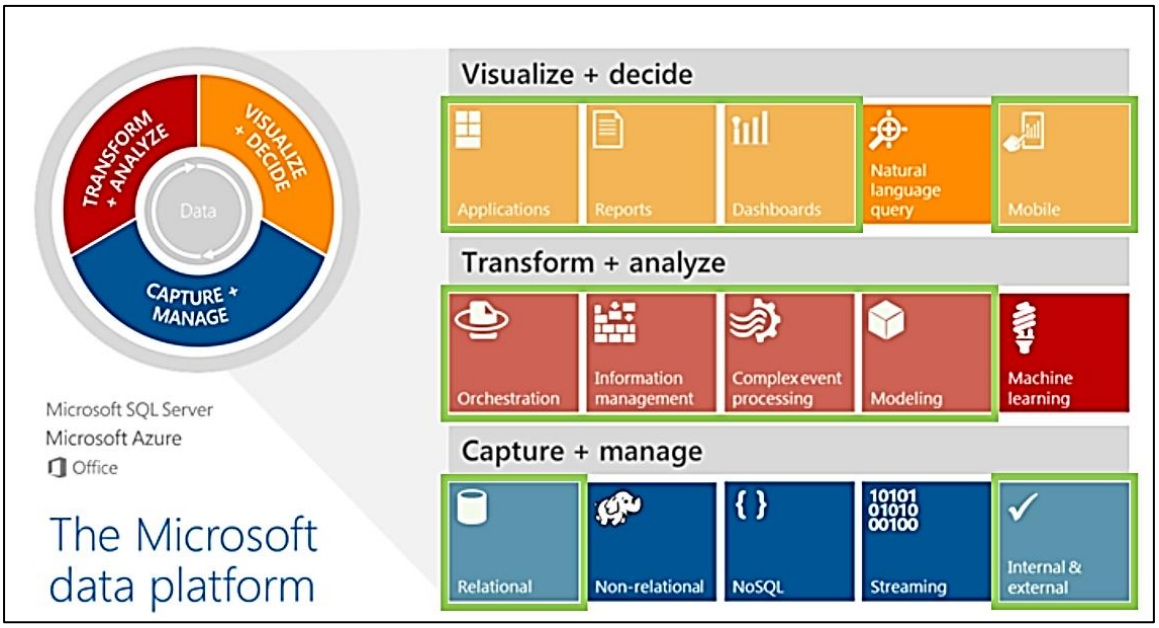



*Figure 13: Team Data Insight and Visualization strengths Microsoft data platform*

*Source: Poloniá, F. (2018, February). Team Presentation. [PowerPoint]. Brussels, Belgium: Business & Decision.*

## 1.2. Elia Group and users' needs

B&D's formal description document of the project contained a list of issues that EVA should solve for the users. As I was not allowed to interact directly with Elia, whenever I had a question, I would write them to Fernando and get answers through him. The information gathered help to map the number and profile of the users: EVA will be used by a handful of Elia employees, who are business analysts and do not have an extended IT background. This last point is important since it will guide the complexity of the interaction between users and EVA. Daily, users use an Excel file made of pivot tables, it includes key performance indicators (KPIs) and calculations ready to be used by them. The Excel file is connected to Elia databases; including 'contractual power' and 'tertiary reserves'.

When users notice data is missing from their Excel sheet, they contact the IT support helpdesk and a 'ticket' is created to document the request, which will later be investigated. Most of the time, because of time lags between the data is recorded and loaded to Elia's systems, the data appears to be missing. Yet the data is not missing per say and often, an update of the database fixes the issue but this time lag confuses users and create misunderstanding because they have no visibility on the reason why the data is missing.

For the IT support helpdesk, looking up data takes resources and times that could be spared especially since there is a huge quantity of data generated each day by the smart captors on the electricity grid is immense. Most of the time, the data end not being missing. According to Fernando, it takes about two hours per ticket to track the origin of the missing data and the IT support helpdesk receives about four to six tickets per month. This bring the costs to investigate

to about 10,500 € per year. Frequently, only one ticket needs a proper investigation. Therefore, the amount that EVA could help spare is about 8,500 €, by reducing the number of tickets to investigate.

EVA's role is to provide users with visibility on the reason the data appears to be missing, in a quicker and more efficient way. If users can't find a satisfying answer, they can still contact the helpdesk, but this time, the helpdesk will receive a snapshot of users' interaction with EVA. This interaction should contain information (i.e. dates) and assist the helpdesk to narrow their investigation.

## 1.3. EVA's template & orientation

According to Denayer, four distinct templates for chat bots exist so far (2018). On figure 14, the horizontal axis captures the impacts on business and customer relationships of chat bots per template. Starting at the far left is the most primitive template, the further right a template is, the higher its impacts. Three layers compose each column, the first layer represents the chat bot's capabilities, the second layer represents its applications and the top layer represents its understanding capacity.

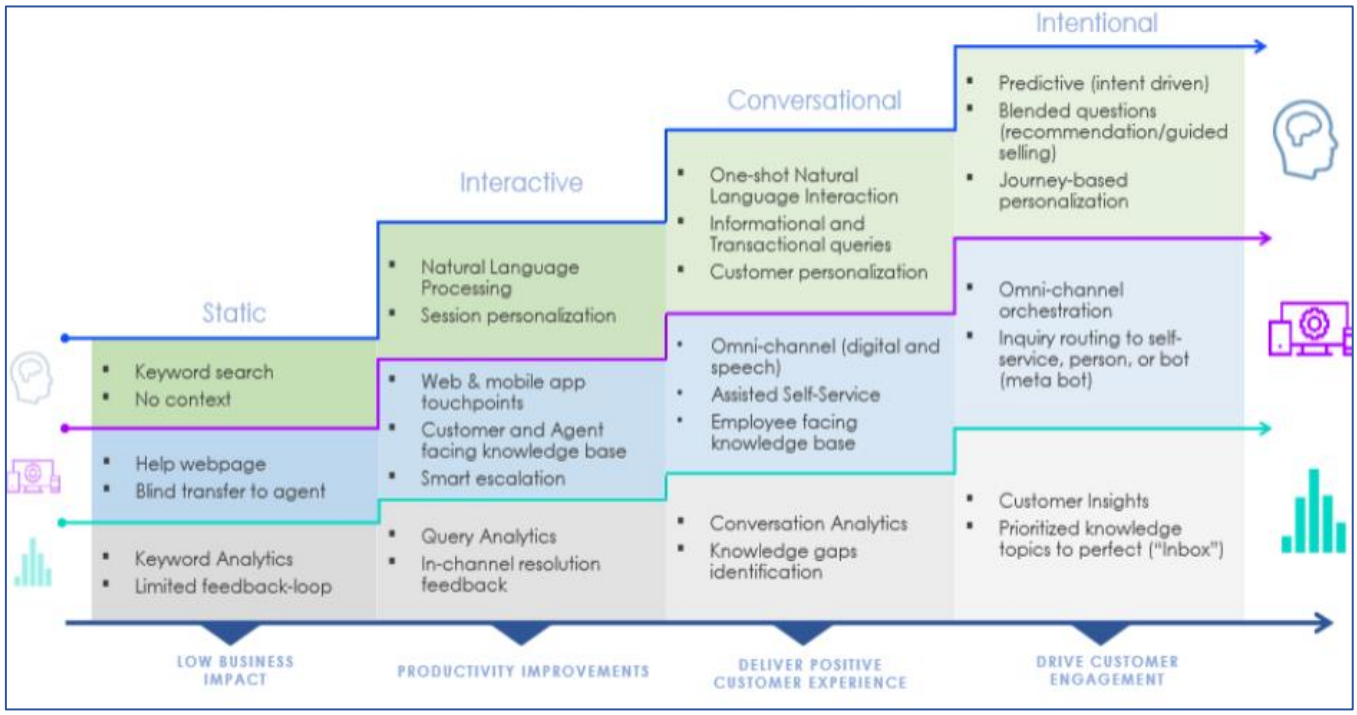



*Figure 14: Chat bot templates*

*Source: Denayer, G. (2018, 11, January). Chatbot presentation. [PowerPoint]. Brussels, Belgium: Business & Decision.*

Comments:

Each advanced template builds on the knowledge and experience gathered by the previous template i.e. to build a chat bot following a 'intentional' template, it is highly recommended to build on the learnings from the three previous templates. Otherwise, the risks of failing the chat bot project increase exponentially in terms of costs, deliverable and timing.

Starting on the left, the impact of the 'static' chat bot on business is low yet this template is fundamental since it serve as the fundamental basis for the development of more advanced templates. This template is relatable to the previous B&D project developed its client active in banking (cf. supra chapter 1, current experience in similar project, p.17).

EVA fits in the 'interactive' chat bot template and its impact on business is to improve productivity. The understanding of the users' queries is made via NLP and although each interaction could be personalized, personalization wasn't applied to EVA since it is not relevant. In terms of application, the chat bot is available on the web and is connected to mobile applications. Regarding the communication channel, EVA is accessible via the online application 'Skype Business'. This channel was chosen since it is common for most companies to use this channel. The 'conversational' and 'intentional' templates are more advanced than EVA's template but it is foreseeable that with time, EVA evolves towards those templates.

According to Denayer, four types of chat bot orientation exist (2018). On figure 15, the horizontal axis ranges from informational to transactional, the first being easier to configure and more likely to fulfill the user's requests. The vertical axis ranges from explicit to interactive conversation, which represent the complexity of the interactions between the chatbot are the users, ranging from predefined questions to complex questions. The green color is associated to a low level of complexity regarding the user – chat bot interactions, as opposed to the dark orange color indicating a high level of complexity.

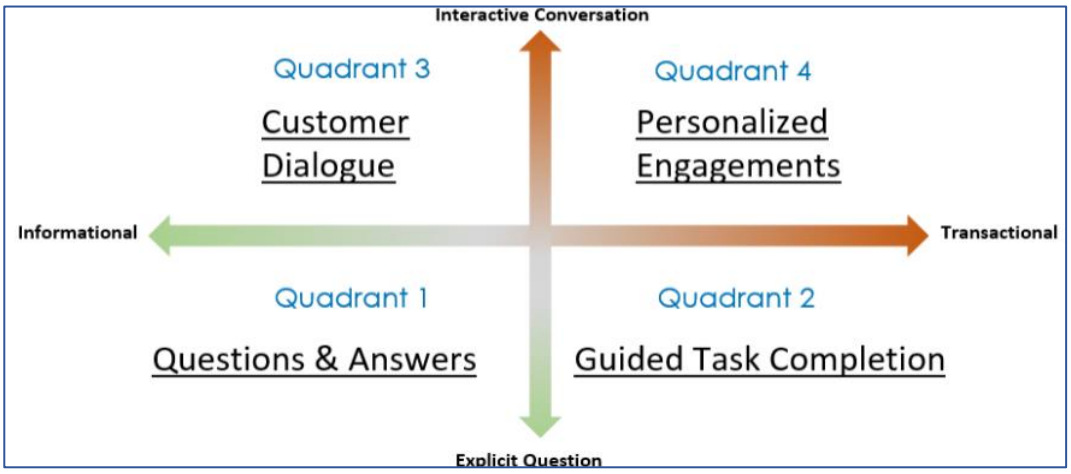



*Figure 15: Four types of chat bot orientation*

*Source: Denayer, G. (2018, 11, January). Chatbot presentation. [PowerPoint]. Brussels, Belgium: Business & Decision.*

To sum up, EVA follows an 'interactive' template. The logical step to start should have been the first called 'static', since both B&D and the client's experiences are limited with the chat bot technology. This constitute a risk that I classified as minor. Also, EVA fits in the first quadrant (informational, explicit question) since EVA's main goal is to provide information to the users' explicit questions.

## 1.4. Chat bots in customer service

According to Accenture Interactive (2016): the chat bot history begins in 1966 with ELIZA, a program simulating a therapist by analyzing the users' questions using a basic matching technique. In recent years, the chat bot has been able to benefit from developments in interpreting techniques such as NLP, which improve the communication and understanding between the human and chat bots. It also benefits from the recent breakthrough in machine learning techniques, which enables chat bots to increase their capabilities to learn, therefore reinforcing its capabilities. From these two elements, we gather that one of chat bots strongest point is their capacity to use and bring together new techniques and technologies to benefit from these and increase chat bots' own capabilities. Nowadays, chat bots are capable of handling sophisticated queries, directly through messaging apps without the need of specific apps to access a specific service.

The recent take off in the chat bots market is mostly due to two key developments: messaging services growth and advances in artificial intelligence. Regarding the first factor figure 16 below illustrates that messaging platforms gather over 3 billion monthly users, i.e. Facebook Messenger and WhatsApp users send over 60 billion messages per day. In addition to the two messaging platforms mentioned before, Line and WeChat constitute the main four messaging platforms.

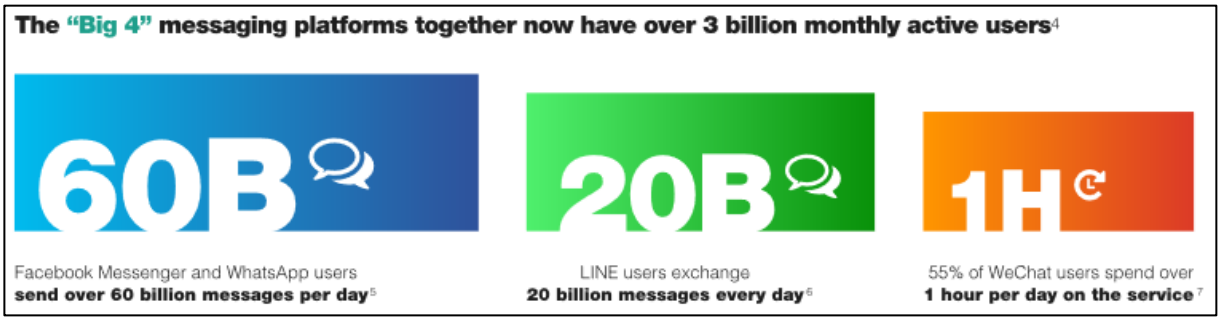



*Figure 16: Messaging platforms in numbers*

*Source: Accenture. (2016). Chatbots in customer service. Accenture Interactive. From https://www.accenture.com/t00010101T000000__w__/br-pt/_acnmedia/PDF-45/AccentureChatbots-Customer-Service.pdf*

According to Accenture Interactive, chat bots are the combination of three parts (2016):

1. **The interface** is the platform on which users communicate with chat bots, this platform can be a messaging application or a chat on a company's website. Thanks to speech-to-text recognition techniques, users can use their voice to communicate directly with chat bots, i.e. personal assistant such as Siri (Apple) have incorporated this option. NLP techniques is mostly used to understand the users' queries.
2. **The intelligence** allows chat bots to understand and resolve user queries and to gather knowledge from interactions. Now, most users-chat bots' interactions follow a predefined path which can be represented by a decision tree. It limits the operating area of chat bots and makes them task-oriented. Only a handful of chat bots such as Amazon's Alexa can pretend to be applicable in many areas.
3. **The integration levels** influence the capacity of chat bots to access data from diverse sources i.e. databases. The more integrated a chat bot is, the more queries it can answer. This part also permits users' queries which are too complex to be transferred to human agents.

According to Accenture Interactive, chat bots matter for three main reasons (2016):

a) **Results**: Chat bots get the work done. I.e. for European telco, on a set of common customer queries and resolved 82%, this number rise to 88% when combined with intervention of a human agent. It took only five weeks to train the chat bot which is a learning pace much faster than the human learning pace.
b) **Convenience**: Chat bots are easy to reach since they are available on many messaging platforms and offer a wide range of services.
c) **Future positioning**: Chat bots are a way for companies to get an understand on how artificial intelligence influences the rules of digital customer services.

In term of numbers, in 2016 Facebook Messenger had over 30,000 chat bots available. In 2017, that number rose above 100,000. Interestingly, following the troubles of Facebook with the Cambridge Analytica of 2018, Facebook has suspended the publication of new messenger bots on their platform amid concerns around privacy, which is a potential issue of ECM mentioned earlier in the sense users can potentially disclose too much information (cf. supra chapter 1, Chat bots and human-robot interactions, p.17).

Chat bots are good when operating in a delimited scope and when it involves a multiple step to fill in (i.e. decision tree). Furthermore, chat bots can process a high volume of requests from customer who are likely to be relaxed and less stressed than when they have wait a long time on the phone before they can ask their questions. In terms of expectations, about 80% of users' queries can be resolved by chat bots. Moreover, chat bots have the potential to reduce customer care costs and improve the customer satisfaction i.e. the customer will not have to wait 10 minutes on the phone to talk with a human to answer a question that can be easily answer by

chat bots. Furthermore, the chat bots can help the brand and companies' images to appear as innovators.

To sum up, chat bots can make a significant impact in customer care, whether the customer are the company's clients or business users. Now, chat bots are efficient in small scope and to perfume well defined tasks. A key advantage of chat bots is they enable companies to get a taste on how AI developments can improve their business. In the future, chat bots will be smarter and able to care a vast number of tasks.

## 1.5. Chat bot market now and perspectives

According to Quoc, the key trends driving the increase interest of companies in chat bots include (2016):

- "Growing usage of mobile messaging applications and an entire generation of mobile-native consumers who are comfortable and fluent with messaging as an interaction paradigm;
- Inflection points being reached in artificial intelligence and natural language processing that enable 90%+ accuracy in machine parsing and understanding spoken or typed requests;
- Rise of sensors, wearables, the quantified self-movement and advances in data science and analytics are bringing never-before imagined levels of personalization and predictive assistance capabilities (as well as rising concerns over privacy);
- Integration of seamless payment technology into devices, increasingly accessible to third parties via APIs;
- Increased sophistication of notifications that are context-aware and available across devices to provide an always-on, intelligent interface layers with consumers."

According to Business Insider, chat applications awoke the interests of businesses and marketers thanks to the following elements: their size, retention and usage rates, and user demographics (2016). The combined user base of the top four chat apps is larger than the combined user base of the top four social networks. Chat applications also have higher retention and usage rates than most mobile apps. Finally, most of their users are young, an extremely important demographic for brands, advertisers and publishers. Figure 17 illustrate this fact as we observe that from 2015 and on, the four big messaging applications have surpassed the four big social networking applications in terms of monthly active users (MAU).

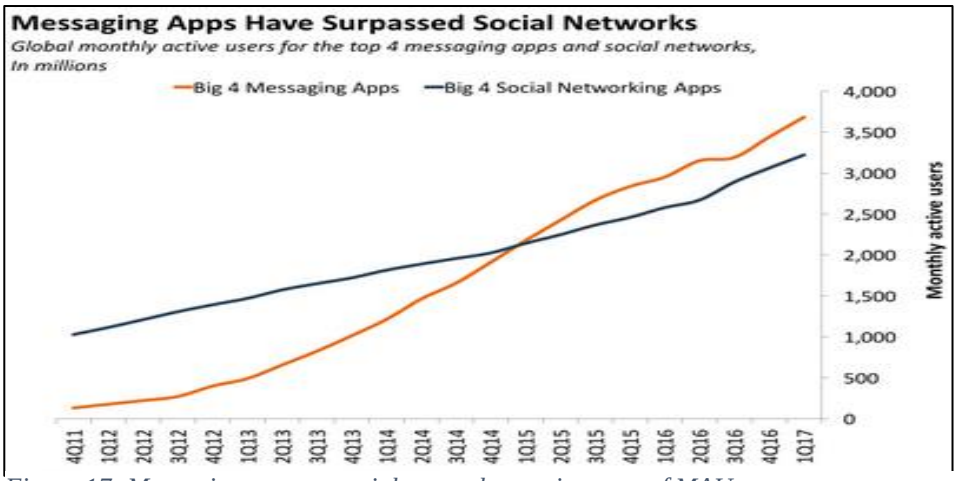



*Figure 17: Messaging apps vs social network apps in terms of MAU*

*Source: Messaging apps are now bigger than social networks. (2016, September 20). Retrieved February, 2018, from http://www.businessinsider.com/the-messaging-app-report-2015-11?IR=T*

According to Nguyen, the chat bot current ecosystem can be represented in the following way (see figure 18) (2017). Under the box 'Deployment channels' are typically messaging applications, SMS and Emails platforms on which the bot is deployed or accessible, it is where users interact with chat bots. Under the box 'Third-party Chatbots' are brands and businesses that users may use to interact with via the deployment channels such as Facebook Messenger for example. Under the box 'Enabling Technology' are companies providing the technology for third-party chatbots to develop their chat bots. The last box 'Native' gathers the chat bots made by and for the platform on which they operate, i.e. Apple's Siri.

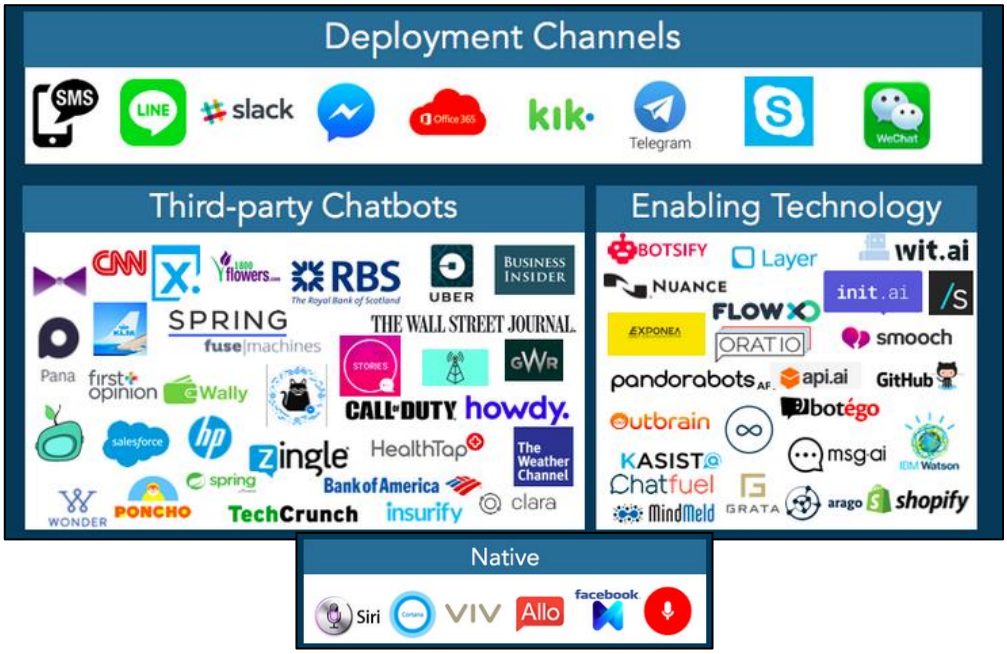



*Figure 18: Chat bot system*

*Source: Nguyen, M.-H.R (2017, October 20). The latest market research trends & landscape in the growing AI chatbot industry. Retrieved March, 2018, from http://uk.businessinsider.com/chatbot-market-stats-trends-size-ecosystem-research-2017-10?r=US&IR=T*

The increasing interest of numerous companies in chat bots enables the of many start-ups tech which have the potential to revolutionize the customer relationship and many industries in which chat bots can bring a significant value. In terms of an acceptance from users approximately 45% of end users prefer chatbots as the primary mode of communication for customer service inquires. To put the chat bot market into perspective, "the global chatbot market is expected to reach $1.23 billion by 2025, a compounded annual growth rate (CAGR) of 24.3%" (Nguyen, 2017).

From this, we gather that the chat bot market will significantly grow in the coming years and will attract many start-ups tech to develop chat bots in customer service. Chat bots will become such an important part of companies' business, it will push companies not using them yet to adopt chat bots or face being perceived as laggards.

Interestingly, in his article, Devlin refers to the "Emotional Chatting Machine" (ECM) developed by a Chinese team of scientists, the aim behind this initiative is to take human-robots beyond the functional aspect (2017). A study performed by the same Chinese team reported that "61% of humans who tested the machine favoured the emotional versions to the neutral chatbot" (Devlin, 2017). This ECMs are predicted to improve the capabilities of virtual assistants, arming them with the notion of empathy. The ECM would be able to understand emotions such as happiness and anger. The ECM acknowledges the emotions share in a conversation with the user and tailor its responses according to the emotional context.

According to Devlin, the ECM raises potential issues and brings new opportunities. For example, ECM could induce the users to divulge personal information. Another issue raised by the article is the potential risk of seeing the users being manipulated emotionally by the ECM to induce a certain behavior (i.e. make the users buy a product or adopt a certain opinion). Lastly, users may become emotionally attached and/or dependent to the ECM. There is also potential for good positive impacts, e.g. on children suffering for autism for example. This interaction with this emotional aware machine could make dialog easier for children with communication issues such as autism.

To sum up, the negative or positive impacts will depend on how ECM is used. As the chat bots are benefiting from the existing and new technologies (i.e. human emotion understanding), and gain new potential by combining them. This illustrates the flexibility of chat bots to incorporate new components and create synergies. Emotional chat bots will change the dynamic of interaction between humans and machines.

EVA is based on the Microsoft Azure 'Information chat bot' framework and does not require a sentiment analysis component now. A future development for B&D could be to investigate how ECM could bring a competitive advantage for its customers (i.e. a personal virtual assistant with a sentiment analysis component.).

# 2nd stage: Comparison of technological components

For this stage, SWOT matrices are used to compare the technological components. The first comparison is regarding the choice of EVA's interpreter. The other comparisons aim to provide information on the components being imposed for the project, namely the programming language C# and NLP interpreting technique (cf. supra chapter 2, framework and constraints, p.29). SWOT matrices enable to assess the strengths, weakness, opportunities and threats of each component regarding B&D and myself.

## 2.1. Interpreter – Dialogflow vs LUIS

| SWOT LUIS | |
|---|---|
| Strengths | Weaknesses |
| + Free basic edition;<br>+ Hands on approach;<br>+ Ergonomic / intuitive;<br>+ Testing included;<br>+ Many prebuild entities (date, email …);<br>+ Easy to integrate to the web bot application (on Azure). | – Pay for full version;<br>– Pay for support. |
| Opportunities | Threats |
| For B&D and me:<br>– New learning experience. | For B&D and me:<br>– Little experience with LUIS. |

| SWOT Dialogflow app | |
|---|---|
| Strengths | Weaknesses |
| Like LUIS (minus the integration to the web bot application). | Like LUIS. |
| Opportunities | Threats |
| For B&D:<br>+ Build on previous experiences (i.e. RoomMe).<br>For me:<br>+ New learning experience. | For B&D:<br>– More complicated to link to the web bot application. |

Comments:

Following this comparison, the role of interpreter was attributed to LUIS. The key reason is the simplicity with which LUIS can be linked to the web bot app, since the two apps were created by Microsoft, and can be easily integrated. For example, when creating a new web bot

application project on the Microsoft Azure platform, it is possible to already select the LUIS application as predefined interpreter. On the other hand, the Dialogflow application belongs to Google, which makes it more difficult to integrate with other Microsoft applications.

## 2.2. Programming language – C# vs Java script

| SWOT C# | |
|---|---|
| Strengths | Weaknesses |
| – A vast number of codes and libraries exist;<br>– B&D's consultants' experiences;<br>– Visual studio 2017 for testing and support. | – Require extensive knowledge. |
| Opportunities | Threats |
| For me:<br>+ New learning experience. | For me:<br>– Little to no experience with this programming language. |

| SWOT Java script | |
|---|---|
| Strengths | Weaknesses |
| Idem (minus the Visual Studio 2017). | Like C# |
| Opportunities | Threats |
| Like C#. | Like C#. |

Comments:

For this project, the two programming languages are quite similar, yet C# highly recommended by Fernando and therefore got selected. The key reason why C# is the best programing language to use for EVA is the availability of the software 'Visual Studio 2017', when paired with a bot emulator can be used to test the code in real time and debug it.

## 2.3. Interpreting technique - keywords vs natural language processing

| SWOT NLP | |
|---|---|
| Strengths | Weaknesses |
| + Focuses on meaning;<br>+ Can understand complex queries. | – Costs more;<br>– Takes more time to configure. |
| Opportunities | Threats |
| + Easier for the user to interact with;<br>+ Trendy. | – Lack of visibility on the interpreting technique. |

| SWOT Key words | |
|---|---|
| Strengths | Weaknesses |
| + Easy to understand and to set up;<br>+ Cheaper. | – Rigid. |
| Opportunities | Threats |
| For me:<br>+ New learning experience. | – Outdated. |

Comments:

Although the NLP interpreting technique was imposed for the project, it is still interesting to do researches on the technique and to compare it with another interpreting technique. As illustrated, the key word matching technique is outdated. Furthermore, the NLP technique is trendy and could open new opportunities for B&D.

Global comment: SWOTs are not exhaustive and focus solely on the relevant aspects of the different technological components regarding the project.

# 3rd stage: Configuration and testing

This stage is the most technical part of EVA's configuration since it necessitates to understand how to use the LUIS application platform and knowledge in the programming language C#. The LUIS application created called and referred to as LUISA for simplification purposes. The **first step** is to make a visual representation of the interactions between EVA and its users. The **second step** is to configure EVA's interpreter: LUISA. The **third step** is to write EVA's code. The **last step** is to test EVA to make sure it can understand users' requests and it is able to reply with the correct response.

## 3.1. Map of interactions between users and EVA

This part is crucial since it help understand visually how EVA interacts with users in the form of a decision tree (see Figure 19 below). The black boxes aim to guide the reader into understanding the process. The symbols on the figure are typical to a decision tree framework.

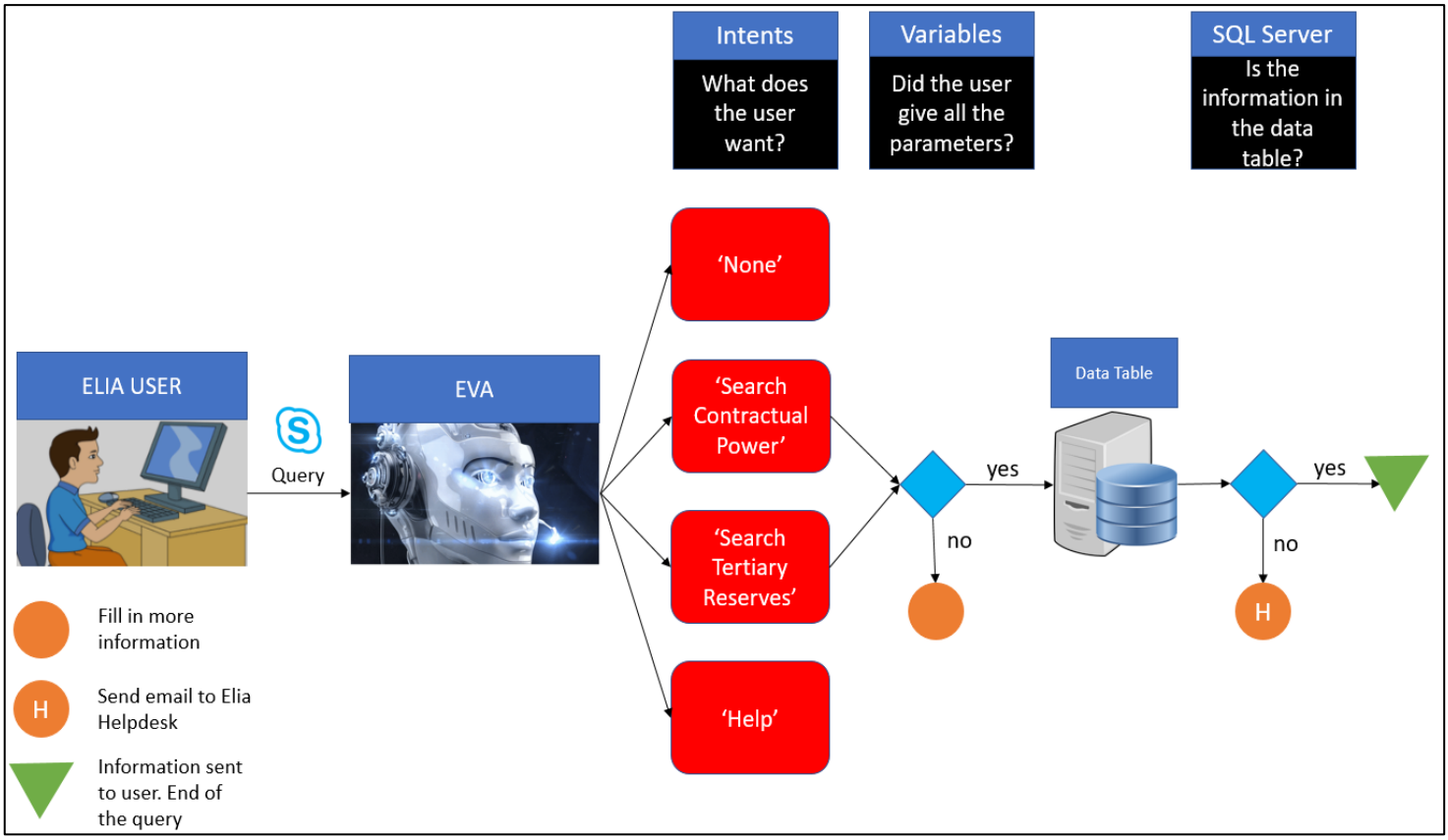



*Figure 19: Map of interactions between ELIA user and EVA (decision tree)*

Comment: Each interaction between users and EVA are via written text messages.

Walkthrough:

**First**, the user sends his request to EVA via his 'Skype Business' application. The query takes the form of a text message. The user is free to formulate his request without constraints since EVA uses a NLP technique to interpret the query. **Second**, EVA receives the message and interpret the user's intent thanks to LUISA. The two-main queries the user can ask is either to require information on data missing from the 'Contractual Power' or the 'Tertiary Reserves' database. The two databases are each associated with the 'SearchContractualPower' and 'SearchTertiaryReserves' intents.

If the user's query is too ambiguous for EVA to understand, EVA associates the user query to the intent 'None'. If the user types 'Help', EVA sends a respond message containing the type of question EVA is sure to understand.

**Third**, once EVA associates user's intent with one of the two databases information requests, EVA verifies that all the relevant parameters to the query are given by the user. If not, EVA sends a message to ask the user to fill in the missing parameters. When all the query's parameters are filled in, EVA accesses Elia's servers to look up for the reason why data is missing from the database.

**Finally**, if the missing data is in the error data table, EVA sends the information back to the user. If the missing information is not in the error data table, EVA sends a message to the user to ask if the user desires to transmit his query to Elia's IT support helpdesk, via email. This email contains a snapshot of the interaction between EVA and the user to facilitate the investigation of the helpdesk.

Comment: this part is linked with the development of EVA's code in this chapter (cf. infra the code in C#, p.62)

## 3.2. Configure LUISA

This part refers to the documentation from Microsoft.com on the LUIS application defining the following key concepts: intents, entities and utterances. These concepts are necessary to build LUISA in a structured and correct way.

To configure the LUISA on the LUIS application platform, this part follows a process divided into five tasks. **Task one** is create a new LUIS application and name it LUISA. **Task two** is to create LUISA's intents list. **Task three** is to create LUISA's entities list. **Task four** is to train LUISA to recognize the users' intents. **Task five** is the testing of LUISA thanks to the 'test' option on the LUIS application platform. Also, LUISA' configuration follows an iterative process.

### Task one: create a LUIS application and name it LUISA

This task consists on logging onto the LUIS application platform and create a new application. Since all the interaction between EVA and users happen in English, the 'culture' of the application is set to 'en-us'. Table 5 below is a snapshot of the location of LUISA on the LUIS application platform. Note that the date displayed is in US date format (month/day/year).

*Table 5: LUIS application – LUISA with culture and creation date*

| Name | Culture | Created date |
|---|---|---|
| LUISA (V 0.1) | en-us | 3/6/2018 |

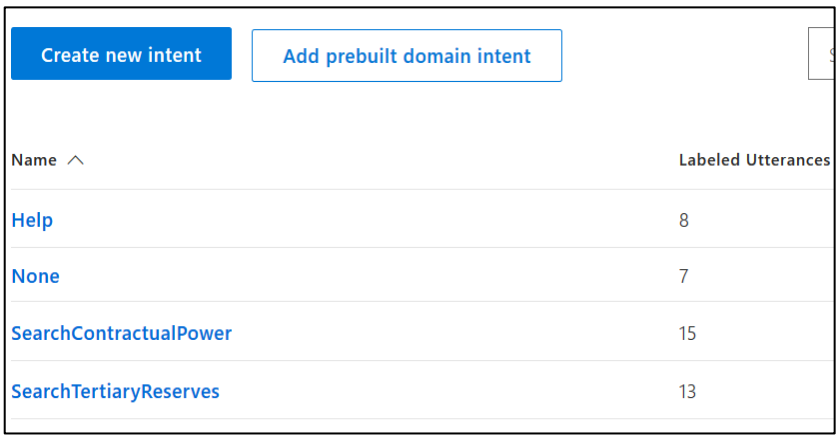
*Source: snapshot of LUISA on LUIS application platform*

## Task two: Create LUISA's intents list

To build LUISA's intents, it is necessary to understand what intents are and how to create them. According to the Microsoft, an **intent** represents a task or action the user wants the chat bot to perform. It is a purpose or goal expressed in a user's **utterance**. Utterances are input from the user that LUISA needs to interpret.

The map of interactions between EVA and users displayed above served as basis to build LUISA's intents. This combined with the information gathered on Elia and users' needs helped to determine what sort of task the users want EVA to perform. Table 6 below lists EVA's intents and the number of utterances for each intent. A high number of utterances per intent increases LUISA's chances to recognize users' correct intent. It is recommended by the documentation to use action words for each intent.

*Table 6: LUISA's intents list with utterances for each intent*




*Source: snapshot of LUISA on the LUIS application platform*

- Intent: SearchContractualPower

This intent is associated with the task to search the reason why data is missing from the contractual power database. Once this intent is recognized, it triggers an action that ultimately

leads to the enquiry of the contractual power error data table. Figure 20 & figure 21 below is a snapshot for the utterances composing this intent.

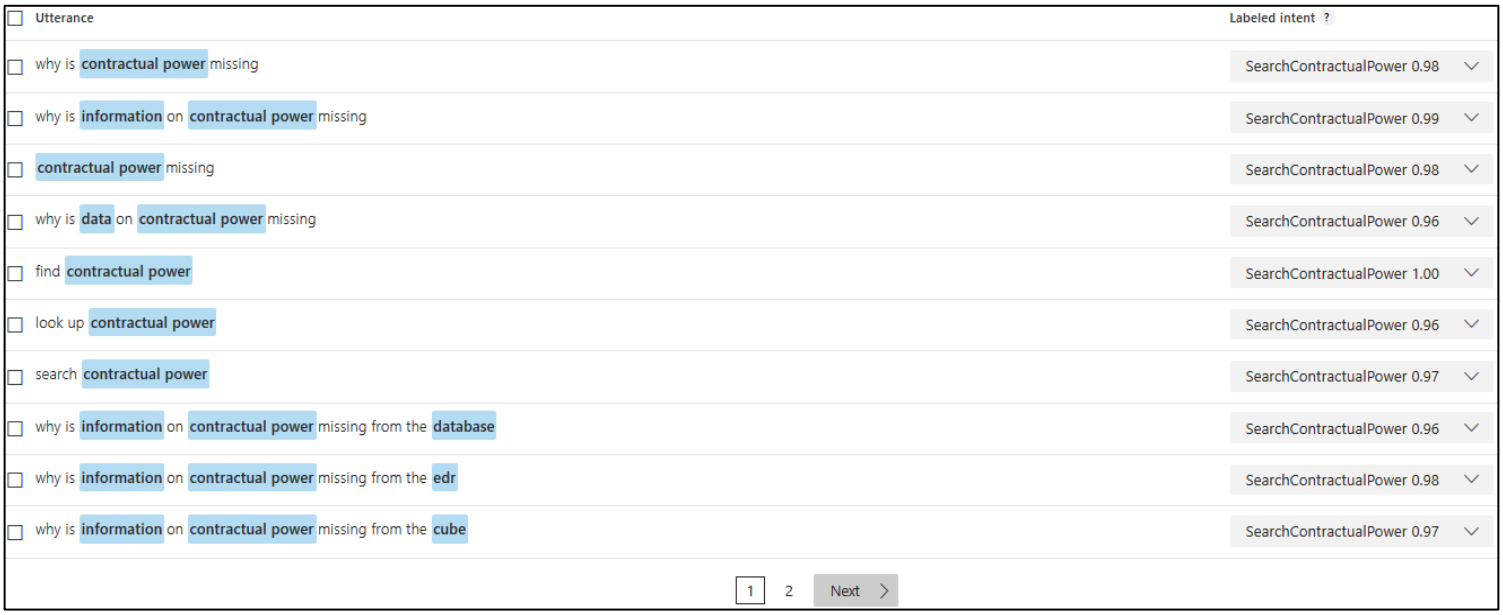



*Figure 20: LUISA's utterances for the 'SearchContractualPower' intent (page 1)*

*Source: snapshot of LUISA on the LUIS application platform*

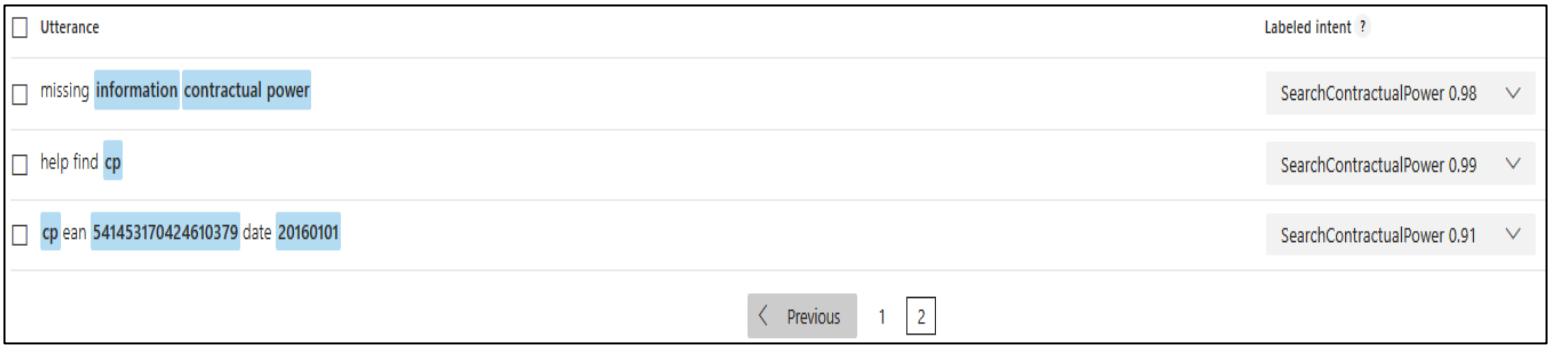



*Figure 21: LUISA's utterances for the 'SearchContractualPower' intent (page 2)*

*Source: snapshot of LUISA on the LUIS application platform*

Comments:

The blue highlight on words is for when LUISA recognizes the entities. The recognition can be done manually or automatically by LUISA. Under labeled intent (top right corner) is the intent associated to the utterance and the in brackets, i.e. for the first utterance '*why in contractual power missing*', the intent associated to it is 'SearchContractualPower' and the matching is of 0.98 on a scale from zero to one (so 98%). The higher the percentage, the better the utterance is. The utterances can be displayed in two ways.

- Intent: SearchTertiaryReserves

This intent is associated with the task to search for the reason why data is missing from the tertiary reserves database. The utterances are like the ones of the 'SearchContractualPower' intent since both intents trigger a task of the same nature.

- Intent: Help

This intent is associated to the task of providing support to users. It aims to provide users with tips on how to formulate a query, i.e. EVA sends to the user a message such as: 'try asking: contractual power missing or tertiary reserves missing'. Figure 22 below lists the utterances associated to the 'help' intent along with the match with the intent (under labeled intent).

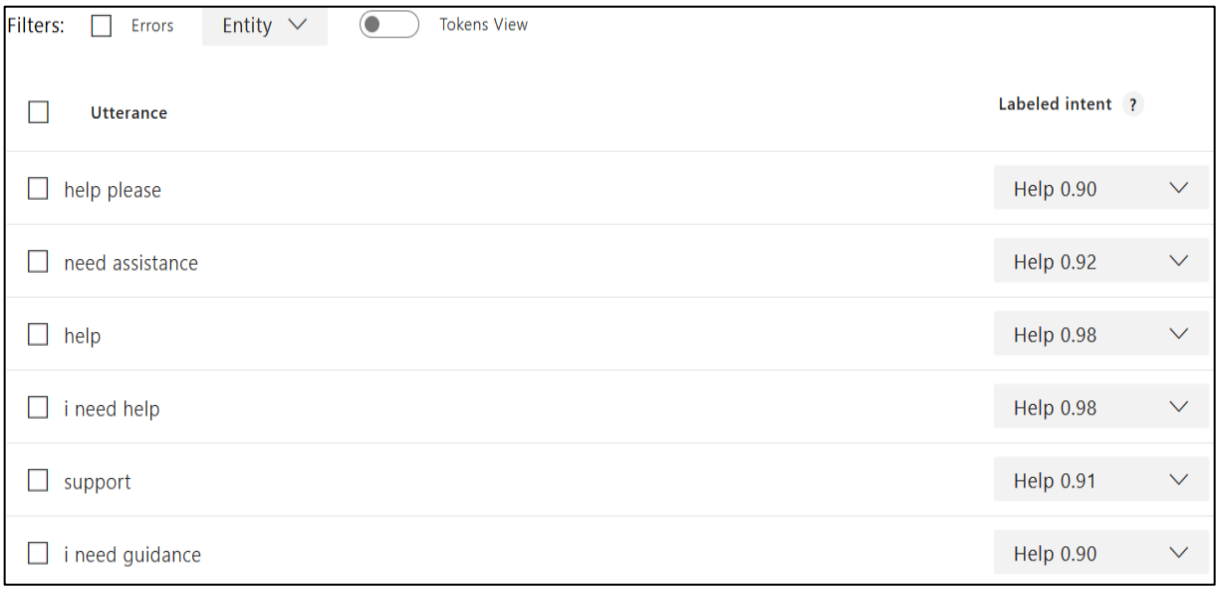



*Figure 22: LUISA's utterances for the 'Help' intent (Tokens view)*

*Source: snapshot of LUISA on the LUIS application platform*

- Intent: None

The 'none' intent exists for every LUIS application, it aims to capture users' queries that cannot be matched unambiguously with one intent. To build this intent, I used my imagination and found inspiration on conversationstartersworld.com. The utterances associated with the 'none' intent have no link with EVA's tasks or domain in which it operates. Figure 23 below is a snapshot of the list of the none utterances.

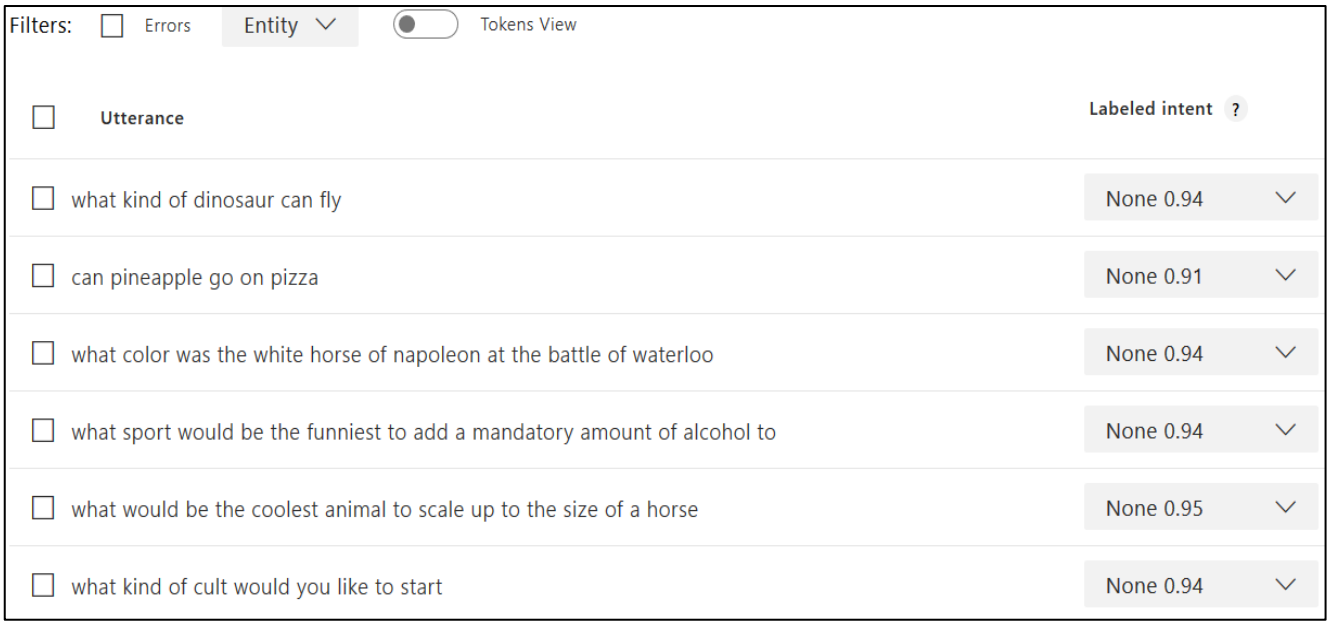



*Figure 23: LUISA's utterances for the 'None' intent (Tokens view)*

*Source: snapshot of LUISA on the LUIS application platform*

## Task three: Create LUISA's entities list

According to the documentation, **entities** are the data to be pulled from the utterance, it can be a name, date, product name, or any group of words. List have been enriched with synonyms found online. In LUISA's case three types of entities exist. Table 7 below gathers the name of the entities, the type and the labelled utterances (meaning how many times the entity appears in the utterances).

*Table 7: LUISA's list of entities, with type and labeled utterances*

| Name | Type |
|---|---|
| BeginDate | Regex |
| Data | List |
| Database | List |
| EAN | Regex |
| contractual power | Simple |
| datetimeV2 | Prebuilt |
| tertiary reserves | Simple |

*Source: Snapshot of LUISA on the LUIS application platform*

The **first type** is called ‘simple’, it is defined as a generic entity that describes a single concept and is learned from machine-learned context. Here, ‘contractual power’ and ‘tertiary reserves’ fall under this type. The **second type** is called ‘prebuilt’, these entities exist already on the LUIS application platform and represent common concepts like numbers, dates, and email. Here, ‘number’ and ‘datetimeV2’ fall under this type. The **third type** is called ‘List’. List entities represent a fixed, closed set of related words. Best used for a known set of variations on ways to represent the same concept. Here, ‘data’ and ‘database’ fall under this type. Table 8 above is snapshot of the list ‘data’, it gathers the root words and their synonyms. The **fourth type** is called ‘Regex’ and uses a matching technique i.e. to capture the EAN entity, I defined the EAN to be composed of numbers between 0-9 and the length to be exactly 18 characters long.

*Table 8: LUISA’s list for the ‘data’ entity, with root words and synonyms*

| Normalized Value | Synonyms |
|---|---|
| Data | value × values × figure × figures × input × inputs × fact × facts × statistics × |
| Information | infos × info × |

*Source: snapshot of LUISA on the LUIS application platform*

Table 9 below is an example of entities for an utterance associated to the ‘SearchContractualPower’ intent. The box in the middle of the table give more detail on each entity identified in the utterance.

*Table 9: Illustration of the composition of an utterance attached to the ‘SearchContractualPower’ intent*

| Intent | Entity | Entity in example utterance |
|---|---|---|
| SearchContractualPower | (1) {"type": "list", "entity": "data"}<br>(2) {"type": "simple", "entity": "contractual power"}<br>(3) {"type": "list", "entity": "database"} | ‘why is information (1) on contractual power (2) missing from the data warehouse (3)’ |

Figure 24 below is a snapshot illustrating how the utterance above appears the when click on the “Entities view” button. The entities are seen in their ‘root’ form. Here, ‘information’ => ‘Data’ (root); ‘data warehouse’ => ‘Database’ (root).

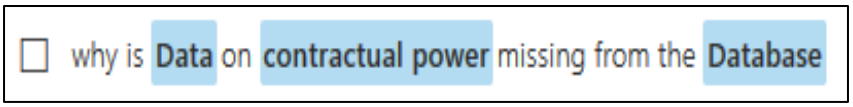



*Figure 25: Utterance from example when displayed with 'entities view'*

*Source: snapshot of LUISA on the LUIS application platform*

## Task four: Train LUISA

This task consists in training LUISA to recognize users' intents. The training involves supervised learning during which it is possible to manually guide LUISA to associate the utterances with the right intent. This is done using the 'test' option on the LUIS application platform (see, Task five: Test LUISA, below). The training also involves unsupervised learning on which I have no control on, a reference can be made to the machine learning mentioned in the previous chapter (cf. supra chapter 1, Machine learning, p.19). LUISA teaches itself to recognize users' intents thanks to the utterances provided for each intent. It is important after each modification of LUISA to click on the 'Train' button on the LUIS application platform, so the changes can be applied.

## Task five: Test LUISA

This task aims to verify that the configuration of LUISA is. Two methods exist to test LUISA, namely interactive testing and batch testing. Since the scope of the project is limited to two databases, the test type chosen is the interactive testing.

Figure 25 below illustrates an example of an utterance irrelevant to LUISA chosen purposely to check if LUISA would recognize the utterance as irrelevant and therefore would logically assign it to the 'None' intent. In this case, LUISA does not assign the utterance to the 'None' intent but to the wrong intent. To correct this, the utterance is manually assigned to the 'None'

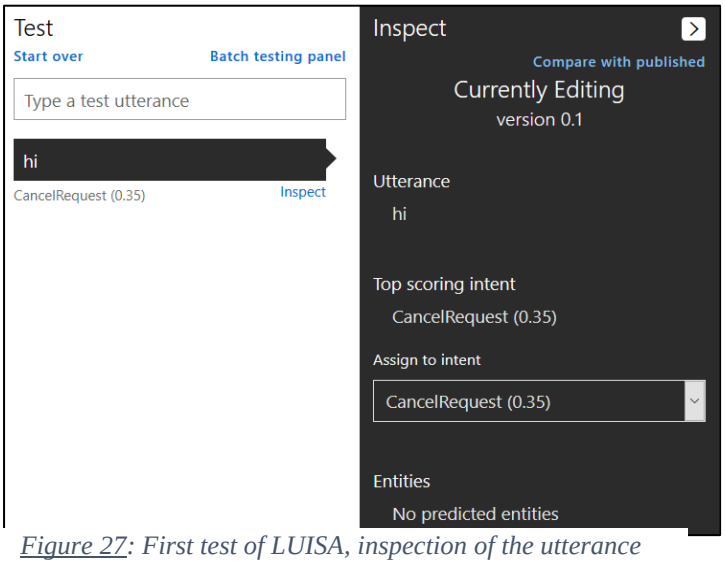



*Figure 27: First test of LUISA, inspection of the utterance*

*Source: snapshot of LUISA on the LUIS application platform*

intent by selecting 'None' under 'Assign to intent' text. Once this is done, LUISA needs to be 'trained' for the modification to be effective. The training adds automatically the utterance to the list of utterance of the 'None' intent.

When the same utterance is tested again, this time LUISA recognize the intent 'None' (see figure 26 below) with a 90% match. This means the issue was fixed and it also illustrates why LUISA's configuration follow an iterative process.

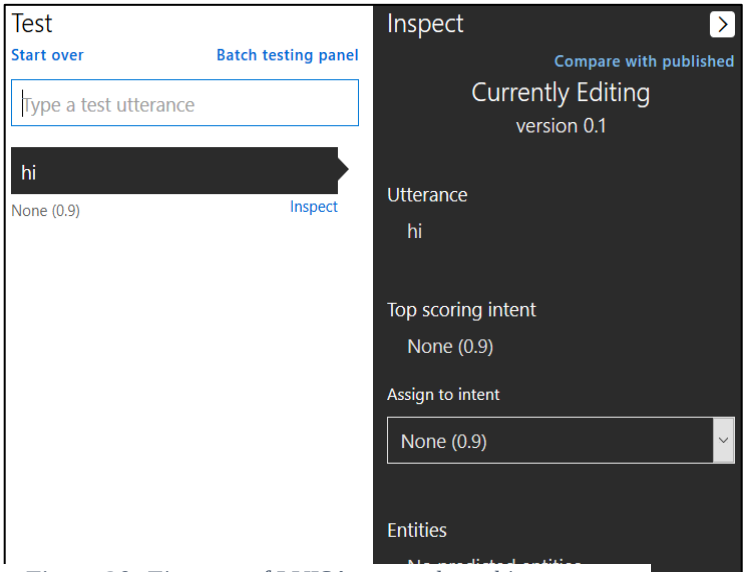



*Figure 30: First test of LUISA, manual teaching*

*Source: snapshot of LUISA on the LUIS application platform*

To take testing a step further, a co-worker of mine was briefed on the project and ask to test LUISA via a roleplaying situation. One my colleague at B&D played the role of the user and was asked to make two inquiries, each formulated in three different ways. **First**, inquire about the missing data of one databases of her choice. **Second**, seek help. The purpose of this test is to assess if LUISA can associate utterances, from somebody external to the project, to the right intent. The colleague testing LUISA is referred to as the 'tester'. In terms of testing protocol, once the tester is briefed about his role as user, the tester is left alone to ask questions to LUISA.

Regarding the **first inquiry**, the tester typed the questions 'where is my data in contractual power', 'help finding contractual power' and 'help finding contractual' (see figure 27 below). It is clear the tester wishes to inquire about data missing from the contractual power database.

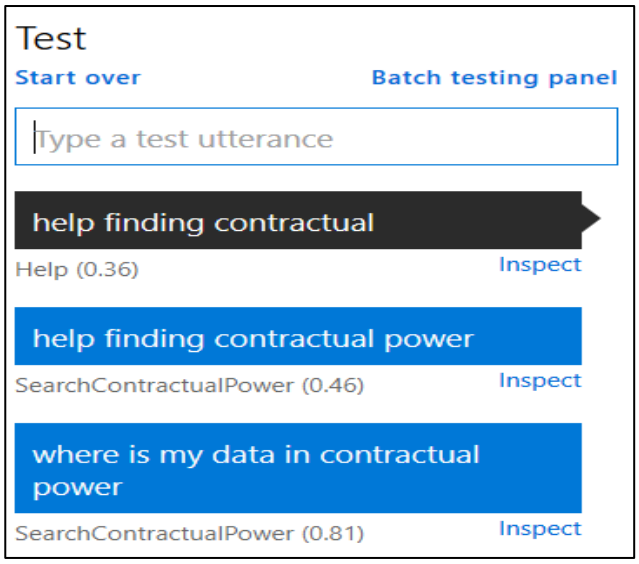



*Figure 33: LUISA's first interaction with tester*

*Source: Snapshot of LUISA's test on the LUIS application platform*

Comments:

The intent of the two first utterances is correctly recognized but the third inquiry is misinterpreted. What causes LUISA's confusing is the word 'help' with is mostly associated with the 'Help' intent. To correct LUISA's confusion, the tester's utterance is manually assigned to the 'SearchContractualPower' intent. After re-testing the utterance, LUISA can assign it to the right intent.

Regarding the second inquiry, the tester simply typed 'help', 'please help me find my data' and 'give me assistance' (see figure 28 below).

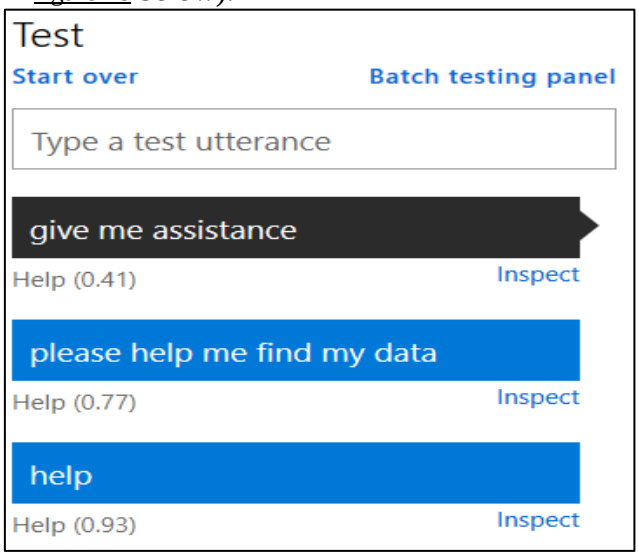



*Figure 36: LUISA's second interaction with tester*

*Source: Snapshot of LUISA's test on the LUIS application platform*

Comment: This time, it appeared that LUISA could get the right intent at for each utterance.

```
//Constants

// Intents
public const string IntentContractualPower = "SearchContractualPower";
public const string IntentTertiaryReserves = "SearchTertiaryReserves";
public const string IntentHelp = "Help";
public const string IntentNone = "None";

// Entities
public const string Entitycontractualpower = "contractual power";
public const string Entitytertiaryreserves = "tertiary reserves";
public const string EntityData = "Data";
public const string EntityDatabase = "Database";
public const string EntitydatatimeV2 = "datetimeV2";
public const string Entitynumber = "number";
public const string EntityEAN = "EAN";
public const string EntityBeginDate = "BeginDate";
```

*Figure 39: snapshot of EVA's code*

To sum up this task 'Configure the LUIS application – LUISA', after LUISA's initial configuration and testing, it appeared LUISA can grasp the intent of external users' utterances meaning the configuration is satisfactory. Now that LUISA is ready, the next part is to write EVA's code.

## 3.3. The code in C#

EVA's code holds commercial value for B&D and therefore will not be included. However, regarding the evaluation, the members of the jury can ask Fernando at fernando.polonia@businessdecision.be, to receive a copy of EVA's code inserted in a Notepad document. I am although authorized to share some elements of the code.

To build EVA's code, **first** I looked up existing code libraries on programming websites such as Github.com and stackoverflow.com. The goal is to find code components that can be useful for EVA's. The challenge is since the application of chat bot is new in the database management field, no code is made specifically exist for this task. Fortunately, EVA's task can be broken down into smaller existing tasks. **Second**, I assembled the code on the software 'Visual Studio 2017', it enables to 'run' the code and use a bot emulator to test the code. The software also provides a debugger and recommendation service.

Below are snapshots of the main elements composing EVA's code:

The first part of the code consists in listing the intents and entities (see figure 29 below):

Comments:

It is important to define the intents and entities at the start of the code since they are referred to in the and they are the link between the web chat app and LUISA i.e. each intent is associated to a part of the code. Another example are the entities 'EAN', 'BeginDate' and 'datetimeV2' are used as parameters in the SQL query to the databases and called later in the code.

- Intent 'SearchContractualPower' (see figure 30 below):

```
try
{
    SqlConnectionStringBuilder builder = new SqlConnectionStringBuilder();
    builder.DataSource = "X";
    builder.UserID = "X";
    builder.Password = "X";
    builder.InitialCatalog = "ChatBot_EDWErrors";

    using (SqlConnection connection = new SqlConnection(builder.ConnectionString))
    {

        connection.Open();
        StringBuilder sb = new StringBuilder();
        sb.Append("SELECT ErrorDescription FROM [err].[ErrorFactContractualPower]");
        sb.Append(" WHERE EAN = ");
        sb.Append(EntityEAN);
        sb.Append(" AND BeginDate = ");
        sb.Append(EntityBeginDate);

        String sql = sb.ToString();

        using (SqlCommand command = new SqlCommand(sql, connection))
        {
            using (SqlDataReader reader = command.ExecuteReader())
            {
                while (reader.Read())
                {
                    Console.WriteLine("{0}", reader.GetString(0));
                }
            }
        }
    }
}
catch (SqlException exception)
{
    Console.WriteLine(exception.ToString());
}
Console.ReadLine();
```

*Figure 40: snapshot of EVA's code, SearchContractualPower intent*

Comments:

To find the information located in the data table 'ErrorFactContractualPower' (indicated in the snapshot of the code by a red arrow), two parameters are necessary, namely: 'EAN number' (18 digits) => 'EntityEAN' and a date (in this format: YearMonthDay) => 'EntityDateBegin'. These two parameters are given right at the start by the user and their location in the snapshot of the code is indicated by green arrows. Once the connection with the SQL server is made, the parameters identified are used to find the information located in the 'ErrorDescription' column

of the table mentioned above. Then the connection with the server is closed and the message containing the information retrieved is sent to the user.

- Intent 'SearchTertiaryReserves' (see figure 31 below):

```
try
{
    SqlConnectionStringBuilder builder = new SqlConnectionStringBuilder();
    builder.DataSource = "X";
    builder.UserID = "X";
    builder.Password = "X";
    builder.InitialCatalog = "ChatBot_EDWErrors";

    using (SqlConnection connection = new SqlConnection(builder.ConnectionString))
    {

        connection.Open();
        StringBuilder sb = new StringBuilder();
        sb.Append("SELECT ErrorDescription FROM [etl].[ErrorFactTertiaryReserveNonCIPUAssociation]");
        sb.Append(" WHERE EAN = ");
        sb.Append(EntityEAN);
        sb.Append(" AND datetimeV2 = ");
        sb.Append(EntitydatatimeV2);

        String sql = sb.ToString();

        using (SqlCommand command = new SqlCommand(sql, connection))
        {
            using (SqlDataReader reader = command.ExecuteReader())
            {
                while (reader.Read())
                {
                    Console.WriteLine("{0}", reader.GetString(0));
                }
            }
        }
    }
}
catch (SqlException exception)
{
    Console.WriteLine(exception.ToString());
}
Console.ReadLine();
```

*Figure 43: snapshot of EVA's code, SearchTertiaryReserve intent*

Comments:

To find the information located in the data table 'ErrorFactTertiaryReserveNonCIPUAssociation' (indicated in the snapshot of the code by a red arrow), two parameters are necessary, namely: 'EAN number' (18 digits) => 'EntityEAN' and a date => 'EntitydatatimeV2'. These two parameters are given right at the start by the user and their location in the snapshot of the code is indicated by green arrows. Once the connection with the SQL server is made, the parameters identified are used to find the information located in the 'ErrorDescription' column of the table mentioned above. Then the connection with the server is closed and the message containing the information retrieved is sent to the user.

Intent 'Help' (see figure 32 below):

```
[LuisIntent("Help")]
public async Task Help(IDialogContext context, LuisResult result)
{
    await context.PostAsync("Hi! Try asking me things like 'why is contractual power data missing, reference: EAN XXXXXXXXXXXXXXXXXX date XXXXXXXX")

    context.Wait(this.MessageReceived);
}
```

*Figure 44: snapshot of EVA's code, None Intent*

Comments:

When the user asks for help, the users receives a respond message that aims to guide the user on what EVA can do, and the suggested ways to interact with EVA i.e.: 'why is contractual power data missing, reference: EAN XXXXXXXXXXXXXXXXXXX date XXXXXXXX or why is tertiary reserve data missing, reference: EAN (idem) date XXXX-XX-XX'. This aims to help the user to understand how to interact with EVA.

- Intent 'None' (see figure 33 below):

```
[LuisIntent("None")]
    public async Task None(IDialogContext context, LuisResult result)
    {
        string message = $"Sorry, I did not understand '{result.Query}'. Type 'help' if you need assistance.";

        await context.PostAsync(message);

        context.Wait(this.MessageReceived);
    }
```

*Figure 45: snapshot of EVA's code, None Intent*

Comments:

When the user types a message too ambiguous for EVA to understand, the message is associated to the None intent. The user receives for response a message containing his query and a recommendation to ask for help.

Global comments:

- In terms of channel interaction between EVA and users, EVA is accessible via Skype Enterprise. The channel is easily set up by selecting Skype Business in the channel option of EVA on the Microsoft Azure platform.
- The snapshots displayed above aim to inform the reader about the type of functions that inspired EVA's code. Therefore, minor differences can exist between the snapshots and the actual code.

## 3.4. Testing

This part is focused on the test of all of EVA's components. Since it is not possible to involve the user in this part of the process, EVA will be tested by a colleague of mine at B&D referred to here as Lisa. To test EVA, the Lisa used her Skype Business application to begin the interaction with EVA.

Before realizing the test, it is necessary to brief Lisa on user's profile since the former roleplays the later. The goal of this is to make Lisa imitate the user's behavior in the more accurate way possible. The testing scenario presented to Lisa in the following way:

Lisa is a business analyst at Elia. While she is working on her Excel Sheet, containing information on the quantity of electricity transported on the Belgian electricity grid, she realizes that data from the contractual power database about EAN number XXX date YYYY is missing, since in the Excel cell contains the message 'ERROR'. She is aware Elia installed a new tool to enquire on missing data. The tool is called EVA. She logs into her Skype Business account and attempts to contact EVA. Once she makes the connection, since its her first time interaction with EVA, she asks to EVA guidance on how to make queries. Eventually, she understands how to ask for her missing data and poses the question to EVA. After this interaction, she goes back to her Excel Sheet and realizes another data is missing but this time it comes from the tertiary reserve database (EAN number ZZZZ date AAAA). She returns to EVA and asks directly why is her data missing. Once she gets the answer from EVA, the test stop.

Success or failure of the test is measure in EVA's capacity to provide the correct answer to the tester' query. Here is the list of criteria to assess EVA's performance during the test:

- EVA's capacity to understand the user;
- EVA's capacity to provide help when the tester is confused on how to interact with;
- EVA's capacity to deliver the correct answer.

After the test, the tester is asked to give his/her feed-back on the experience and on the interactions with EVA.

The result of the test will be disclosed in front of the jury to present a new element during the Master's thesis presentation.

## 4th stage: Suggest KPIs to track EVA's performances

In this part are listed the suggested KPIs relevant to assess EVA on a technical and qualitative level.

Regarding the technical level, on the Microsoft Azure platform, a service called 'Insight & Analytics' exists and is available on demand. This service provides support on technical performances and insights on the operating application. However, this option is not free and therefore, should be used once EVA is implemented at Elia.

Regarding the qualitative level, to assess EVA's capacity to provide users with the right answer to their queries, I recommend adding a feed-back component to EVA. At the end of each interaction with a user, the user should be asked if EVA correctly answered the queries asked. The answer should be dual, namely: 'yes' or 'no'. The user' answer would be stored and a simple formula the one bellow can serve as measurement for EVA's global efficacity.

$$EVA's\ effectiveness\ rate = \frac{number\ of\ times\ users\ answered\ 'yes'}{Total\ number\ of\ queries\ made\ by\ users}$$

According to the research described in the previous chapter (cf. supra chapter 1, Chat bots and human-machine interactions, p.17), EVA can expect to answer around 80% of users' queries. This number will be used as a landmark for EVA.

Comment: Once EVA is further developed and more capabilities have been added, it is imaginable to also provide users feed-back in writing.

# Chapter 4: Critical review and perspective

This final chapter is a critical review of the project accomplishments and offers a perspective on the potential of the chat bot technology in the field of database management for the energy sectors. First, all the project objectives are assessed in terms of results and rate of completion. Also, the list of difficulties faced during the realization of the project and EVA is captured, then leads to improve EVA are gathered along with my personal contribution. Second, EVA's next step is to be presented at Elia and some guidance to that effect is presented. Finally, it opens with a discussion on chat bots in database management of energy carriers and on business opportunities for B&D in the field of artificial intelligence and chat bots.

## 4.1. Critical review

### 4.1.1. Result assessment and rate of completion

The main goal of the project, being to deliver a chat bot to help manage databases to Elia is achieved. EVA can provide information to users on the reason why data is missing from the two databases EVA manages.

It took some time to come up with a definitive list of objectives. Initially, my first draft list contained about ten objectives. Shortly after, input and feed-back was gathered. First, I met with Fernando to check my understanding of the project in terms of goal and deliverable, to be aligned with him. Second, I met with the two experts of B&D namely: Gerrit, who has experience on chat bots' projects from a managerial perspective, and Guillaume and Arnaud who are programmers working on another chat bot project and who have experience in terms of technical knowledge. Finally, I gathered input regarding the time allocate to objectives, from my colleagues at school during a seminar on the project.

To sum up, the list of objectives went from ten to eight objectives since we could regroup some objectives. In terms of number of days allocated per objectives, modifications were also made. All objectives durations were reduced but one which was increased, the objective #6 involving the writing of EVA's code.

Below is the list of each objective and my assessment of rate of completion:

- Objective #1: Understand B&D's expectations (100% rate of completion)

This objective was successfully accomplished. First, thanks to my interactions with Fernando, Gerrit and other B&D's colleagues, second thanks to the information gathered on B&D's website, internal resources such as PowerPoint on chat bots, and external sources (i.e. chat bot market trends).

All this information enabled me to understand B&D's needs. It was also possible to put the project into perspective by assessing the trends in the chat bot market.

The availability of Fernando, Gerrit, my colleagues at B&D and internal resources that were made accessible to me, made information gathering relatively easy. Also, numerous articles on chat bots are available on the internet and I could refer to them, despite most of the chat bot literature being focused on its application in customer service. EVA has similarities with customer service related assistance since it is aimed towards providing information to its users.

To sum up, the information gathered from both internal and external sources enabled me to see B&D's needs by looking at the project view a 360° view and therefore, justifies in my view the 100% rate of completion.

- Objective #2: Understand Elia Group and users' needs (75% rate of completion)

To complete this step at 100% rate of completion, interactions between users and myself was necessary. Unfortunately, it wasn't allowed for me to have direct contact with users for two main reasons. First, it is B&D's policy to limit interactions between their clients and interns (such as me). Second, although the project is directed towards helping Elia, it is B&D which is behind the initiative of the project.

Interaction with users is especially important when it comes to test EVA. This issue was tackled in two ways. First, information on users was gathered via Fernando, who is also B&D's consultant working at Elia in the past five years. A handful of emails were exchanges to inquire on users' needs such as what will Elia users ask to EVA and how can EVA help. Second, especially regarding the test a testing protocol combined with a roleplaying of a tester external to the project should reduce the risk significantly.

To sum up, not being able to interact with users constitute a risk for the project. The reasons above explain my assessment to 75% of rate of completion).

- Objective #3: Select EVA's technological components (80% rate of completion)

The framework to develop the project namely, the Microsoft Azure platform was imposed and provided me with all the tools necessary to realize EVA.

Regarding the coding component, the programming language C# wasn't imposed but highly recommended by Fernando. Later in my comparison, I confirmed that C# was the best choice of programming language. Regarding the interpreter software, choice was left to me.

Regarding the technique to interpret users' queries, NLP was imposed. With a step-back and considering the relatively recent experience of B&D and Elia with the chat bot technology, key words interpreting technic could have been interesting to consider.

These constraints were useful to help on the project since my knowledge in the chat bot technology was limited at the start. Therefore, more time was dedicated to gathering, comparing and selecting the technology components that compose EVA such as the interpreter (LUISA).

To sum up, having such technical constraints imposed meant more time could be spent on other aspects of the project i.e. do research on the chat bot technology and the selection of the interpreter. Hence, my personal assessment of rate of completion is high (80%).

- Objective #4: Create a web bot application on the Azure platform (100% rate of completion)

The Microsoft Azure platform is used as main development frame and is where all of EVA's components are assembled together. Accomplishing this objective was relatively simple. First, I used a free month trial period subscription create the web bot application on the Azure platform. Then I linked EVA's components developed on other platforms to the web bot application. Then, when the free trial month ended, EVA was migrated and the hosting costs were assigned to one of B&D's resource center specially created for the project.

EVA's main component to link is the interpreter: LUISA, created on the LUIS application platform. Regarding the EVA's code, developed on Visual Studio 2017, the dossier containing the code was uploaded to the web bot application on the Azure platform.

To sum up, creating and assembling EVA on the Azure platform was relatively easy to set up and all the elements to do so were at my disposal, hence the 100% rate of completion assessment.

- Objective #5: Create a LUIS application: LUISA (100% rate of completion)

The choice of selecting the LUIS application platform to develop EVA's interpreting component was made during the completion of objective #3. The platform proved to be intuitive and straight forward to use. Documentations online made me grasp key interpreting concepts such as: intent, entities and utterances.

Information gathered during the completion of objective #2 namely users' typical queries were used to configure LUISA. The configuration of LUISA followed an iterative process: first build intent, second create entities, third create a list of utterances composed on entities for each intent, finally the testing provide with insight on how well LUISA understands the users queries and how to improve LUISA's understanding.

As mentioned earlier, direct interaction was not allowed with users therefore I set up a testing protocol to test EVA and bypass this constraint. The testing of LUISA by a person external of the project proved it was well configurated.

With the completion of the interpreter (LUISA), EVA should be able to recognize users' queries.

To sum up, creating and configuring LUISA was a task which I consider fully attained. It required a lot of attention to details and much precision. After each testing, LUISA's understanding improved i.e. via guided learning during which utterances are manually associated to a specific intent.

- Objective #6: Write EVA's code (100% rate of completion)

Writing of EVA's code was the most challenging technical part of the project since at the start of the project, I had little to no knowledge of the C# language. During the configuration of EVA, I grew more and more familiar with the language and could understand and identified the key components that EVA's code needed i.e. how to connect to the database and retrieve data from it. To review the code, I could count on the help from Arnaud.

Team work as an important element of EVA success and allowed full completion of the EVA. project.

- Objective #7: Test EVA (90% rate of completion)

To test EVA was one of the most exciting objectives of the project to complete since it is the conclusion to all the steps realized during the EVA's configuration and it determines if EVA can successful or not answer to the user. Fortunately, the testing proved EVA can answer the user's queries with success. Regarding the conception of the scenario, it was crucial to brief the EVA's tester how to behave as if it was the user that was using EVA. Only 10 % are missing from the rate of completion since to a direct interaction with the user is missing.

- Objective #8: Establish a list of KPI to track EVA's performance (100% rate of completion)

The KPIs identified aim to track EVA's performances on the technical and qualitative levels. Regarding the technical level, the Microsoft Azure platform already integrates a service including multiple KPIs. Regarding the qualitative level, the KPI suggested by me is simple, it consists on measuring the rate of effectiveness by taking the number of queries answered correctly by EVA, divided by the total number of queries asked.

### 4.1.2. Difficulties faced

This part aims to list the difficulties faced in terms of method, human and technical aspects.

Regarding the **method**, it took some time to find the right approach but once I grew familiar with the chat bot technology and read on how to realize and IT project, the method to follow became clearer. First the main goal project was divided into eight objectives, which are either of a managerial or technical nature. To implement EVA, four stages were defined during which all the project's objectives were accomplished.

Regarding the **human** aspect of the project, no difficulties were faced since Fernando and my colleagues at B&D were welcoming and made themselves available when I needed guidance.

Regarding the **technical** aspect; two big challenges were faced. First, was writing EVA's code which was the most difficult aspect of the project since it required extensive knowledge of the programming language of C# I do not possess. Fortunately, a lot of documentation on the programming language exist online and I could rely on B&D's experts in this field. Second, as the application of chat bots in database management is innovative, the platform to develop a chat bot aimed for database management does not exist yet. Eventually in the future, when companies realize the potential of chat bots in database management, software companies such as Microsoft will develop tools to facilitate the development of such chat bots. Perhaps, the next generation of chat bots will not necessitate knowledge in coding just like interpreting software do i.e. LUIS.

To sum up, although the challenges were numerous I was well supported by Fernando and the B&D's team who shared their knowledge and gave their time to work on the project. Also, due to my thorough research, I could define a suitable method to realize the project.

### 4.1.3. Suggestion for improvement

This part lists all the suggestions to improve EVA in the short and long term.

In the **short term**, once EVA has been implemented at Elia it will help users to manage two databases, yet it should be easy to scale up the project by incorporating new databases for EVA to help managing. Another improvement could be to instigate a greeting intent which could be used to check the status of EVA, i.e. users would say 'hi' and EVA would return a message depending on the operating status such as 'hi, my name is EVA database X is up for maintenance and it not yet accessible'. On another level, it is important to involve users in development process therefore users should take part into the implementation of EVA at Elia.

In the **long term** at Elia, EVA's final goal should be to assist in the management of all of Elia's databases and go from a reactive to a proactive stand. Now, EVA assist users by providing them with information when they require it. Later, EVA could investigate the databases in real time without necessitating to be asked to by users.

For B&D, EVA could take a step further in to database management and go from assisting users to taking things charge. For example, future users could interact with EVA directly to modify, update and delete data in the databases. Also, EVA could be implemented in more companies to improve their databases management. This would enable EVA to be perfected. It would also enable B&D to gather more experience with chat bots and their application in the databases management.

To sum up, in the short term, EVA offer tangible gain to Elia and to B&D. In the long term, EVA's goal should be to manage all of Elia's databases. In the field of database management, EVA's has the potential change the way data are managed in databases.

### 4.1.4. Personal contribution

This part aims to gather **my contribution** to the realization of EVA

First, during my researches I gathered information on the chat bot technology as well as the current and future trends of the chat bot market. Although the project was demanding, I had the time to take a step back during EVA's the conception and implementation.

Second, my education at ICHEC management school gave me training to understand both managerial and technical aspects of IT related projects. Therefore, I could assess the expectations and needs of interested parties in the development of EVA. Moreover, I was also able to grasp quickly concepts such as intent, entities and utterances. Also, I am much more knowledgeable how coding: Initially, I only had previous programming experience with language R, while now I am familiar with language C.

## 4.2. EVA's perspectives

### 4.2.2. EVA's next step: 'Pitch' to Elia and business case

EVA's next step is to be presented to the Elia Group. To do so, it is typical in the consulting world while pitching to the client, to use a PowerPoint presentation as a support. The PowerPoint presentation could contain information on the chat bot market trends, a demonstration of EVA's capabilities and the benefits highlighted in this thesis of the chat bot technology used in the database management field.

At present, EVA is still at the stage of a POC but it is sophisticated enough to be presented at Elia and tested by users. As mentioned earlier regarding the project success factor #8: 'User involvement to shape solution', the implication of the users during the software development phase is crucial for its success (cf. supra chapter 1, IT guidelines, p.13).

Once EVA is implemented at Elia, B&D could use it as a reference framework for new chat bot related projects and add EVA to its portfolio of experiences to present to its current and prospect clients.

### 4.2.1. Proof of technology

A subsequent goal behind the delivery of EVA is to test the potential of the chat bot technology applied in the database management field. As EVA proved, the use of chat bots in data management is not only possible but it is also desirable specially to help non IT-savvy employees to interact with databases to get information. Chat bots are simple to use, especially combined with the NLP interpreting technique. Now it is even possible to interact with them using speech recognition techniques.

The literature on the use of chat bots in database management is meager since as for now, chat bots have been used mostly in the field of customer management. The greatest strength of chat bots is their capacity to absorb new development technologies and assimilate them, to benefit from synergies. Chat bot can be assimilated to an iceberg, what users see is the visible part of the iceberg, what makes the chat bot run is not visible to users. I believe the chat bot technology can use the same metaphor since only in the past two years have companies realized the potential of chat bots can offer and I believe we are only starting to grasp the potential of this technology.

With the impact of global warming increasingly visible all around the globe, the pressure from the public on energy carriers, like the Elia Group, to efficiently carry energy is growing. Eventually, Elia's environment will change for two reasons. First, even if now storing electricity is costly (i.e. using giant batteries), it is foreseeable in the mid distant future that it will be possible to store electricity at some points of the electrical grid network. Second, with the rise

of energy self-sustaining homes (i.e. using solar panels or geothermic) the demand to for electricity will evolve.

Though Elia's main challenge will remain the same: to manage the electrical flux on the electric grid network or in other words, to efficiently carry the right quantity of electricity on the grid network, when and where it is needed. Chat bots can help to tackle Elia's challenge because behind their simplicity to interact with users, the full power of chat bots is hidden in their codes and connections with external resources (i.e. databases). Now, chat bots take a reactive role and only the most advanced chat bots contain predictive elements. In the future, chat bots could be incredibly proactive i.e. make predictions on the electricity demand and adjust the electricity carried on the grid network in consequence.

Similarly, to most electronical products already, what differentiates between competitors is not the hardware but the software, in other words the power behind the product i.e. the algorithms. For an IT consulting company like B&D, the importance of getting familiar with artificial intelligence and possibly owning algorithms is vital to sustain and grow. Therefore, it is important for B&D to meddle with the chat bot technology since it can also grant B&D a decisive strategic advantage.

To sum up, both Elia and B&D should take interest in the matter of chat bots in database management since applying chat bots to database management is a 'value innovation' and the chat bot technology is fully of potential, evolving fast and builds up on experiences.

# Conclusion

At the start of the project, the two most important parts were to assess the expectations of B&D and needs of Elia, the final customer. The next stage was to determine which technology components were the most relevant to build in EVA. Then EVA was configured and tested. Finally, a list of KPIs was drawn to assess EVA on a technical and qualitative level.

EVA's brings more clarity on the reasons of missing information needed by Elia operators. Once EVA will be implemented, they will be able to receive information on the reason why data is missing from their Excel Sheet. Also, EVA aims to bring the costs of investigations down by reducing the number questions asked to the IT support helpdesk. This will indirectly help the IT support helpdesk to better focus its efforts on other issues. EVA is a first small step for Elia to manage its databases and help to tackle challenges in the management of their huge databases; Yet EVA is a big step towards chat bots operating in database management since it proved the technical operation was possible and brings value to users. EVA could even bring major advantage if implemented in a wider database management scope, growing outside the database management field. For example, rather than being just reactive, EVA could evolve to play a proactive role in the identification of the missing data. At this moment, chat bots are task oriented and they operate in narrow scopes. In the future, powerful chat bots will be collection of several chat bots. It is therefore likely that in the future, EVA will merge with other chat bots to grow.

At the start of the internship, I had little experience with the chat bot technology and the management of significant IT projects. However, my initial contact with B&D took place in in autumn 2017 during interactive sessions organised by *ICHEC Brussels Management School*. It gave me a very favorable impression in terms of talent management. And it proved to be this way and I could count on the expertise of the people interested in the project. In addition, I searched the IT managerial literature to find the right methodology to apply to the project. Later, the methodology selected proved to be effective as EVA passed several tests with success. Also, most of the objectives results review reach a 100% rate of completion, according to my rating. The first goal of the project, namely: to deliver a POC chat bot, which I called EVA, was successfully achieved. The second goal was also achieved, namely to use EVA as a proof of technology regarding the potential of chat bots in the database management field.

Currently at B&D, a specific platform to create chat bots which are aimed at database management does not exist. However, it is crucial for B&D and the client to take the lead and hop on the innovation train since it is much harder to catch up than to take an early interest in technologies. It is especially true for the chat bot technology, since developing complex chat bots requires to build on existing knowledge and past experiences.

To conclude, working on EVA made me learn on a new field, which however nicely builds up with what I learned during my studies at *ICHEC Brussels Management School*, especially for the managerial aspects.

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